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Revisiting Edward Said's contributions toward decolonising higher education

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Introduction

Our editorial's first section focuses on examining Edward Said's transformative contributions to postcolonial thought and its enduring relevance to higher education. Said's penetrating critique of Western academic institutions' role in perpetuating colonial ideologies provides a crucial framework for understanding current power dynamics in global higher education. His insights into the relationship between knowledge production and institutional authority remain remarkably pertinent as we navigate questions of epistemological justice and educational equity.

Our Editorial's second section contextualises the ongoing discourse surrounding artificial intelligence in higher education in our journal by identifying themes in the numerous articles that we have published over the past two years. Finally, we present a comprehensive overview of this issue's remaining diverse contributions.

Edward Said's greatest masterpiece is reputedly *Orientalism*. The Palestinian-American public intellectual and scholarly activist's magnum opus examines and exposes an ideology purported by supposed Western experts he labels as 'Orientalists'. With an intimidating brilliance, wit, and charm, Said weaves together a ground-breaking response to Western intellectual thought against the backdrop of its techno-scientific dominance, religious strife and regional conflicts in the resource-rich Middle East.

An influential literary theorist and postcolonial intellectual, Said's life is marked by a complex interplay of personal struggles, intellectual growth, conflicts, and steadfast political activism for the Palestinian cause. His critical devotion to literature and profound engagement with music reveal the multidimensional passions that shaped his thinking. We will be discussing different aspects of this in the following sections.

Revisiting Edward Said

Describing key contributions of a luminary like Edward Said (1935-2003) is no ordinary task, nor is it easily accomplished. Despite, and because of, our admiration for the legendary scholar, we shall make a concerted attempt. Said is a key figure in postcolonial studies and a pioneer of postcolonial theory, an unwavering advocate for Palestine, a distinguished literary and music critic, a reflective, erudite proponent of literature's profound influence on politics, personal and public life and above all, a compassionate human being. Said navigated an extraordinary range of influential roles, from being an orchestra impresario in Weimar to sharing stories on national television – and even, at times, appearing in films as himself (Brennan, 2021). His books have been translated into 36 languages (Barenboim & Said, 2002).

Identity, exile, and marginalisation

Said's early life helped shape his worldview. Born in Jerusalem in 1935, Said's early life was disrupted by displacement, as his family had to relocate to Cairo after the British Empire established the state of Israel in 1948. Said's background as a Palestinian Christian was instrumental in his scholarly activism against the Israeli occupation of Palestine (Bayoumi & Rubin, 2000). Being a Palestinian Christian placed him on the margins of a myriad of cultural contexts. His experiences of exile, colonialism, and cultural marginalisation informed his later intellectual work, focusing on issues of identity, representation, cultural imperialism, education, colonialism, and power.

Said's cosmopolitan education, shaped by his formative years at elite institutions like Victoria College in Cairo and later at Princeton and Harvard, was foundational to his intellectual development (Brennan, 2021). His exposure

to Western and Eastern intellectual traditions fostered the critical lens that facilitated his engagement with Western cultural hegemony. In addition, Said's early childhood experiences with displacement made him attuned to the power dynamics between the coloniser and the colonised.

Said's early life (see Figure 1) was tainted by a sense of alienation and displacement (Brennan, 2021). His challenging formative years in Anglophone institutions away from his native land led to his acute sense of not fully belonging to any one culture or place, a sentiment that deeply influenced his later work on exile, nationalism, and identity (Brennan, 2021). Victoria College's acting headmaster doubted Said's potential, seeing "no notable achievement" and only "average promise" (cited in Brennan, 2021, p. 35). Yet, despite his early teachers' perceptions of him as undisciplined and inclined toward mischief, Said was immersed in elite education, reading canonical European texts that would later shape his intellectual life (Leonardo, 2020). This exposure, though steeped in British imperial ideals and restrictive language policies, cultivated in him a lifelong engagement with the 'great books' he would eventually critique (Sellars, 2024).



Figure 1. Said with his sister Rosemarie (1940).Public Domain.

Said's father, Wadie Ibrahim, was a flourishing businessman who had spent time in the United States and eventually acquired U.S. citizenship. Anticipating the conflict and upheaval that would transpire following the United Nations partition plan for Palestine and the creation of the state of Israel, Wadie relocated the family from Jerusalem to Cairo. In 1951, Said enrolled at Northfield Mount Hermon School in Massachusetts. He later attended Princeton University, earning a B.A. in 1957, followed by an M.A. (1960) and a Ph.D. (1964) from Harvard University on the life and works of Joseph Conrad. Said began his academic career at Columbia University in 1963 as a lecturer in English, and by 1967, he had been promoted to assistant professor of English and comparative literature (Said, 1999). His first book, *Joseph Conrad and the fiction of autobiography* (1966), expanded on his doctoral thesis, analysing Conrad's short stories and letters to uncover and discuss the tension in the author's narrative style, focusing on the cultural challenges of starting a literary or scholarly work.

Said was promoted to full professor in 1969 and was awarded the first of several endowed chairs in 1977. This was followed in 1978 with the publication of *Orientalism*, his best-known work and one of the most influential scholarly books of the 20th century (Brennan, 2021). Although other post-colonial writers such as Franz Fanon (1952, 1961), Albert Memmi (2021) or Gayatri Chakravorty Spivak (2023) have significantly contributed to interrogating colonisation's contentious and detrimental effects, Said was arguably the most well-known and distinguished among them. Said's (1978) *Orientalism* revolutionised scholarship by critiquing Western perceptions of the 'Orient', particularly the Arab Islamic world. Said's interest lay in how the West interrogated and apprehended the Orient and examined the ways the Orient was dominated. He argued that Western scholars had constructed a biased and stereotypical image of the East, which not only distorted the reality of the Islamic world but also served to justify colonial dominance as a noble effort to save the East from the void of regression and destruction.

Exile is a persistent theme in Said's writings, both literally and metaphorically. He viewed exile not simply as a physical displacement but as a state of mind that provided a unique vantage point from which to critique dominant ideologies (Brennan, 2021). In his memoir *Out of place* (1999), Said recounts his feelings of marginalisation and fragmentation, which shaped his intellectual perspective. This sense of being between worlds, never fully at home in either the Arab or Western contexts, became a defining feature of Said's intellectual and scholarly perspective. Said's exile and displacement experience shaped his perceptions of pushing the boundaries of nationalism and challenging notions of identity while advocating for a cosmopolitan worldview transcending nationalistic and political boundaries.

Exile is a deeply personal theme for Said that evokes strong emotions. Said sees himself as a Palestinian exile. In his memoir, Said (1999) described his experiences of being forcefully displaced and how this affected his identity as a Palestinian. He described his experience as a cumulative tragedy where each time he tried to reconstruct a world he had lost, he found that he was losing this world further. Said described the world as one which has 'changed

irrecoverably' in his life (Bayoumi & Rubin, 2000). He constantly questioned his sense of belonging to a particular nation or community and challenged established norms in these societies. This sense of displacement and the absence of belonging to a particular group allowed him to maintain a safe distance from dominant and repressive ideologies, thus facilitating the development of his resistance manifested in *Orientalism*. He also lamented the psychological toll of his exile, the loneliness that plagued him, and his constant questioning of his identity (Said, 1999). His reflections on exile go beyond the personal and extend to the broader Palestinian struggle for self-determination, freedom, and international recognition, positioning exile as both a lived experience and a metaphor for the broader condition of dispossession Palestinians face. Once, on a visit back to his native Palestine, when grilled by Israeli immigration officials about when he left Palestine, he firmly responded by saying that he left Palestine in 1947 and accented the word 'Palestine' (Brennan, 2021) as a show of defiance.

Said felt denied of his identity as an Arabic-speaking Palestinian Christian and instead spent most of his life in the West speaking English. His first name "Edward" was inspired by the Prince of Wales. Said "hated" his first name and "would have preferred an Arabic name" (Brennan, 2021, p. 4). Said's displaced experience extends into his broader critique of nationalism. His experience informs his advocacy for cosmopolitanism and commitment to dialogues and addressing political divides (Bessen & Bessen, 2017). He warns against the risks of adopting rigid national identities, which can advance exclusionary politics and intolerance (Bayoumi & Rubin, 2000).

Although Said specialised in literary criticism, he became an influential voice for Arab causes, especially Palestinian rights. His critiques of U.S. foreign policies in relation to Israel and its foreign policies concerning its occupation generated intense public debate. These led to contentious exchanges with their advocates and political hawks (Said, 1994; Sazzad, 2017). His advocacy for the Palestinian cause was perilous. Said's office was firebombed, and he and his family received death threats and "used condoms in swastika-bedecked letters of extraordinary violence", calling him, amongst other things, a "commie sympathizer" and a "dirty, sneaky, Arab" (Brennan, 2021, p. 217; Sellars, 2024).

Palestine and nationalism

In 1977, Said was elected to the Palestine National Council, which functioned as the legislative body of the Palestine Liberation Organisation (PLO). He became increasingly disillusioned with the Oslo Accords in the 1990s and criticised the peace process as flawed and biased towards the interests of Israel (Feldman, 2023). He argued that the efforts towards a peaceful resolution were nothing more than a veil to disguise the true intention of occupying the entire Palestinian territories (Schabowska & Bartoszewicz, 2022).

Said's vocal and acerbic criticism of the formation of the state of Israel at the expense of the Palestinians and his support for Palestinian self-determination created a distinct

polemic between his supporters and his detractors (Sazzad, 2017; Said, 1995). These polemics gained him admiration, controversy and infamy for going against the grain of mainstream thought. Naturally, his political stance affected and strained his relationships with colleagues, students, and the wider academic community, especially in the West.

It was evident that Said saw himself not only as a voice for the Palestinian people but as a staunch opponent of all forms of imperialism and oppression. From his works, it is clear that his advocacy went beyond the Palestinian cause to encompass broader concerns about the dispossession and disenfranchisement of colonised peoples globally. Despite being confronted with backlash and death threats, Said remained steadfast in his commitment to the Palestinian cause, as illustrated by his involvement in the Palestinian National Council and his persistent critiques of both Israeli policy and Palestinian leadership (Sa'di, 2023).

Throughout his life, Said was a vocal critic of Israel's occupation of Palestinian territories and a passionate advocate for Palestinian self-determination. His political writings, including *The question of Palestine* (1979) and *Peace and its discontents* (1995), provide a nuanced analysis of the Israeli-Palestinian conflict, informed by his own experiences of exile and displacement and also his intimate knowledge of both Western and Middle Eastern politics.

In the aforementioned books, Said vehemently criticises both Israeli policies and the complicity of Western powers in perpetuating the occupation. He adopts an equally accusatory tone with the Palestinian leadership, accusing them of corruption and authoritarianism hindering the Palestinian cause. In the same vein, Said argues critically against American imperialism during the Gulf War and also the 'War on Terror', boldly claiming that these campaigns were merely extensions of their imperialistic ambitions (Biswas, 2006).

Said's gifted ability to integrate rigorous academic analysis, supported with impassioned political commentary, offers a model for scholars and a keen audience seeking to engage with critical events in the world beyond the ivory tower. Said's engagement with the Palestinian struggle goes beyond mere advocacy. It is deeply rooted in his broader critique of imperialism and his commitment to justice, human rights and political activism, making him one of the most influential public intellectuals of his time (Bayoumi & Rubin, 2000). At the heart of Said's intellectual contribution is his ground-breaking *Orientalism* (1978), a work that altered the advocacy of Palestinian independence and postcolonial scholarship (Gani, 2022).

Orientalism and postcolonial critique

When the Middle East or Arabs are mentioned, some may picture parched landscapes of endless golden sands, air warped by searing desert heat, and the melancholic strains of an oud—its haunting, crude melody a parody of the region's supposed mysticism. These tropes, embedded in our collective consciousness, shape the images we conjure of the Middle East. They outline what Said described as

'Orientalism'.

Said's (1978) seminal book (see Figure 2) explores the subtle ways Western authors, whom he labels as 'Orientalists', have come to understand and describe the Middle East (Wilcox, 2018). It confronts the very bedrock of white supremacy and dismantles the assumptions of cultural superiority and the West's patronising view of the 'other' (Sellars, 2024). *Orientalism* exposes a tightly woven system of images that rendered European dominance over other cultures seemingly natural, facilitating colonial conquest. Said noted that, by 1914, Europe had claimed roughly 85 per cent of the earth's surface as colonies – a fact that has largely faded from common memory (Said, 1993).

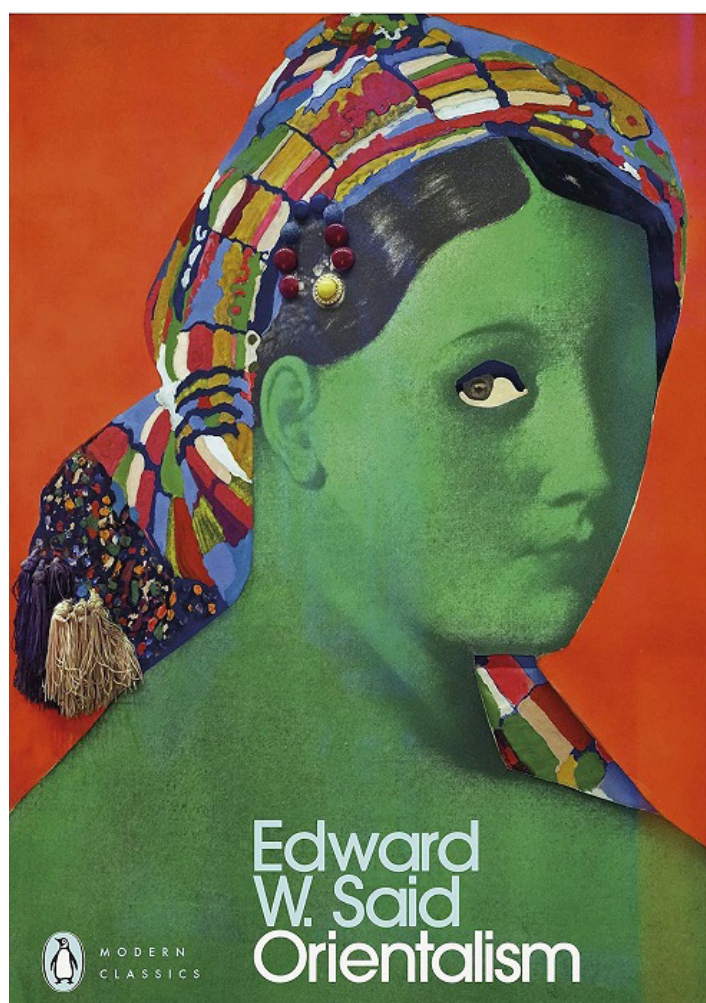


Figure 2. Book cover of *Orientalism*.

For all its success, *Orientalism* was challenged by the lack of interest from major publishers (Bayoumi & Rubin, 2000). Many of the publishing houses did not find the ideas forming *Orientalism* 'groundbreaking' (Bayoumi & Rubin, 2000, p. 63) and were apprehensive at the idea that the essence and political views in the book did not resonate well with mainstream views of Palestinians, Arabs, and the Middle East as an entirety. However, to Said's surprise, his book transformed the study of literature and culture and challenged the illusory perception that the dominant Western perspective was correct and accurate.

Said's presence also looms large over the current cultural landscape. The influence of this literary scholar is so significant that an incredible number of commentaries about art, literature, cinema, music, culture, education, and history now ritually genuflect to his ideas and subscribe to his 'postcolonial' critique with religious fervour.

Said's *Orientalism* is a radical critique of Western representations of the Middle East. Such an endeavour can be found in earlier works such as Antonio Gramsci's examination of cultural hegemony (Forgas (Ed.), 1999; Adamson, 2014) and Michel Foucault's (1980) discourse on knowledge and power (Brookfield et al., 2022). Said drew from the concepts discussed in these works and cemented his legacy through the publication of *Orientalism*. Its publication positioned itself within the broad political landscape of anti-colonial movements, rising nationalistic sentiments, and the increasing prominence of postcolonial theory (Labelle, 2022).

Said's central argument in *Orientalism* is that the depiction of the East by Western empires was far from merely a matter of scholarly interest but instead served as an imperial instrument designed to dominate and subjugate the subalterns in the East with profound implications for cultural, literary, and postcolonial studies. The enduring relevance of *Orientalism* reshaped the way scholars understand, analyse, and evaluate the politics of representation, displacement, and colonisation (Bayoumi & Rubin, 2000). Our admiration for Edward Said's *Orientalism* stems from how profoundly it provoked and challenged the field of Oriental and Middle Eastern studies, compelling Western intellectuals to confront their complicity in sustaining colonial ideologies (Brennan, 2021).

A distinct feature of Said's work is his concept of *contrapuntal* reading – a method that interprets texts within the imperial contexts in which they were created. Said's method alludes to musical counterpoint, where independent melodies align without merging into a single harmony, thus suggesting coexistence rather than dominance (Brennan, 2021; Leonardo, 2020). This approach implicitly underpins Said's (1978) approach in *Orientalism* of how Western powers have historically constructed and controlled the 'Orient'. The methodology of contrapuntal reading was first introduced in *Culture and imperialism* (1993). Said sees this as a methodological approach to further his critique of *Orientalism*, focusing on cultural, especially literary scrutiny. This approach involves reading texts through a critical analytical lens and an acute awareness of dominant narratives, particularly from the West, and looking out for suppressed or dismissive perspectives, likely of that of the 'Orient'.

Furthermore, Said's advocacy for interdisciplinary approaches in academia influences educational theory by encouraging the dissolution of artificial barriers between disciplines. This interdisciplinary ethos enables a more comprehensive understanding of complex cultural and social phenomena, mirroring the multifaceted critique of *Orientalism* that drew from literary theory, history, and anthropology. Said's assertion in *Orientalism* is that the West's depiction of the East was not an innocent or objective exercise but a deeply

motivated political act that justified and sustained imperial control. This theme underscores how orientalist discourses are still pervasive in modern representations of the Middle East, preserving dismissive and degrading stereotypes and sustaining hegemonic ideologies. In Said's critique, we can observe that examining these representations is rooted in the Foucauldian analysis of power, knowledge, and representation (Bayoumi & Rubin, 2000; Foucault, 1980).

Said's work illustrates how knowledge systems are constructed to serve imperial benefits and fulfil their colonial visions. His works reverberate across literature, sociology, anthropology, history, cultural studies, and education. Our own contrapuntal reading is critical to understanding the many layers of Said's work. Said's focus on the ideological underpinnings of Western scholarship and ideologies exposed the reality of knowledge creation and placed Eurocentric academics under scrutiny. One criticism Said was confronted with throughout his life as a professor was his deeply embedded position and presence within elite Western institutions in the United States despite being an advocate of postcolonial resistance. This often led him to have his loyalties and principles questioned by both Western academics and his Palestinian community, and he also experienced a confounding dilemma with his own identity.

Cultural imperialism and postcolonial thought

Beyond Orientalism, Said majorly contributed to literary and cultural criticism. Works such as *The world, the text, and the critic* (1983) and *Culture and imperialism* (1993) expanded on the ideas initially laid out in *Orientalism*, examining how cultural production in both colonial and postcolonial epochs was shaped and determined by political, military, and economic power.

One major theme Said discusses in *Culture and imperialism* is the consequences of the interaction between culture and forces of imperialism. Said (1993) argues how Western cultural artefacts – novels, literature, classical music, operas, and academic discussions – orientate, support, and justify imperial conquest and colonial ambitions. He underscores how canonical works by renowned authors like Jane Austen and Joseph Conrad reflect and justify imperial ideologies, subtly reinforcing the West's moral and political superiority over colonised communities (Said, 1993). By embedding imperial ambitions and colonial values within the fabric of European culture and society, Said contends that imperialism became normalised and legitimised.

The central theme in the book draws attention to the complicity of culture in maintaining imperialist structures. Said clearly suggests in this book that culture is not separate from policies but deeply intertwined and, in fact, could be responsible for driving ideologies and controlling sentiments (Said, 1993). Through close examination of texts, Said demonstrates how literature and art shape perceptions of otherness, often portraying colonised peoples as passive, exotic, or uncivilised. These representations, Said argues, are instrumental in justifying imperial control.

European culture fuelled imperialism, sustaining a Eurocentric worldview that classified and dominated non-European societies, thus undergirding political and economic expansion (Said, 1993). The drive for imperial conquest was a form of 'geographical violence' that erased local identities, forcing colonised people to reclaim their sense of place (Said, 1993). Said (1993) notes that many humanists fail to link Western culture's high achievements with its oppressive practices, such as slavery and colonialism.

Importantly, Said critiques falsely unifying labels such as 'America', 'the West', or 'Islam' that homogenise diverse groups and enable oppressive mobilisation. He argues that such simplifications should be resisted for their harmful impact (Said, 2001). Said warns against nativism, seeing it as a divisive response to imperialism that often reproduces the very stereotypes and divisions it opposes. True resistance, Said (1993) contends, requires moving beyond essentialised identities like 'Islam' or 'the West'. Instead, Said advocates a cosmopolitan vision, where one's local identity is just one layer in a broader, open engagement with the world (Said, 1993). He argues that in today's interconnected world, no one is solely defined by a single label – 'Indian', 'Muslim', or 'American'. These categories are starting points, not endpoints, as imperialism has left a legacy of blended identities that challenge pure, exclusive labels (Said, 1993). Ultimately, Said (1993) urges intellectuals to adopt a contrapuntal approach that resists hierarchical thinking and rejects both cultural chauvinism and isolationism, fostering a more concrete and empathetic understanding of the world's diversity.

Said's contrapuntal perspective on music

Music held a central place in Said's intellectual and personal life. He wrote numerous musical essays and was a skilled pianist (Guzeliman, 2002). While deeply knowledgeable, he remained a self-described 'amateur', resistant to specialisation and critical of musicology's detachment from broader social and political contexts (Barenboim, 2009; Capitain, 2024). Influenced by his mother's musicality, Said had once considered a concert pianist career but struggled with performance anxiety (Said, 1991; Brennan, 2021).

Said appreciated Nietzsche's view of music as both profoundly accessible yet inherently mysterious and viewed it as the "most silent and esoteric" of the arts, aiming in *Musical elaborations* to bridge its separation from rational discourse and social engagement (Said, 1991; Brennan, 2021; Barenboim & Said, 2002). Drawing on Adorno's ideas, he saw music as both resisting and reflecting the inhumanity of the society that produces it, lamenting its commodification under capitalism (Said, 2004).

Famed conductor and concert pianist Daniel Barenboim, who admired Said's encyclopaedic knowledge of music history, keys, tempos, and repertoire, co-founded the Barenboim-Said Akademie in Berlin with him, bringing together Arab, Israeli, and German musicians in a setting that emphasised cultural understanding and unity. The academy, housed in Frank Gehry's 'cosmic egg' concert hall, continues under the guidance of Said's wife, Mariam (Barenboim & Said,



Figure 3. A photo from the Facebook page of the Barenboim Said-Akademie (<https://www.facebook.com/BarenboimSaidAkademie/>).

2002; Sellars, 2024). The collaboration between the Israeli Barenboim and the Palestinian Said was a remarkable testament to their shared belief in the transformative power of music and underscored their commitment to fostering dialogue and mutual understanding through art, creating a space where young musicians from opposing backgrounds can connect and grow together.

Decolonising education

In addition to cultural artefacts such as literature and music, another form of imperial control is through education. Although Said never produced any specific work in education, it is undeniable that many of his works are intricately intertwined with education and colonialism. Although Said never formulated an educational theory, his perspectives on postcolonial and critical theories significantly shaped educational discourse and practice. The concepts discussed in Said's (1978) *Orientalism* function as a helpful lens to examine and facilitate reforms to address stereotypes and imbalances in global educational policies and practices. In fact, *Orientalism's* ideas are relevant in our global multicultural educational contexts and have far-reaching implications. Said (1978) argued that Western scholarship has systematically misrepresented and undermined knowledge and perspectives from the East, including the Middle East. He further argued that this misrepresentation created a distorted difference between the 'Orient' and the 'Occident' (Said, 1978).

In educational contexts, if examined carefully, we can observe distinct disparities in many instances of the representation of dominant Eurocentric cultures as compared to non-western ones. There exist many implicit biases in the modern curriculum that laud the achievements of the imperial powers while dismissing the knowledge centres and rich history of the 'Orient' as inferior and backward (Guilherme & Picoli, 2021). Leonardo (2020) suggests that education institutions in the U.S., for example, engage in a form of 'educational Orientalism' by highlighting privileged Western knowledge systems and perspectives and reinforcing biases about the East in their curriculum and also in their pedagogical

approaches. He contends that these approaches only serve to maintain hegemonic powers within academic institutions and within the societies they operate (Leonardo, 2020). For example, the case studies used as a pedagogical approach may reflect only colonial perspectives and class discussions, which orientate towards diminishing the knowledge centres and rich history of the East.

Scholars have highlighted regimes of knowledge created by colonial rule (Gani & Marshall, 2022). Alongside Said, Homi Bhabha and Gayatri Spivak are fellow pioneers of postcolonial studies (Sawant, 2011). Bhabha (2012) argues that colonial anxiety pushes the coloniser to want to reinforce their identity constantly and emphasise the differences and superiority between the coloniser and the colonised. Bhabha (2012) describes the anxious and unstable nature of the colonial relationship as ironic. The reason is an unsettling encounter for the colonisers, as they are sharply aware that despite being in power, they are still dependent on the colonised 'natives'. The colonised becomes a mirror image of the coloniser or what Bhabha terms a 'mimicry' (Spivak, 2014). Bhabha (2012) suggests that because of this anxiety, the coloniser seeks to emphasise the difference between the colonised and the coloniser, thus creating stereotypes that are, in fact, contradictions. For example, natives are described as cunning in one place but intellectually inferior in another or as lazy and unintelligent yet are found to be efficient and skilled workers.

In *Out of place*, Said (1999) (see Figure 4) provided insights into how education shaped his sense of identity and belonging. As someone displaced and later educated in Western institutions, he was informed and shaped by his experiences in elite institutions in the West. His perspective suggests that we should be discerning when examining education materials and reflecting on learning experiences in the classroom. Throughout his works, Said argues that the relationship between knowledge and power is intricate and dynamic. This relationship is vital to the relevance of key concepts in *Orientalism* to global education. Said underlined how scholarship steeped in imperial values reinforced imperial power dynamics (Said, 2002). Leonardo (2020) explained this by narrating how Napoleon's occupation of Egypt was a "turning point toward a modern form of imperialism whereby an aggressor's canon is supplemented by their canons" (p. 12). In other words, Napoleon used not only weapons to conquer the Egyptians but also unique weaponry manifested through canons of knowledge through botanists, educators, historians, philosophers, and philologists (Said, 1978; Leonardo, 2020).

Said's ideas here suggest that educators should:

- 1) assist students in navigating through different and complex cultural identities;
- 2) demonstrate sensitivity towards students from diverse backgrounds;
- 3) plan and create inclusive educational environments that embrace diversity;
- 4) use critical pedagogy to examine stereotypes and

bias in texts, during classroom discussion, and in curriculum material;

- 5) encourage material fostering multi-disciplinary knowledge and global awareness;
- 6) motivate themselves and students to examine power dynamics in matters beyond their academic discipline; and
- 7) foster a sense of social responsibility, gratitude, and civic responsibility through education regardless of the academic discipline.

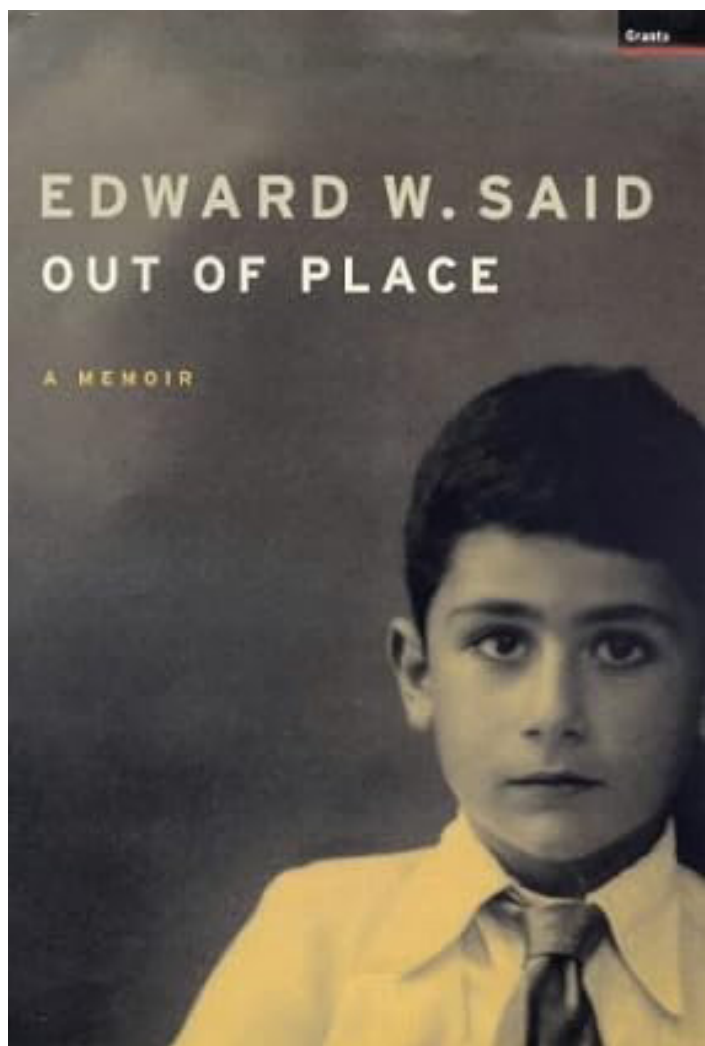


Figure 4. Book cover of 'Out of Place'.

Said's discourses in *Orientalism* inform us to examine, scrutinise, and evaluate educational policies carefully. Different educational policies continue to rely on Orientalist ideas, and their ill effects are pronounced in marginalised communities (Moosavi, 2020). For example, policies still organise and label students from underprivileged communities as 'at-risk' and 'underperforming' without them getting fair access to resources and educational opportunities (Moosavi, 2021). In some policies, educational interventions and support are framed as providing equity and education to an uncivilised population, mirroring imperial discourses and ambitions in the past (Johnstone & Lee, 2020). The voices and experiences of marginalised communities are often excluded in policy development

and considered secondary (Chowdhury, 2023). Said's postcolonial discourses provide us with a useful critical lens to unmask power dynamics within education policy and practice and counter the highfalutin values of institutions determined to uphold imperial values and sustain colonial hierarchies.

In this spirit, Said tirelessly advocated for establishing American studies programmes at universities across the Middle East while simultaneously pressing for the expansion of Arab studies in the United States (Brennan, 2021). Despite his many passions and responsibilities, Said took teaching very seriously. Although he admitted to the "uncomfortable, stomach-churning, palm-sweating anxiety" he experienced before – and even during – class (cited in Brennan, 2021, p. 242), students overwhelmingly felt that he was "the best teacher they had ever seen" (Brennan, 2021, p. 244).

Deeply rooted in Western traditions, Said regarded himself as conservative in his respect for the classical canon (Leonardo, 2020). He critiqued postmodernism's elevation of popular culture over high culture, aligning himself with the Frankfurt School's critique of the culture industry (Horkheimer & Adorno, 1997; Leonardo, 2020). For Said, an uncritical celebration of popular culture amounted to a narrow intellectual stance; instead, he held an enduring, discerning appreciation for high art, classical music, and literature, free from elitist fetishism (Said, 1993).

In *Humanism and democratic criticism*, Said (2004) builds on his *Orientalism* arguments and laments how academia now suffers from restricted intellectual perspectives and disconnection from reality that separates academics from understanding and addressing broader social and cultural issues. This results in academic insularity and detachment from real-world challenges. Said firmly believed that intellectuals should be committed to universal principles of justice, equality, and human dignity and advocated for engagement with political and social realities to transform communities.

Said (2004) advocates for a form of humanism that is secular, sceptical, and inclusive. He emphasises the need for a form of humanism that is not rooted in Eurocentrism and colonial ideas but one that is inclusive of different cultures and perspectives. Said (2004) argues that this is not an abstract idea but one that must inform educational policies and practices to challenge oppression and dominant Eurocentric ideas by encouraging dialogues that transcend social and political boundaries. Said's vision can be realised through decolonising the curriculum, applying critical pedagogies in class, and encouraging students to reflect beyond social and cultural boundaries when engaging with what they are learning. Education and humanism are likely the antidote to the schismatic Oriental-Euro divide in an increasingly interconnected world. Said's suggestion of cosmopolitanism and the development of a global citizen might allow the next generation to transcend Eurocentric labels and Orientalist divides, the very divides that Said has critiqued and challenged his entire life. We owe a debt of gratitude to Edward Said now that colonialism is critically examined in cultural and social discourse, politics, economics, and culture. The very idea that Western secular modernity represents

civilisation is now sharply challenged, and academics such as Ammiel Alcalay (1993), Judith Butler (2011), and Moira Ferguson (2014) have continued this examination and share the approach of Said’s *Culture & imperialism*. As academics, we must continue this rich tradition.

Articles on generative AI in this and previous issues

The remainder of our Editorial discusses generative AI-specific contributions and others. In our fast-paced times and hectic academic lives, we sometimes forget to look back and review what has happened. Between January 2023 and June 2024, over three regular issues, we published 44 manuscripts: three editorials, two commentaries, 24 research articles, two interviews, three opinion pieces, six EdTech articles, one brief article and three book reviews (Rudolph, 2023, 2024a, 2024b). Disregarding the book reviews and a much earlier article by Samson Tan (2020), an analysis of the 41 manuscripts arrives at 18 themes (see Table 1).

Table 1. JALT Generative AI themes between January 2023 and June 2024.

Number	Theme	References	Occurrences
1	Future of Higher Education (HE)	Ifelebuegu, 2024; Luckin et al., 2024; Popenici, 2023; Popenici et al., 2023; Rudolph et al., 2023a; Rudolph et al., 2023c; Rudolph et al., 2024	7
2	Benefits and Challenges of AI	Gamage et al., 2023; Ifelebuegu et al., 2023; Kouam & Muchowe, 2024; Ogunleye et al., 2024; Rasul et al., 2023; Rudolph et al., 2023a; Van Wyk, 2024	7
3	Ethics	Huang et al., 2023; Luckin et al., 2024; Popenici, 2023; Xames & Shefa, 2023	4
4	Academic Integrity	Mohammedkarimi, 2023; Sevnarayan & Potter, 2024; Sullivan et al., 2023; Van Wyk, 2024	4
5	AI Plagiarism Detection	Chaka, 2023; Chaka, 2024a; Chaka, 2024b; Hassoulas et al., 2023	4
6	Literature Reviews	Ismail et al., 2023; Ismail et al., 2024; Stracke et al., 2023; Tlili et al., 2023	4
7	Graduate Employability	Popenici et al., 2023; Rudolph et al., 2023c; Rudolph et al., 2023d; Waring, 2024	4
8	Scholarly Research and Publishing Ethics	Perkins & Roe, 2024; Sobaih, 2024; Xames & Shefa, 2023	3
9	Assessment	Ifelebuegu, 2023; Khademi, 2023; Ogunleye et al., 2024	3
10	Technology Awareness	Ahmad et al., 2024; Joseph et al., 2024	2
11	Developing Countries	Adarkwah et al., 2023; Joseph et al., 2024; Kouam & Muchowe, 2024	3
12	Big Tech Critique	Popenici et al., 2023; Rudolph et al., 2023a; Rudolph et al., 2023b	3
13	AI Literacy	Rasul et al., 2023; Waring, 2024	2
14	Perceptions of AI (Students and Academics)	Firat, 2023; Limna et al., 2023	2
15	Student Voice	Sevnarayan & Potter, 2024; Sullivan et al., 2023	2
16	Chinese AI	Huang et al., 2023; Rudolph et al., 2023b	2
17	Chatbot Testing	Rudolph et al., 2023b; Santandreu Calonge et al., 2023	2
18	Open Educational Practices	Mills et al., 2023	1

Due to limitations of space, we only focus on the top seven themes but cross-reference other themes in the following high-level summary. First, the *future of higher education* is poised for significant transformation as it confronts the generative artificial intelligence (GAI) hype and students’ rapidly increasing use (Ifelebuegu, 2024; Rudolph et al.,

2023a). The question of whether to integrate GAI into higher education and how it will reshape teaching, learning, and assessment raises fundamental queries about the role of education in an increasingly automated world (Rudolph et al., 2023c). As AI tools like ChatGPT continue to evolve, their impact on graduate employability, the traditional roles of educators, and the broader purpose of higher education will become increasingly pronounced (Popenici et al., 2023; Rudolph et al., 2023c, 2023d; Waring, 2024). While GAI offers the potential to enhance educational outcomes, it also necessitates rethinking curricula to ensure that students are equipped with the critical thinking and ethical decision-making skills necessary for a technology-driven job market. As educators and institutions adapt to these changes, the future of HE will likely be defined by how effectively it balances the benefits of AI with the preservation of human-centred education (Luckin et al., 2024; Popenici, 2023; Popenici et al., 2023; Rudolph et al., 2023c, 2024b).

Secondly, AI in higher education presents a double-edged sword, offering significant benefits and notable challenges (Rudolph et al., 2024a). On the one hand, AI has the potential to revolutionise educational practices by enhancing learning experiences, personalising education, and streamlining administrative tasks, thereby increasing overall efficiency within institutions (Gamage et al., 2023; Ifelebuegu et al., 2023). However, these benefits are tempered by challenges such as the potential for widening the digital divide between and within countries, ethical concerns regarding data privacy, and the risk of over-reliance on technology at the expense of critical human interactions (Adarkwah et al., 2023; Joseph et al., 2024; Kouam & Muchowe, 2024; Rasul et al., 2023; Van Wyk, 2024). Furthermore, the implementation of AI in assessments and other academic processes raises questions about fairness and the integrity of educational outcomes, requiring careful consideration and adaptive strategies (Mills et al., 2023; Ogunleye et al., 2024; Rudolph et al., 2023a, 2023b). Assessment, in particular, needs to be rethought and made more authentic, practical, and intellectually stimulating (Ifelebuegu, 2023; Khademi, 2023; Ogunleye et al., 2024; Rudolph et al., 2023a, 2023b).

Third, the integration of artificial intelligence (AI) into higher education raises critical ethical concerns that must be carefully addressed. Key issues include the potential for GAI Large Language Models (LLMs) to perpetuate biases, the handling of sensitive data, and the broader implications of replacing human judgment with algorithmic decision-making (Huang et al., 2023; Luckin et al., 2024; Popenici, 2023; Xames & Shefa, 2023). These ethical dilemmas underscore the need for a thoughtful and responsible approach to AI adoption to enhance rather than diminish the human elements of higher education. Furthermore, educators and institutions must develop frameworks that promote transparency, fairness, and accountability in the use of AI, safeguarding the integrity of higher education (Luckin et al., 2024; Popenici, 2023).

Fourth, the rise of AI in higher education presents significant challenges to maintaining academic integrity. With AI tools capable of generating human-like text, the potential for misuse in academic settings has grown, raising concerns about plagiarism, cheating, and the authenticity of student

work (Sullivan et al., 2023; Mohammedkarimi, 2023). To address these issues, higher education institutions must promote a culture of academic honesty and ethical behaviour among students (Van Wyk, 2024). In addition, educators need to rethink assessment strategies and incorporate AI literacy into the curriculum to prepare students for ethical engagement with AI technologies (Ifelebuegu, 2023; Khademi, 2023; Ogunleye et al., 2024; Rasul et al., 2023; Sevnanarayan & Potter, 2024; Waring, 2024).

The fifth point is directly related to maintaining academic integrity. The increasing sophistication of AI tools has led to growing concerns about AI-facilitated plagiarism in higher education. As students gain access to AI-driven platforms capable of producing high-quality, human-like text, the challenge of detecting such content has become more pressing (Hassoulas et al., 2023). Research indicates that existing plagiarism detection tools are often inadequate in identifying AI-generated material (Chaka, 2023, 2024a, 2024b).

Sixth, literature reviews in the context of AI in higher education are becoming increasingly crucial as the field evolves rapidly. Transparency and methodological rigour in conducting these reviews ensure that they provide a comprehensive and unbiased overview of existing knowledge (Tlili et al., 2023; Ismail et al., 2023). Given the rapid advancements in GAI, systematic literature reviews must be regularly updated and standardised to maintain their relevance and accuracy in informing educational practices and policies (Stracke et al., 2023). As the body of literature grows, these reviews will continue to play a pivotal role in synthesising research findings and guiding future studies (Ismail et al., 2024a, 2024b).

Finally, the advent of AI is significantly reshaping the landscape of graduate employability, challenging traditional notions of the skills and attributes needed in the workforce. There is an increasing demand for graduates who possess advanced problem-solving and decision-making abilities, and who are adaptable, creative and critical thinkers (Rudolph et al., 2023c; Waring, 2024). Therefore, educational institutions must adapt their curricula to focus on these competencies, ensuring that graduates are employable and equipped to thrive in an AI-driven job market (Popenici et al., 2023). Moreover, there is a growing discourse around the potential of AI to replace certain job roles, further emphasising the need for graduates to cultivate uniquely human skills that AI cannot replicate (Rudolph et al., 2023d).

Our above approach addressed the challenge of keeping track of the overwhelming volume of articles on AI and higher education published in JALT alone. In the following, we connect the new pieces in this issue to the previously identified themes while uncovering an additional theme along the way.

Our Editorial is succeeded by Damaševičius's "Commentary on Artificial intelligence and graduate employability: What should we teach Generation AI?", which highlights the impact of AI on graduate employability, urging curriculum reforms for Generation AI. Building on Waring's (2024) advocacy for moving away from rote learning to enhance analytical skills, it

proposes integrating AI literacy in higher education to foster ethical decision-making and critical analysis, suggesting empirical studies to refine AI's educational integration.

The first AI-specific research article in our current issue is Broadhead's "Insidious chatter versus critical thinking", which warns that generative artificial intelligence (GAI) tools risk perpetuating Eurocentric biases in higher education. By showing how AI can reinforce these biases in syllabus creation, Broadhead calls for caution in adopting AI technologies, particularly in decolonisation efforts within academia. Broadhead's important contribution is arguably located in the Big Tech critique (Table 1, theme 12).

Second, Neupane et al.'s "Threading the GenAI needle" explores GAI's impact on higher education. They reveal that while students and educators see potential in GAI's personalised learning features, administrators express concern about over-dependence and declining student proficiency. In a related piece, Kutty et al.'s "Generative AI in higher education" examines perspectives from key stakeholders – students, educators, and administrators – on GAI's role in education. Their findings highlight benefits like personalised learning and language support but also reveal a need for more research on the administrative challenges of AI integration. Neupane et al.'s and Kutty et al.'s articles belong to themes 14 (perceptions of AI) and 2 (benefits of challenges; see Table 1).

The next three articles fall largely into the AI literacy discourse (Table 1, theme 13). Al-Ali et al.'s "LAIK your classroom" proposes the LAIK framework for integrating GAI into teaching and learning activities. The LAIK framework (Laying the foundation, Assembling GenAI-friendly classes, Investigating and monitoring, and Keeping the teacher informed) offers a practical approach for teachers to manage AI's implementation before, during, and after its adoption, ensuring smoother transitions in educational practices. Complementing Al-Ali et al., Sullivan et al.'s "Improving students' generative AI literacy" demonstrates that even a short workshop significantly enhances students' confidence and understanding of GAI. The authors suggest that ongoing AI literacy training is essential for helping students navigate AI tools responsibly. Saliu's "Navigating media literacy in the AI era" critiques classic media literacy texts by Potter and Baran for overlooking key concepts like AI's role in online communication, mob censorship, and social media literacy. Saliu calls for a more holistic media literacy approach to better equip learners for today's AI-driven, digitally mediated landscape.

In this issue, there are several contributions that specifically look at how certain disciplines or skills can be aided by GAI. In "On feedback from bots", Taylor and Marino examine the use of AI in providing feedback for writing. While acknowledging AI's potential to assist students, they highlight the importance of human oversight, particularly in developing students' critical thinking and metacognitive skills. Alvarez and Cress's "The uses of digital technologies in dissertation writing" looks at the role of digital tools in the writing process for Argentine graduate students. The study shows that AI and other digital technologies are transforming academic practices in a pandemic-accelerated

digital age. Both Taylor and Marino's and Alvarez and Cress's contributions could be located in theme 13's literacy discourse (see Table 1). They also partially belong to theme 8's scholarly research and a previously unidentified theme that can be termed "teaching and learning applications".

Next, Sabbaghan's "Exploring the synergy of human and AI-driven approaches in thematic analysis" investigates how AI can enhance qualitative research in education (Table 1, theme 8). By combining AI's efficiency with human interpretive skills, the study reveals that a collaborative approach can produce richer, more nuanced analyses.

Jayasinghe's "Promoting active learning with ChatGPT" offers strategies for leveraging ChatGPT to transform traditional teaching methods in resource-constrained environments such as those experienced at Sri Lankan higher education institutions. The study provides practical solutions for integrating AI to foster critical thinking and collaborative learning and falls into a new theme of "teaching and learning applications".

In the 11th research article, "Can instructors detect AI-generated papers?", Murray and Tersigni assess instructors' ability to distinguish between AI-generated and student-written essays. Their findings reveal that while AI essays often score higher on technical aspects, they lack depth in argumentation, highlighting the challenges in detecting AI use. Murray and Tersigni cast serious doubt on the reliability of GAI detection and arrive at conclusions similar to those of previous JALT authors (Table 1, theme 5).

The 12th and 13th contributions discuss the use of GAI in learning languages. Kamali et al.'s "Exploring the challenges and affordances of integrating ChatGPT into language classrooms" adopts an ecological perspective to assess the integration of AI in teaching languages. The study identifies the benefits and challenges of using ChatGPT, particularly in balancing AI with traditional methods. Thanh Khoa and Tran's "AI-assisted learning applications in English courses in Vietnam" explore how students' motivations to use AI tools are influenced by factors such as social and technological gratifications. Their research shows a positive correlation between these factors and students' enjoyment of AI-assisted learning. Both articles are located somewhere within the benefits and challenges of AI (theme 2), AI literacy (theme 13) and the new theme of "teaching and learning applications".

There are two other discipline-specific articles in our current issue. Leite's research article "Generative Artificial Intelligence in chemistry teaching" reflects on the broader challenges of teaching in the AI age, proposing several recommendations for effectively incorporating AI into education, particularly in STEM fields. Divino's opinion piece "Hey, ChatGPT: How should we teach law to Generation AI?" proposes strategies for teaching law to a generation raised with AI. He suggests that legal education must adapt by integrating AI into the curriculum, ensuring students are equipped for an AI-driven future.

There are two more research articles on GAI in higher education that use quantitative research methods. Ofem et al.'s "Curriculum factors and sustainable artificial intelligence (AI)-driven classroom assessment" examine the role of digital literacy and curriculum innovation in ensuring sustainable AI-driven assessments, highlighting the importance of integrating AI into the educational infrastructure (Table 1, theme 13, AI literacy). Finally, Hasanein et al.'s "Examining Google Gemini's acceptance and usage in higher education" explores student perceptions of Google Gemini in Saudi universities, revealing both positive and negative factors influencing the adoption of AI tools in higher education settings (Table 1, theme 10, technology awareness).

There are a total of three opinion pieces on GAI, including Divino's above-discussed contribution. Giray's "Negative effects of Generative AI on researchers" focuses on three potential harms: publishing addiction, the Dunning-Kruger effect, and skill erosion. He argues that over-reliance on AI may cause researchers to prioritise quantity over quality, leading to a decline in research rigour (Table 1, theme 8, scholarly research and publishing ethics). Barrera et al.'s "The personalising power of error" advocates for leveraging AI to transform mistakes into learning opportunities. By using AI to analyse errors, the authors argue that educators can create personalised learning environments that encourage students to embrace failure as a catalyst for growth (Table 1, theme 1, future of higher education).

The remainder of the issue

The remainder of the issue presents a diverse collection of studies, opinion pieces, and reviews that engage with contemporary topics in higher education. Roe et al.'s research article "Paraphrase or plagiarism?" investigates ESL students' approaches to paraphrasing in an EAP context, revealing a reliance on sentence-level adjustments and cautious language use to avoid plagiarism. Participants showed low confidence in generative AI, underscoring the need for refined EAP instruction.

Costabile et al. propose a micro-model taxonomy for effective simulation-based learning design, adaptable to any software, with guidance grounded in the ASSURE and Design Thinking frameworks to enhance learning outcomes in STEM and health sciences. Teague and Hudson's study on data analytics for non-STEM students highlights gains in technical confidence and digital literacy, contesting stereotypes about non-STEM students' tech skills and underscoring digital literacy's role in employability.

Calonge examines situational engagement in statistics classes, finding that social interaction boosts engagement and effort while individual tasks decrease them. Insights into test anxiety and intrinsic motivation provide valuable implications for curriculum design. Ng et al. explore the impact of an eight-week metacognitive intervention on career resilience among young and mature employees. Findings underscore the role of metacognitive strategies in workplace adaptability and resilience. Namaziandost et al. investigate peer support's effect on language learning among Iranian undergraduates, with results showing

reduced anxiety, improved performance, and greater enjoyment among peer-supported learners.

Barlas et al. reveal Afghan graduates' perspectives on their education's relevance, noting gender disparities in employment outcomes and advocating for entrepreneurship training to empower female graduates. Ridley and Fynn evaluate the efficacy of Digital Community Health Awareness Training (DCHAT) for nursing education, demonstrating its positive impact on addressing unconscious bias and enhancing nurse-patient relationships in digital and global contexts.

Mariyam and Karthika explore posthumanist pedagogy through wordless graphic assemblages, showing how this innovative approach in an Indian ESP classroom enhances students' speaking skills, motivation, and agency. Lawthong and Thepsathit validate the Online Learning Scale (OLS) in Thailand, providing robust psychometric data and establishing effective cut scores to assess online learning quality. Chan and Ismail examine gratitude in higher education, linking it to enhanced well-being and engagement. The authors suggest integrating gratitude intentionally into curricula to foster a positive academic environment.

The issue also contains an interview, and in addition to the previously discussed three opinion pieces, there are another two. In "The oxymoronic pursuit of pleasurable academic writing," we interviewed Helen Sword, who discusses her research methods and the creative potential within academic writing, offering valuable insights for academics seeking to write more engagingly. Kefalaki's opinion piece on strategic management in Greek public universities highlights the importance of innovative leadership for institutional success, collaboration, and a competitive global position. Or discusses competency-based education in Singapore, focusing on its role in cultivating a future-ready workforce through initiatives like SkillsFuture, which enhance adaptability and lifelong learning.

The issue concludes with five book reviews. Lim reviews Co-intelligence: Living and working with AI by Ethan Mollick, advocating for a shift in AI perception from a tool to a collaborative partner, reshaping human-AI interactions in professional and educational settings. Hulpke's review of Daniel Bell's The Dean of Shandong offers insights into academic life in China, highlighting the importance of non-Western perspectives in business education and the global relevance of China's influence.

Rohmatulloh and Winarni review Johnson's Becoming a more assertive teacher, discussing strategies for teachers to assert themselves in ways that strengthen their professional presence and foster constructive classroom dynamics. Mahendra and Tampang examine the Handbook of teaching competency development in higher education, focusing on the framework's applicability for adapting to digital transformations like 5G and AI in teaching. Finally, Dinata et al. assess the Handbook of technical and vocational teacher professional development in the digital age, offering insights into practical strategies for digital integration, though noting repetitive language as a critique.

This issue brings together forward-thinking research and reflections that tackle complex issues of teaching and learning within the global higher education context. While we would not presume to second-guess Edward Said, we believe this issue honours his spirit by presenting an array of international scholars offering contrapuntal, critical analyses. By offering cutting-edge insights into educational practices and digital literacy, our issue equips educators to critically engage with the challenges and opportunities in creating a more inclusive, reflective, and innovative academic landscape.

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Commentary on Artificial Intelligence and graduate employability: What should we teach Generation AI?

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Abstract

This commentary explores the critical role of artificial intelligence (AI) in shaping graduate employability and the subsequent need for curriculum reforms aimed at Generation AI. An earlier commentary, authored by Peter Waring, argues for a shift from traditional education models focused on rote memorization and standardized testing towards fostering analytical thinking and the ability to ask the right questions. With AI and automation increasingly influencing high-cognitive job roles, Waring advocates for integrating AI literacy within higher education, emphasizing ethical decision-making and critical analysis. Waring's "Input/Output/Action" model serves as a structured framework for teaching AI interaction, encouraging students to engage with data critically, evaluate AI-generated outputs, and make informed decisions based on these insights. Waring's recommendations emphasize the need for further empirical validation through pilot programs and interdisciplinary research to optimize AI integration across diverse educational settings.

Keywords: AI literacy; Artificial Intelligence in education; critical thinking; workforce transformation.

Introduction

The commentary by Peter Waring on educating the "Generation AI" advocates a shift in educational paradigms—from a focus on delivering right answers to fostering the ability to ask the right questions (Waring, 2024). This shift is vital as we navigate a landscape increasingly dominated by AI and automation, which are poised to transform the job market radically (Cristianini, 2014).

Waring's perspective resonates deeply with the changing demands of the workforce in an era where AI technologies like ChatGPT and Large Action Models (LAMs) are not just augmenting but in some cases, replacing human roles in high-cognitive fields (Banerjee, 2023; Dhar, 2023). The traditional educational model, which prioritizes memorization and standardized testing, may no longer suffice in preparing students for future careers that require advanced cognitive

and interpersonal skills, which AI is steadily encroaching upon (Grubaugh & Levitt, 2023; Saulnier et al., 2008). The article stresses the urgency for universities to integrate AI literacy within their curricula, not just as a technical subject, but intertwined with ethical decision-making and critical analysis. This approach is crucial because while AI can enhance productivity and decision-making, it also presents risks such as data bias, ethical quandaries, and the potential for misinterpreting AI-generated outputs. Educators are thus called upon to teach students not only how to use AI tools effectively but also how to critically assess and challenge the outputs these tools generate (Holmes et al., 2021).

Waring's "Input/Output/Action" model is an excellent framework for this, emphasizing the need for students to understand the entire process of AI deployment—from inputting data to acting on AI-generated insights. This model encourages students to consider the sources of their data (Input), critically evaluate the information produced by AI (Output), and make informed decisions on how to use this information (action), all within an ethical context.

Comparative analysis

The article by Peter Waring emphasizes the critical need for curricular reform in higher education to accommodate the influences of AI, particularly advocating for an education that pivots from providing answers to fostering question-asking capabilities in students (Leou et al., 2006). This aligns with the findings of the World Economic Forum's Future of Jobs Report (2023), which also underscores the increasing importance of analytical and creative thinking skills in response to AI integration in the workforce (Cao et al., 2023). However, Waring's advocacy for a specialized "Input/Output/Action" model to specifically address the nuances of AI interaction distinguishes his approach from more general calls for skill enhancements (Ratnawati & Idris, 2020).

Waring's perspective contrasts with traditional educational theories like Bloom's Taxonomy, which emphasize a structured hierarchical model for learning objectives that may not fully encapsulate the fluid and dynamic skills required to interact with and interrogate AI systems effectively (Zoller,

1999). While Waring projects a future where AI deeply integrates into job roles, necessitating an acute focus on AI literacy and ethical use, traditional models place a broader emphasis on a progressive mastery of knowledge that may not specifically account for the rapid adoption and ethical challenges posed by emergent technologies (Shimizu et al., 2023).

Waring's "Input/Output/Action" model offers a structured approach to integrating AI literacy within educational systems, aligning closely with emerging technologies and methodologies discussed in contemporary literature. Damasevicius and Zailskaite-Jakste (2024) and Huang et al. (2023) explore digital twin technology (DTT), which like Waring's model, emphasizes immersive and hands-on learning environments. The "Input" phase of Waring's model can be enriched by incorporating DTT to simulate real-world scenarios in a controlled digital environment, providing students with real-time feedback and the ability to experiment and iterate, which are crucial in understanding and manipulating AI systems. I suggest moving beyond traditional hierarchical learning models towards more dynamic and fluid frameworks, which resonates with Waring's push for a model that accommodates the non-linear and expansive nature of AI learning needs (Damasevicius, 2023). The "Output" phase in Waring's model could integrate insights from this work, suggesting that the assessment of AI-generated content should involve critical thinking and adaptability, moving away from rigid learning stages to more flexible, outcome-oriented evaluations.

In the context of immersive and gamified learning environments explored in (Damasevicius and Sidekerskiene, 2023), the "Action" phase of Waring's model could be expanded to include metaverse technologies. These environments offer practical applications of AI in a simulated, interactive setting, enhancing the actionability of AI knowledge through real-world applications in a controlled, gamified context. This approach not only solidifies theoretical knowledge but also enhances engagement and retention through experiential learning. The potential for AI to act as a teaching assistant (Rudolph et al., 2023) aligns with Waring's model by suggesting AI's role in not just delivering content but also in evaluating and adapting educational content to meet individual student needs (Damasevicius and Sidekerskiene, 2024). The integration of AI in this manner speaks to a continuous cycle of input, output, and action where AI tools are used to both deliver personalized content and assess student engagement and learning outcomes, providing a feedback loop that is crucial for effective learning.

Finally, the exploration of pedagogical memes (Sidekerskiene and Damasevicius, 2024) introduces an innovative method for engaging students, which could be incorporated into Waring's model as part of the "Output" stage. By using AI to generate educational memes, students could engage with content in a format that is familiar and engaging, increasing the accessibility and relatability of complex AI concepts. This approach could also foster a deeper connection with the material, encouraging more profound reflection and discussion, thereby enhancing the educational process.

Critical analysis

The article by Peter Waring on integrating AI into higher education curricula presents an essential, if somewhat incomplete, blueprint for adapting academic environments to the demands of the AI era (Chang et al., 2022). Waring's call for a shift in educational practices toward cultivating AI literacy and ethical awareness is timely, addressing a real and urgent need as AI technologies become increasingly prevalent in all sectors of society (Xia, 2019). However, the primary foundation of the argument rests on theoretical projections and hypothetical scenarios rather than concrete empirical evidence. This reliance potentially undermines the strength and applicability of the recommendations, as it leaves the proposed changes without a robust evidentiary base to predict their effectiveness in real-world educational settings (Popenici & Kerr, 2017).

Waring's analysis could benefit from a broader and more diverse literature review (Zawacki-Richter et al., 2019). The discussion primarily engages with sources directly related to AI's technological and employment implications, overlooking extensive bodies of work in educational psychology, pedagogy, and curriculum development that could provide deeper insights into how students learn complex new technologies and adapt to changing job markets (Sanasintani, 2023). Incorporating findings from these fields could strengthen the argument by situating AI education within broader educational theories and practices, thus offering a more holistic approach to curriculum reform (Crompton & Song, 2021).

The speculative nature of the article concerning AI's impact on the workforce is another point of contention (George & Wooden, 2023). While it is crucial to prepare for future technological shifts, the discussion leans heavily on assumptions about AI's trajectory without sufficient consideration of current trends and data (Crompton & Song, 2021). This forward-looking stance, while visionary, might benefit from a more nuanced analysis that includes potential short-term impacts, the speed of AI adoption across different industries, and varying levels of technological readiness among populations (Crompton & Song, 2021).

Waring's analysis also lacks a thorough examination of cultural and ethical variances in AI adoption and application, which are vital for developing a globally applicable educational model (Sanasintani, 2023). AI technology does not exist in a vacuum; it reflects and amplifies the values and biases of the societies that develop and deploy it (George & Wooden, 2023). An in-depth exploration of how different cultural contexts might affect the reception and effectiveness of AI education would provide valuable insights into designing adaptable and inclusive curricula that respect and respond to diverse ethical perspectives and societal norms.

Suggested modifications

To enhance the original article's approach, a key modification could involve a more empirical method to validate and refine Waring's "Input/Output/Action" model. Specifically, integrating a series of case studies and pilot programs within

various university settings could provide tangible evidence on the effectiveness of the model (Lombardi et al., 2017). These studies should assess both the implementation challenges and the learning outcomes associated with integrating AI literacy and ethical decision-making into existing curricula (Vereschak et al., 2021). Such empirical research could measure student engagement and proficiency in AI-related skills over time, offering insights into the long-term impacts of such curricular adjustments (Zakarijahet al., 2018).

Expanding the interdisciplinary focus of the model to include insights from cognitive science and psychology could deepen the understanding of how students interact with and process AI-driven content (Jones, 2017). This broader academic perspective could offer a more nuanced understanding of the cognitive load and adaptability required by students when engaging with complex AI systems (Martinho et al., 2020). By incorporating cognitive strategies that enhance learning and retention of AI concepts, educators could tailor instructional methods that align more closely with the cognitive development stages of learners (Koochang & Paliszkievicz, 2013).

The proposed model would also benefit from an enhanced ethical component, particularly through the development of a comprehensive framework that not only teaches the ethical use of AI but also engages students in the ongoing ethical debates surrounding AI in society (Ashley & McLaren, 2001). This could involve interactive workshops, scenario-based learning, and debates that simulate real-world ethical dilemmas in the use of AI (Shimizu et al., 2023). Such an approach would prepare students to not only use AI responsibly but also to actively contribute to shaping the ethical guidelines and policies that will govern AI use in various professional fields (Vereschak et al., 2021).

Lastly, to address global variations in AI adoption and the cultural dimensions of technology use, the model should incorporate comparative studies of AI integration across different educational and cultural contexts (Jakubik et al., 2022). This would help in customizing the curriculum to reflect diverse student needs and the specific socioeconomic and technological landscapes of various regions. By understanding these variations, educators can better prepare students from all backgrounds for a future where AI plays a central role in their professional and personal lives (Boobier, 2018). This global perspective is crucial for fostering a generation of graduates who are not only technologically proficient but also culturally competent and ethically prepared to navigate the complex global landscape of the AI era (Martinho et al., 2020).

Broader implications for the field

The insights from Peter Waring's article underscore broader multidisciplinary education concerns in the 21st century, particularly as they relate to the integration of technology in learning environments and the need for curricula that are responsive to rapid technological advancements (Shi & Xuwei, 2023). Waring's emphasis on AI literacy and ethical decision-making as core components of modern education reflects a broader shift towards multidisciplinary learning,

where technology, ethics, and traditional disciplines intersect (Register et al., 2022). This shift acknowledges that the challenges and opportunities presented by AI cannot be confined to computer science or engineering fields alone but are pervasive across all areas of study—from humanities to business, from social sciences to health sciences (Lee et al., 2021).

The article's advocacy for teaching students to ask the right questions rather than just providing the right answers aligns with a growing recognition of the importance of critical thinking, problem-solving, and adaptability in a diverse range of professional and academic contexts (Figaredo & Stoyanovich, 2023). This approach is fundamental in preparing students for a workforce where human roles are continually redefined by technological capabilities (Saylam et al., 2023). The skills to question, analyze, and ethically engage with AI outputs are crucial, not just for ensuring effective use of technology but for maintaining accountability in its application (de Oliveira Silva & dos Santos Janes, 2020). These skills are essential across disciplines as varied as law, where AI can impact issues of responsibility and privacy; healthcare, where AI's role in decision-making can affect patient outcomes; and media, where AI influences content creation and dissemination (Wang, 2021).

Waring's discussion about the need for a new curricular model resonates with the broader educational concern of how to prepare students not just for their first job but for lifelong learning and adaptation (Lee & Perret, 2022). The rapid evolution of AI technologies means that the knowledge and skills acquired during one's education may quickly become outdated (Harry, 2023). Hence, education systems need to emphasize flexibility, resilience, and the ability to continually learn and adapt—qualities that are highly valued across all disciplines (Sanusi & Olaleye, 2022). This lifelong learning approach is critical as the boundaries between disciplines blur, creating a demand for professionals who are not only specialists in their fields but are also knowledgeable about AI and its implications (Xu, 2020).

The focus on an ethical framework for engaging with AI also taps into broader discussions about the role of values in education (Akgun & Greenhow, 2021). As AI becomes embedded in everyday life, there is an increasing need for an education system that rigorously addresses the ethical, social, and political dimensions of technology (Ciampa et al., 2023). This involves a multidisciplinary approach that combines insights from ethics, philosophy, sociology, and technology studies to equip students with the tools to make informed decisions and lead in the shaping of tech policies and practices (Ng et al., 2021).

Future directions

Building on the original article's exploration of integrating AI into higher education curricula, further research could delve into several innovative areas to clarify and expand the findings. One promising avenue involves the longitudinal impact of AI literacy programs on student outcomes (Slimi, 2023). Researchers could track cohorts of students who receive AI-focused education versus traditional curricula over

multiple years, analyzing not only academic performance but also employability, job satisfaction, and adaptability in the workplace (Zeegers, 2001). Such studies would provide concrete data on the long-term benefits and potential drawbacks of AI-centric educational models.

Exploring the intersection of AI with non-technical disciplines presents a rich area for further inquiry. For instance, research could examine how AI tools can be leveraged in humanities and social sciences to enhance critical thinking and creativity, rather than focusing predominantly on their application in STEM fields (Figaredo & Stoyanovich, 2023). This could involve developing AI-driven tools that assist with historical research, ethical dilemma simulations in philosophy, or even AI that can analyze complex societal trends for social sciences (Anuyahong, 2023). The effectiveness, ethical considerations, and educational outcomes of these interdisciplinary applications would provide valuable insights into the broad applicability of AI in education (Akgun & Greenhow, 2021).

Another critical area for further research is the development and impact of AI-generated content in educational settings (Cheung & Slavin, 2012). Studies could investigate how AI tutors, personalized learning environments, and automated content generation affect learning processes and outcomes (Palmer et al., 2023). This research should also consider ethical implications, such as the potential for bias in AI outputs and the impact on students' critical thinking abilities when they are frequently interacting with AI-generated content. Comparative international research could illuminate how different educational systems integrate AI and the resultant effects on student learning and workforce preparation (Amer, 2020). Such studies would help identify best practices and cultural considerations that influence the effectiveness of AI education strategies, potentially leading to a global framework for AI integration into higher education (You & Nguyen, 2012).

Lastly, given the rapid evolution of AI technologies, ongoing research should examine the implications of emerging AI capabilities (Palmer et al., 2023) that were not anticipated in the original article. For instance, the impact of quantum computing on AI's problem-solving abilities could revolutionize educational methods and curricula (Zeegers, 2004). Research in this area could provide proactive strategies for educational institutions to continuously update their teaching methods in response to technological advancements, ensuring that they remain relevant and effective in preparing students for the future.

These areas of research could enhance our understanding of the optimal strategies for integrating AI into education, ensuring that such integration is beneficial, ethical, and effective across various disciplines and cultural contexts.

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Insidious chatter versus critical thinking: Resisting the Eurocentric siren song of AI in the classroom

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AI;
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Abstract

This article contributes to the ongoing discussion about the impacts of utilizing emerging technologies – especially AI learning – in higher education. After reviewing the pros and cons of using ChatGPT in the classroom as they are typically considered, I raise a deeper, less frequently addressed concern: the pervasive persistence of Eurocentric biases in the academy and the danger that AI-empowered software will reinforce them further. To this end, I present the findings of a simple experiment I conducted, directing ChatGPT to produce and refine a syllabus for an undergraduate course on modern political philosophy, together with an essay responding to one of the questions set in the syllabus. The results clearly demonstrate the grave potential for such supposedly 'time-saving' technological shortcuts to re-inscribe Eurocentric thinking and unconscious biases, thus seriously complicating the vital, already challenging task of decolonizing the academy.

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Introduction

Like many academics, I faced a new challenge in the spring of 2023 when a relatively large number of students in an introductory political studies course I was teaching submitted essays entirely generated by ChatGPT. It was immediately clear that the students had not written these essays. However, I had somehow missed the buzz about the new Open AI software and its extraordinary ability to transform workplaces and educational institutions in the blink of an eye.

Enough has been written about OpenAI and its much-hyped software ChatGPT [Generative Pre-Trained Transformer] (Rudolph et al., 2023b; Heaven, 2023; Limna et al., 2023; Wu et al., 2023) that I need not cover the same ground here. Suffice it to say that this program had been released for use in November 2022, and by the time I was grading papers the following April, this new AI-driven “tool” was seen by students – especially by those for whom English is a second language – as a quick and painless way to fulfil the essay assignment in my course. Like others in this situation, I grappled with the dilemma of what to do given the fact that the work submitted was not original and could not, therefore, be seen as a legitimate submission for course credit. Following the end of the semester, numerous formal and informal discussions were held with colleagues about how to deal with this new software and its implications. Some saw the technology as simply another research source that should be listed in the bibliography, while others (me included) raised a number of concerns, principally around the potential loss of opportunity for developing research and writing skills.

The essays I read that ChatGPT had generated were grammatically correct and coherently (if blandly) ‘composed’. They were also full of errors of fact along with inaccurate or, in some cases, fictitious citations. There was an absence of passionate argumentation, depth of analysis, a loss of voice and a lack of substance. There was no indication that the students had used the chatbot for creative experimentation or had learnt anything from the exercise other than a new way to avoid completing the required assignment.

I am, of course, aware of the frequently made argument that if it is possible to cheat on an assignment, then it is not the chatbot that should be banned but, instead, the assignment that should be abandoned (Heaven, 2023). This is not an adequate response for those of us who want to incorporate various assessment strategies into a university course so that students can develop different skills. Eliminating essays and replacing them with assignments such as in-class short answer tests or, even worse, multiple-choice questions is not the way to build critical thinking skills. Rudolph et al. (2023a, p. 10) are surely correct to insist that “Teachers’ and students’ critical thinking remains of key importance. We must never outsource critical thinking to generative AI.” Additionally, while it is important to note that some believe that AI-powered assessment of essays is now possible (Dong, 2023), I remain dubious about the quality of feedback beyond basic advice and would personally miss the time I spend working with students through the various stages of research for, and writing of, essays.

Engaging deeply with an issue of current importance necessitates reading critically, thinking critically, and then developing a well-argued response that is defended with appropriate research. Indeed, is it not more than a little odd that one of the proposed benefits of ChatGPT – according to Imran and Almusharraf (2023, p. 3) – is its “ability to generate coherent and well-structured text” and that this, in turn, means that students can “save time and focus on other aspects of their work”? These authors also praise the ways in which it helps students because it “generates new ideas... they might not have considered otherwise”, an argument that actually celebrates the replacement of the crucial function of research, which, although time-consuming, is the task that enables students to develop the ideas needed for their personal intellectual development (Imran & Almusharraf, 2023, p. 3).

While struggling with the problem facing me about how to deal with a large number of AI-derived essays, I was simultaneously assisting a senior student who was writing a thesis on the problems inherent in Eurocentric-biased education. Our conversations about the difficulties in shifting long-standing assumptions prompted me to think more clearly about the dangerous potential for this popular new software to act in ways that might well serve to reinforce Eurocentric assumptions in my own areas of study and teaching. This is the source of inspiration for the arguments I aim to put forward here.

This article is intended as a contribution to the ongoing discussion about the impacts of utilizing emerging technologies – especially AI learning – in higher education. After reviewing the pros and cons of using Chat GPT in the classroom as they are typically considered, I raise a deeper, less frequently addressed concern: the pervasive persistence of Eurocentric biases in the Academy, and the danger that AI-empowered software will act to further reinforce them. To this end, I present the findings of a simple experiment I conducted, directing ChatGPT to produce and then refine a syllabus for an undergraduate course on modern political philosophy, together with an essay responding to one of the questions set in the syllabus. As this article details, the results demonstrate the grave potential for such supposedly ‘time-saving’ technological shortcuts to re-inscribe Eurocentric thinking and unconscious biases, thus seriously complicating the vital, already challenging task of decolonizing the academy.

‘Unlimited miracles’ or limited thinking? The pros and cons of ChatGPT in the classroom

Even if it might seem hyperbolic to claim, as Imran and Almusharraf (2023, p. 11) do in their literature review of ChatGPT, that “the launch of the ChatGPT represents a new era of unlimited miracles in science, technology, and education”, it is certainly the case that a commonly heard refrain from those celebrating the use of new technology in academic settings is that generative AI chatbots such as ChatGPT can significantly assist students by acting as a tutor to ensure they succeed. It is also commonly noted that students need to be aware of how such tools are currently being used outside the classroom, especially in business

and government workplaces. The many advantages cited are that the chatbots provide personalized assistance to students who need help, offer immediate answers to questions arising from coursework, provide clarification on difficult and complex concepts, assist with communication skills and generally support research (Farrokhnia et al., 2024; Rasul et al., 2023; Ifelebuegu, 2024; Imran & Almusharraf, 2023; Rudolph et al., 2023b; Limna et al., 2023). ChatGPT is seen by many as a tool that can be utilized to “brainstorm, kick-start an essay, explain a confusing idea, and smooth out awkward first drafts” (McMurtrie, 2023).

The presentation of the upside for academics is framed around the notoriously heavy workloads they must deal with in the modern academy. When a student, for example, seeks the answer to a question about coursework from a chatbot instead of contacting the instructor, time is freed up for the professor to engage in “higher-order tasks” (Limna et al., 2003, p. 68). Any tool that can reduce the time spent on grading, administrative work, and curriculum planning is seen as a major advantage. Others have pointed to the time saved with AI-assisted grading (Bernius et al., 2022; Rasul et al., 2023), with some pointing out that this will free up time to spend with students (Akinwalere & Ivanov, 2022).

On the flip side, of course, there are warnings offered. In addition to factual errors (often referred to as hallucinations), Wu et al. (2023) note concerns surrounding the protection of intellectual property; safety concerns due to the empowerment of novice and wannabe computer hackers to conduct cyber attacks; issues around ethics and integrity, including plagiarism as well as the generation of harmful content; and the environmental impacts given the enormous energy needed to conduct both training and searches. On this latter point, we must consider the “power-hungry servers required by AI models” (McLean, 2023) as well as the “equally important and enormous water (withdrawal and consumption) footprint” they leave. (Li et al., 2023, p. 1). As Mariana Mazzucato (2024), director of the Institute for Innovation and Public Purpose (University College London), vividly expressed it, the “ugly truth behind ChatGPT” is that “AI is guzzling resources at planet-eating rates”. There are unquestionably “profound and pervasive environmental costs accompanying AI’s technological advancements” (Rudolph et al., 2024, p. 18) and, arguably, any academic institution seriously committed to reducing its carbon footprint is obliged to eschew one way of dramatically increasing that footprint: the widespread use of ChatGPT by its faculty, staff, and students.

It is important to note that even the champions of using this new technology in higher education often temper their enthusiasm by noting potential problems. The obvious one is, of course, the accuracy of the answers provided – either in terms of facts or biases (Limna et al., 2003). What if the AI tutor gets things wrong? What if Marcus and Davis (2023) are correct that “you can never really trust what it says”? What if there are biases that go unchallenged? Although efforts have been made to combat racial bias, it appears that it continues to be a problem (Vock, 2022; Piers, 2024; Metz, 2023). Margaret Mitchell may well be correct that efforts to deal with the problem “simply paper over the rot” (cited in Gibney, 2024). Evidence is mounting that responses

to queries provided by ChatGPT display “covert racism via dialect prejudice” (Hofmann et al., 2024, p. 2). It is worth asking: If there is even a glimmer of a possibility that the information provided by an AI-empowered chatbot will be incorrect or biased, how can professors or other educators condone its use?

There is one area here worth special attention: disability rights. Gerard Quinn, UN Special Rapporteur for the Rights of Persons with Disabilities, released a nuanced report (2021, p. 4) urging caution regarding the supposedly “liberating potential of artificial intelligence for persons with disabilities.” Quinn acknowledges that certain kinds of AI can, if “properly tailored to individual circumstances,” benefit persons with disabilities “across numerous domains,” including education. “At the same time,” he notes, AI “poses acute challenges to the enjoyment of human rights,” some of them unique to persons with disabilities, especially with regard to inbuilt algorithmic biases and hard-wired preconceptions. Some in the disability rights community, scarred by terrible experiences of withdrawal of support and services during the COVID pandemic, also worry that the hyping of the ‘unlimited miracles’ of AI will lead to a loss of human, in-person and in-community, networks of solidarity and empowerment.

Farrokhnia et al. (2024, p. 468) point out the dangers of utilizing tools such as ChatGPT in the classroom by listing the perceived weaknesses of the “internal factors” – the lack of deep understanding; the difficulty in evaluating the quality of response; the risk of biases and discrimination; and the lack of higher-order thinking – as well as offering a list of the perceived threats posed by the “external factors” – the lack of understanding of the context; the threat to academic integrity; the perpetuation of discrimination in education; the democratization of plagiarism in education; and the decline in high-order cognitive skills. Yet, even after the presentation of this useful summary derived from their SWOT [strengths, weaknesses, opportunities, threats] analysis, the authors suggest that the best possible strategy for dealing with the current situation is to “reflect deeply on the issue and take advantage of ChatGPT’s opportunity for education while attempting to minimise its threats to education” (Farrokhnia et al., 2024, p. 468). Academics can minimize the possibility of academic dishonesty, for example, by ensuring that students are educated “on the responsible and ethical use of ChatGPT and other generative AI tools” (Rasul et al., 2023, p. 48).

Despite warnings and concerns, there is a widely held belief that “artificial intelligence will inevitably change the way higher education works” (Akinwalere & Ivanov, 2022, p. 1) and, given that ‘fact’, we must work to ensure it is used ethically and productively. A common response to the opportunity-risk assessment is a general sense of squaring the circle by working to “collaboratively harness the potential of AI technologies, such as ChatGPT, to enhance learning experiences and outcomes in higher education while mitigating potential risks and unintended consequences” (Firat, 2023, p. 62).

It is important to note that there are many thoughtful voices encouraging the development of ethical guidelines for using AI-powered chatbots (Van Wyk, 2024), while others offer recommendations for dealing with them to “advance education innovation” (Rudolph et al., 2023b, p. 354). Further, some scholars urge us to utilize “open educational practices” – participatory and anti-hierarchical practices that can include students in the discussions and allow for collaboration “across institutions, countries, and established power dynamics” all in an effort to “enable a richer, more justly distributed emerging response to AI” (Mills et al., 2023, p. 16) as a way of dealing with the issues arising in a way that focuses on social justice. Such considerations of the power dynamic at play are crucial because they remind us of all of the principles and values we bring to our work in the academy. This is necessary, but is it sufficient?

We seem to be left with a set of responses that take the technology for granted and the argument that it is here, and we must, therefore, deal with it. The truth is that the widespread faith in technology and the belief that information can be produced at the click of a button has led us to a situation where it becomes harder and harder to challenge answers provided by a machine which, by its very nature, is deemed to be a neutral, unbiased source of knowledge. As Stefan Popenici argues, we “are completely unprepared due to our glorifying of technology” (Popenici et al., 2023, p. 323). This is a dangerous situation. It becomes even more concerning when we consider the reliability of the material generated by ChatGPT in the context of a broader concern with the impact of the ongoing reinforcement of the Eurocentric worldview, a bias that is much deeper and more insidious than the more obvious racial and cultural biases most people are concerned with.

The matrix and the maze: Eurocentrism in the academy

The adoption of AI in educational settings is frequently described as inevitable, with the task for educators being to work out the best way to integrate AI-powered chatbots such as ChatGPT into their classrooms. The public, apparently, expects no less if the comments collected by Glen McInnis for his *Outburst* (25 May 2024) show for Canada’s Cable Public Affairs Channel (CPAC) are anything to go by. When asked, “Should AI be included as an educational tool in schools,” the general response was in the affirmative, with one respondent suggesting that “academics and professors can step up their game” to ensure students learn how to use AI responsibly. The meaning of *responsibility* in this context is not entirely clear, but it is a theme, as noted above, that repeats itself in the academic literature published in the wake of the introduction of ChatGPT.

Although I have become more innovative when deciding how to assess students over the course of more than three decades of teaching, there is a core goal that has remained constant. Since my earliest days as a professor, I have felt that I must provide my students with the critical thinking skills they need to develop their own arguments – including those needed to challenge my own views or mainstream perspectives they find themselves immersed

in. To accomplish this goal, I aim to create an educational space conducive to open and frank discussions: Students should be able to try arguments out, work on them, refine them, and ultimately reject them as lacking. I encourage them to go beyond the easy, status quo acceptance of the given nature of any social, political, or economic ‘reality’ they encounter. I want my students to use their knowledge to engage with the world and reach their own conclusions after rigorous intellectual investigation. In short, they should understand, as Jane Thompson has argued, that:

there is no such thing as a neutral education process. Education either functions as an instrument which is used to facilitate the integration of generations into the logic of the present system and bring about conformity to it, or it becomes the ‘practice of freedom’, the means by which men and women deal critically and creatively with reality and discover how to participate in the transformation of their world. (Thompson, cited in May, 1999, p. 5)

The world in which I live and teach is that of a settler colonial state, the structural operation of which few students arrive at university having ever thought about. The Eurocentrism that is attached to settler colonialism is embedded in the knowledge production of the academy, within which one can find academics continuing to defend its central premises. While it may appear to be an extreme example of the defence of Western superiority, the argument that “All the traditional disciplines originated in the West, and so did most of the great philosophes, historians, scientists, composers and painters. The very idea of cultural development is Western... European higher culture must always remain at the center of higher learning because there is no higher culture” (Duchesne, 2006) is simply a blunt way of expressing widely held assumptions of what constitutes knowledge and deserves to be taught.

OpenAI’s attempt to eliminate bias and for the chatbot to refuse inappropriate questions has been mentioned. Even if these efforts were proven to be successful (which they have not been), there nonetheless remains the issue of the presence of a deeper bias – one that is harder to detect without an understanding of the fact that, as Blaut (1993, p. 10-11) argues:

Eurocentrism is the colonizer’s model of the world in a very literal sense: it is not merely a set of beliefs, a bundle of beliefs. It has evolved, through time, into a very finely sculpted model, a structured whole; in fact a single theory; in fact a super theory, a general framework for many smaller theories, historical, geographical, psychological, sociological, and philosophical.

Chickasaw scholar Sákéj Henderson notes that Eurocentrism “has been the dominant artificial context for the last five centuries” and argues forcefully that “as an institutional and imaginative context, it includes a set of assumptions and beliefs about empirical reality” (Henderson, 2000, p. 58). Reliance on ChatGPT quite clearly operates within – and fails to challenge – this context.

Mi'kmaw scholar Marie Battiste (2013) also makes the direct link between racism and Eurocentrism when she confronts the role of the university in its perpetuation: "Racism is intimately related to Eurocentrism and the colonial curricula. It was developed by the universities to demonstrate superiority." She also notes that "To understand why Indigenous knowledge was ignored or marginalized in the colonial educational curricula was first to unravel Eurocentrism, something that each of us, despite the school we attended, have been marinated in. Eurocentrism is not just an opinion or attitude that can be changed by some multicultural or cross-cultural exercise, for Eurocentrism is a contrived foundation of all dominant scholarship, law, media, consciousness and structure of contemporary life."

The concept of *coloniality* has been introduced by scholars to get to the heart of the matter of the marinating process Battiste has pointed to, and it can be defined as the "colonial matrix of power through which world order has been created and managed" (Mignolo, 2011, p171.). This matrix of power serves to privilege Eurocentric ways of knowing and being, which are clearly linked to colonization and the shaping of the modern world. Ideas and worldviews are powerful things, and if ChatGPT responds to prompts in ways that simply reproduce Eurocentrism, the result is that the largely veiled structures of power are perpetuated.

The simple question to be faced is: Can AI-powered chatbots help us confront the problem of Eurocentrism, or do they reinscribe it in new technological ways?

A thought experiment: Studying political philosophy in the age of AI

To consider whether or not ChatGPT helps or hinders in realizing the goal of decolonizing the university, I developed a thought experiment that I believe to be a realistic test of the popular chatbot's use.

Let us imagine the case of a faculty member assigned a course which is in a secondary area of interest. This is, in fact, a scenario I found myself in several years ago. Although I have long been interested in political philosophy, this had not been a central focus of my Ph.D. I agreed to teach the course, and when I consulted the syllabus used by my predecessor, I found that it seemed overly focused – ideologically speaking – on the history of liberal theory. I read widely and thought deeply in order to move the course in the direction of challenging the Eurocentric assumptions embedded in the syllabus as well as in the most popular textbooks available. But that was all prior to the existence of ChatGPT. Would the existence of such a tool be tempting to a young academic in the position I had found myself in especially given the current enthusiasm for such tools on the part of many university administrators unwilling to provide young academics with the necessary time and support necessary to develop new areas of teaching expertise? As Rudolph et al. (2024, p. 12) warn, the "advent of AI in education threatens to relegate university teachers from subject specialists and mentors to mere facilitators of AI-curated content, undermining their expertise and value in the educational landscape."

Let us assume that the young, overworked academic consults a few standard texts, recalls her own experience and decides to use ChatGPT as the first step, knowing that she can amend it later if she feels the need.

For the experiment, I offered the basic instruction: "Produce a syllabus for an Introduction to Modern Political Philosophy: Locke to present - include required readings and essay questions for each topic."

In the blink of an electronic eye, ChatGPT produced a syllabus that a young scholar could simply insert all the details (name, email address, office hours) and run with. The course description is basic and bland:

This course provides an overview of modern political philosophy from the works of John Locke to contemporary thinkers. Students will explore key political concepts, theories, and debates that have shaped the political landscape. The course aims to develop critical thinking and analytical skills through close readings of primary texts and engaging with various perspectives on political issues.

The weekly sessions covered enormous swaths of the history of political philosophy, and anyone who has ever taught such a course would know that you could not possibly cover the three main social contract theorists – John Locke, Thomas Hobbes, and Jean-Jacques Rousseau – in the first two weeks of the course. Such combinations of philosophers in two-week modules were a problem throughout, with "Liberalism and its Critics" (running the gamut from such liberals as John Stuart Mill through Karl Marx to Isaiah Berlin) being followed by "19th Century Political thought", "20th Century Political Thought", and "Contemporary Political Thought" each being given two weeks. Each module contained reading lists that generally included three books. ChatGPT offered helpful advice that the professor could "Adjust the readings and topics as needed based on the length of the course and specific interests".

For my thought experiment, I was most interested in the range of topics and readings, and it is crucial to note that there is not a single topic, writer, or required reading from outside the Western canon despite my request being more general than the results would indicate. If the young scholar seeking the general syllabus as a starting point was unaware of the critiques (which go largely unnoticed in textbooks), they might simply tweak the syllabus by paring down the reading requirements and number of philosophers covered and carry on or, alternatively, they might seek to use ChatGPT to further refine it.

For the sake of the experiment, let us assume that our young professor thought the essay topics were a little too broad. Take, for example, the chatbot's offering in the course's first module: "Compare and contrast the political theories of Locke, Hobbes, and Rousseau. Analyze their views on the state of nature, social contract, and the role of government in society." So, our young professor refines the search by requesting a couple of specific topics to separate out the major writers of the canon. Perhaps she asks: "Produce a

syllabus for an Introduction to Modern Political Philosophy: Locke to present - include required readings and essay questions for each topic including one on Locke's theory of private property and one on Rousseau's idea of the Legislator". The resulting syllabus does indeed offer more space for these two writers and provides essay topics to match:

Essay Question: Analyze Locke's theory of private property, discussing its foundations, implications, and potential critiques.

Essay Question: Examine Rousseau's idea of the Legislator and its role in shaping the General Will.

But in neither case do the readings reflect anything outside of the Western canon. Would our young professor know that Locke's theory of private property was written explicitly to justify the appropriation of Indigenous lands in North America? Or in fact Locke had a major professional and personal interest in accelerating the processes of European colonization in North America and beyond. Locke's dark, racist shadow rarely falls across the standard, mainstream material and literature and is therefore highly unlikely to make it into an artificially generated syllabus on the Western 'pantheon' of political philosophy.

Let us also take the case of a student with access to ChatGPT who is as pressed for time as her professor was when producing the syllabus for the course. If that student asks the chatbot to produce an essay using the topic provided in the syllabus, there is no mention of this Indigenous land grab justified in Locke's theory. The essay is the usual presentation of liberty and the law of private property and concludes:

John Locke's concept of property, as outlined in the "Second Treatise of Government," is a foundational element of modern political philosophy. The justification for private property, the labor theory of property acquisition, and the implications for individual rights and the role of the state together form a coherent and influential framework. Locke's ideas continue to shape discussions on property, individual rights, and the proper role of government, leaving an enduring legacy in the development of liberal thought.

This is a true statement, but it misses an essential point: the 'labor theory of property acquisition' is a sanitized way of saying that Locke justified the appropriation of Indigenous land with the spurious argument that because people living on the land were not "improving" it through their labour, the settlers had the right to claim it as their own. Indeed, the enduring appeal of this self-serving argument to the settler-colonial orthodoxy is one of the main reasons that, as the artificially generated content says, Locke's ideas 'continue to shape' our dominant, Eurocentric outlook.

Interestingly, one of the most prominent critics of Locke's theory of private property and its underlying intent regarding land appropriation appears in the bibliography – James Tully – but there is no mention of his argument. The issue of Eurocentrism and the racism it embodies is central to the history of Western political thought. John Locke's justification for the appropriation of Indigenous lands, to take one particularly relevant example, was grounded on the notion that Indigenous peoples in North America had no recognizable governance structures and, therefore, did not constitute a "civilized" society. This was nonsense, of course, but this argument became the 'common sense' (in the Gramscian sense) idea that underpinned and, crucially, continues to reinforce settler colonial logic.

Let us make a final assumption about our young professor under pressure. Perhaps she has a colleague who suggests that she should be considering critiques of Eurocentrism in her new political philosophy course. She decides, then, to have another attempt to work with ChatGPT to ensure that she is up to date with teaching this kind of course. She refines her request and asks the chatbot to:

Produce a syllabus for an Introduction to Modern Political Philosophy: Locke to present - include required readings and essay questions for each topic - ensure coverage of readings to counter Eurocentrism.

Although this new iteration of the syllabus tacks on a module at the end, entitled "Postcolonial Political Thought", which includes an article on coloniality, there is still no critique of the ways in which the ideas of the writers included in the canon are, in fact, Eurocentric and have been instrumental in producing the matrix of coloniality discussed above. There is no mention of the leading critic of the Eurocentric biases inherent in the canon of Western political philosophy, Charles Mills (1997, p. 1), who begins his classic book, *The Racial Contract*, by arguing that "White supremacy is the unnamed political system that has made the modern world what it is today." There is not even a mention of Tully's critique of John Locke's arguments on the justification for appropriating Indigenous land, even though he was mentioned in an earlier version of the syllabus – if only in the bibliography without any mention of what his critique is. I am not intending to present a lecture here on the history of Western political thought. I am, though, attempting to demonstrate by example the profound limits that are evident in ChatGPT when we consider the ways in which Eurocentric knowledge operates.

It might be reasonable to ask why a young professor, asked to teach a political philosophy course in the twenty-first century, would even focus on the Western canon. Why not just create a course that introduces thinkers who challenge Eurocentrism and white supremacy? It is a good question, and the answer is quite straightforward. First, for better or worse, we are shaped by the ideas these canonical figures put forward, and we need to know their theories well enough to understand at a deep level how they have become so deeply embedded that they can be presented over and over again (for centuries!) as the *timeless truths* of political philosophy. As Philipose (2007, p. 4) argues, "Students ought

to comprehend the ideas that shape their subjectivities and political locations to understand their sense worlds through relevant explanatory language. It is also the case that without comprehending the ideas that shape us in our political locations, we are without the necessary language to challenge and disrupt the continued institutionalization of traditional concepts and ideals."

And to return to our example of John Locke very briefly, it is important to note, as does Tully (1994, p. 167), that even after more than 300 years, Locke's ideas continue to be reinforced because his "theory of political society and property was widely disseminated in the eighteenth century and woven into theories of progress, development and statehood." And in terms of the rights of Indigenous peoples, the "destruction of centuries-old native American socio-economic organizations and the imperial imposition of commercial agriculture is made to appear as an inevitable and justifiable historical development" (Tully, 1994, p. 189). It was, of course, neither inevitable nor justified. And yet students continue to read Locke without the historical, political, and economic context within which he wrote it and thereby continue to perpetuate this dangerously Eurocentric view. This will continue to be the case if AI-powered chatbots such as ChatGPT are utilized without an awareness of the profound limitations in this regard. The over-worked professor believed she had covered all the necessary requirements of the course, and the student believed she was responding in kind to the essay question posed. And being unaware of the underlying Eurocentrism, everyone was happy with the results.

It is worth taking a moment to consider the argument that, as one educator reported to Heaven (2023), it is "great" that ChatGPT is not always correct. In this view, educators can take the incorrect first draft and use it as a teaching tool to encourage the development of critical thinking skills. While that may work in the case with obviously incorrect factual material or easily detectable biases, it is certainly not the case with the deeply ingrained Eurocentric notions that I am discussing here. One of the aspects of AI-powered chatbots that I find so disturbing is that it is so easy to simply reinforce the dangerous mindset that new technology changes are necessary "advances". Costa et al. (2023, p. 5) point out that the education technology market "presents itself as a colonizing force ...leaving little space for alternative educational experiences that highlight the human side of education." And, while some of those writing about AI-powered applications such as ChatGPT, seek to make space for that human side (Rudolph et al., 2023), it is nonetheless crucial that we consider the importance of resisting "the instrumentalization of education and the technological stance that supports it" (Costa et al., 2023, p. 5).

Reflections/conclusions

As with all new technologies, one could usefully adopt the question posed by Neil Postman (1997, p. 230) – "What is the problem to which this technology is a solution?" – as a guide to investigating whether or not we ought to utilize AI in our classrooms. If professors are feeling overwhelmed with workload and in need of assistance to complete the myriad

tasks they are faced with, and if students are overwhelmed because their time is split between their education and the need to make money to deal with rising tuition costs and debt levels, then we should perhaps be looking for solutions that deal with workload issues in a way that calls into question the neoliberal shift in higher education through a demonstration of the need to "humanize the academy" and to "create a kinder, more compassionate educational environment" (Tan, 2022, p. 7). Theodore Roszak (1994, p. 63) was surely correct when he reminded us that we should keep the image of face-to-face education in mind:

Free human dialogue, wandering wherever the agility of the mind allows, lies at the heart of education. If teachers do not have the time, the incentive, or the wit to provide that, if students are too demoralized, bored, or distracted to muster the attention their teachers need of them, then *that* is the educational problem which has to be solved—and solved from inside the experience of the teachers and the students. Defaulting to the computer is not a solution; it is surrender.

Framing the issue in terms of the question as to whether or not the use of AI-powered technology serves to enrich or degrade the educational experience of both students and professors would seem to be a more fruitful avenue for consideration than simply focusing on the more functionalist questions such as those around the reliability of the information delivered by ChatGPT. We must constantly remind ourselves that "the one absolute principle in educational philosophy" is, as Roszak (1994, p. 86) insisted, "*never cheapen*".

We should also be asking ourselves if we are failing our students by encouraging them to rely on technology for assistance with their personal intellectual development. Is the argument that AI-powered chatbots can inspire students to think more creatively, correct? Could it be, on the contrary, that encouraging our students to rely on technology is leading to a situation in which a new phenomenon, referred to as "Google Mind" by Langdon Winner, in which "memory, thinking, imagination, and conversation have been replaced, perhaps even crippled, by excessive reliance up the search engine" (Winner, 2020)? Winner's argument is that, in this age of digital education, the "forms of inquiry fundamental in an education are supplanted by a relationship to powerful algorithms and knowledge on the Net."

Winner has long been a critic of the rush to embrace new technologies for teaching. Having presented many lectures setting out his concerns, he decided in the late 1990s to "present a send-up of the typical edu-tech pitch" at a conference on computers and education. The resulting lecture included the introduction of the "Automated Professor Machine" – a machine looking very much like an automatic bank teller machine – that could replace professors by dispensing the lessons, receiving the finished assignments and dispensing grades (Winner, n.d.). In reflecting on the satire, Winner declared: "I thought the debate about education and technology had gone too far in one direction. It was sort of all enthusiasts and all people going, 'This is the wave of the future'" (cited in

Young, 2001). As Winner's satirical presentation makes clear, the fear of technology replacing professors predates "the current generative AI hype", but there can be no doubt that the "debate on AI potentially substituting teachers is intensifying, with the prospect appearing increasingly likely" (Rudolph et al., 2023a).

Ifleebuegu (2024, p. 6) dismisses the idea that machines can replace teachers when he argues that educators simply need to prove that they are indispensable by "embracing technology and developing a comprehensive awareness of its capabilities and constraints" and ensuring that they "possess the means to ensure that technology functions as a facilitator rather than a disruptor." This, alas, seems too optimistic even if we set aside the dire implications for the way this particular technology serves to protect the status quo structures of society.

We should be extending our analysis to a consideration of the ways in which the new enthusiasm for AI-powered technology serves to re-inscribe Eurocentric views, making it ever more difficult to confront the necessary task of decolonizing the academy, or indeed, modern Westernized societies more generally. Adams (2021, p. 186), who views AI as "a form of remote colonial rule," suspects "that AI's uncritical promotion of Western notions of intelligence" – and, thus, proper ways to make progress – "may underlie the lack of diversity in the field" (p. 189) of 'machine learning'. It certainly, she believes, acts to prevent or stymie an urgently needed "rethinking of the politics of intelligence" as part of a broader strategy of decolonization, a move away from what Roszak (1994) aptly dubbed the "cult of information," the mistaking of information for intelligence, the conflation of data with insight that has done so much to privilege and empower certain modes of knowing (and learning) over others.

Eurocentrism is the intellectual air we breathe, and it has played a central role in the education system. It is also true, as Zembylas (2023, p. 25) has argued, that effort is being made in some quarters to "identify some of the mechanisms through which universities reproduce ideals of Eurocentric epistemologies and function in neo-colonial ways." Despite this work, however, concerns remain regarding the perpetuation of Eurocentrism through "algorithmic coloniality" (Mohamed et al., 2020, p. 665). Clearly, the lack of widespread questioning of technology is a part of the problem of coloniality. In their extraordinary consideration of the similarities between "historical colonialism's landgrab" – something we see justified through Locke's ideas of private property – with Big Tech's "data grab", Mejias and Couldry (2024, p. 4) note that "our present and not just our past is irredeemably colonial, and the new data colonialism is a core part of that." No wonder the same justifications are deployed to ensure our compliance and secure our participation. The Technosphere is just the new Frontier, the latest, virtual manifestation of our 'destiny'. As Eurocentric moderns, "our unwavering belief in the rightness of data extraction and Big Tech's supposedly superior rationality leads us to trust whatever civilizing mission the computer scientists put forward to 'improve' our lives, overriding our doubts." (Mejias & Couldry, 2024, p. 46)

I believe that Adams is correct when she goes to the heart of the matter by pointing to a "central assumption" being made: "that intelligence and the production of knowledge can be outsourced to a machine presupposes such knowledge to be both separable from the context in which it was produced and applicable to other contexts and realities" (Adams, 2021, p. 185).

I have presented an example of the perpetuation of Eurocentric notions embedded in Western political philosophy, and this, it seems to me, provides a concrete example of the argument Adams makes. As noted, the assumptions embedded in the "canon" led to a belief that there was one way – a superior way – to organize a political society. Those societies – such as Indigenous societies in the so-called new world – were deemed to be backward precisely because they did not adhere to notions of private property. To move forward, we must reveal the true history of such appropriation claims so that we can "undercut the ubiquitous and self-evident assumption that the settler state was and is entitled to assert sovereignty over Indigenous peoples and territories" (Mackey, 2016, p. 13). Alas, the Lockean justification for the appropriation of Indigenous land is now being perpetuated precisely because we are told to believe that knowledge is neutral. In short, coloniality is being "re-instituted through AI behind the veil of technocracy" (Adams, 2021, p. 190).

The sad truth is thus revealed. Either deliberately or inadvertently – ultimately, it does not matter which – the AI tools being utilized by students and professors reinforce the Eurocentric context of academic inquiry and its "totalizing claim and frame" (Mignolo & Walsh, 2018, p.2). What we need, instead, is a commitment to decoloniality, a practice that "seeks to make visible, open up, and advance radically distinct perspectives and positionalities that displace Western rationality as the only framework and possibility of existence, analysis and thought" (Walsh, in Mignolo & Walsh, 2018, p. 17). We cannot know in advance what the results will be if we succeed in challenging the Eurocentric knowledge systems that continue to deform and limit our options, but we should be clear that the breaking open of the fixed context must occur if we are committed to the "elsewhere" (Tuck & Yang, 2012, p. 36) of decolonization.

So, where do we go from here? How can we address this problem? Mohamed (2020, p. 677) argues that it is "incumbent upon AI communities to strengthen the social contract through ethical foresight and the multiplicity of intellectual perspectives available to us, aligned with the goal of promoting beneficence and justice for all", but is this likely? At this juncture, is a more radical move perhaps necessary, one in which we are "imaginative enough to conceive of a future without AI" (Adams, 2021, p. 191)? And how best should we go about answering this momentous and urgent question? By asking ourselves and each other? Or by asking a machine?

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Threading the GenAI needle: Unpacking the ups and downs of GenAI for higher education stakeholders

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generative artificial intelligence;
higher education;
integration;
personalised learning.

Abstract

The incorporation of Generative Artificial Intelligence (GenAI) in higher education has transformed learning and teaching. When GenAI (e.g. ChatGPT) was released, it almost immediately began to feature heavily in learning and teaching practice. Many research studies are currently being undertaken to evaluate the potential perceived benefits and challenges of GenAI, especially in higher education. This paper leverages these studies to conduct an in-depth exploration of GenAI through a systematic literature survey to identify the common GenAI approaches implemented in the higher education (HE) sector, gather the perception of GenAI among stakeholders of higher education, and review cases of GenAI use in learning and teaching. The survey findings revealed that integrating GenAI into educational pedagogy enriches personalised and adaptive learning experiences facilitated by ChatGPT and virtual learning assistants. Furthermore, it is noted that the stakeholders have mixed perspectives on GenAI: education administrators are more concerned about the potential consequences of GenAI, such as excessive dependence and declining student proficiency, while teachers and students foresee opportunities for enhanced teaching and learning through GenAI.

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Introduction

The evolution of Information and Communication Technology (ICT) enables significant changes in our education, especially in learning and teaching processes (Maatuk et al., 2022). Most importantly, after the COVID-19 virus outbreak in 2020, institutions' and students' adoption of education technologies has skyrocketed (Qazi et al., 2024). The constant improvement and innovation in teaching and learning have been witnessed in the recent past as disruptive technologies such as Generative AI (e.g. ChatGPT) swiftly emerged (Rasul et al., 2023). Furthermore, higher education institutions are continually enhancing the learning experience for students by adopting various modes of learning, such as virtual learning, online learning, distance learning, and e-learning. These methods are supported by widely used learning management systems (LMS) like Moodle, Canvas and Blackboard, which are essential platforms for facilitating online education and teaching activities (Chugh et al., 2023). Moreover, the integration of advanced AI tools has revolutionised the educational landscape.

For example, a web-based chatbot introduced by OpenAI, widely known as ChatGPT, engages students in colloquial conversations, effectively responding to user-generated prompts, which have significantly influenced teaching and learning practices within the academic domain (Mhlanga, 2023). The headline "AI will revolutionise education worldwide", and many research reports claim that AI will transfer higher education by offering personalised teaching, collaborative learning, lifelong connections, interactive learning, and 24/7 support for instructors and students (Villarreal et al., 2023). It tailors learning activities to individual needs, provides feedback based on student strengths and weaknesses, and facilitates collaborative skill development in some difficult subjects such as language and mathematics. Generative AI, a subset of AI, further enriches teaching and learning by providing continuous support in various activities like automated essay grading and language translation. Tools such as ChatGPT contribute to improved student learning experiences, increased productivity, efficiency, and adaptive learning environments (Dhawan & Batra, 2020).

Given the exciting opportunities leveraged by generative AI (GenAI) in higher education learning and teaching, it is paramount that the implications of such tools in teaching and learning from various perspectives need to be analysed. In this paper, we aim to explore the common GenAI approaches implemented in higher education and their perception by stakeholders. We extensively examine diverse GenAI methodologies employed in higher education pedagogy and their effective integration of GenAI into teaching and learning. In addition, a comprehensive exploration of the practical use case of GenAI in teaching and learning contexts is provided, elucidating the potential challenge and future opportunities associated with integrating GenAI within an educational setting.

Continuing further, the section "Literature review" presents the existing work on GenAI and higher education. It further develops the research questions for this survey. Next, the research methodology employed for conducting this

survey is presented in the section "Methodology". Then, the results of the survey are reported in the section "Results". This is followed by the findings of the survey discussed in the "Discussion" section. Finally, the section "Conclusion" concludes the paper with limitations and future works.

Literature review

The use of technology in teaching and learning has been investigated for a long time. Higher education stakeholders have been constantly looking for innovative technologies that could enhance the learning experience for students. For example, virtual learning (Treve, 2021), online learning (Osobajo & Oke, 2022), distance learning, and e-learning (Mahfoodh & AlAtawi, 2020) are a few digital learning strategies that have been explored in the literature. For this, learning management systems (LMS) are the most popular backbone of educational institutions. Recently, the integration of AI into such learning platforms has been increasing and is truly revolutionising the learning paradigm (Jaboob et al., 2024). In particular, a GenAI-based chatbot, ChatGPT, has been used heavily in teaching and learning. It has brought several opportunities for enhanced learning, such as personalised learning, collaborative learning, and adaptive learning (Dhawan & Batra, 2020).

GenAI in higher education might enable students to receive personalised instruction and distinct assignments crafted to support their success and accomplish specific learning objectives, which ultimately boosts adaptive learning practice (Salinas-Navarro et al., 2024). Further, customisation and integration of GenAI in the learning management system will benefit in various ways. It enables individuals to progress through the learning material at a speed that suits their preferences and capabilities, thereby providing an inherent framework for the learning process. It empowers instructors to offer tailored assistance and support based on individual needs and enhances the involvement and participation of learners in the educational process (Michel-Villarreal et al., 2023). Finally, it has been claimed to enhance the student learning experience and increase productivity, efficiency, and adaptive learning (Elbanna & Armstrong, 2024).

Over the last few years, the literature review has explored the potential penetration of generative AI for effective and accessible personalised learning (Grájeda et al., 2024), collaborative learning (Tan et al., 2023), and the assessment of potential effects on academic integrity, critical thinking, and cognitive skills of learners (Chaudhry et al., 2023). However, it is essential to provide a timely review from the perspective of stakeholders' perception of integrating GenAI in higher education and its potential use case in teaching and learning. To fill the gap, this research is focused on seeking the answer to the following research questions.

- RQ1. What are the common GenAI approaches implemented in education and pedagogy?
- RQ2. How do education stakeholders perceive the implementation of Generative AI?

The RQ1 helps identify the most appropriate GenAI approach in higher education teaching and learning. RQ2 helps to know the stakeholders' perceptions of the application of GenAI in teaching and learning. Since the use of GenAI has recently boomed in academia, it has been used for various teaching-learning activities such as brainstorming for content creation, in-class activities support and evaluations. Therefore, RQ2 is supplemented with the pros and cons of using GenAI in these activities, which will help the stakeholders move forward.

Methodology

GenAI has sparked considerable debate in higher education ever since the public accessibility of ChatGPT in November 2020. Furthermore, the COVID-19 pandemic has left us with the habit of online learning, teaching, and working from home (WFH) culture. Education researchers and leaders have kept an eye on this development regularly and keenly. Researchers have taken it as an opportunity to evolve technology-enhanced teaching and learning and published their work for the digestibility of the scientific community (Akiba & Fraboni, 2023; Grájeda et al., 2024, Habibi et al., 2023; Nikolic et al., 2023; Rudolph et al., 2023b, 2023c;). Hence, a systematic literature review would be a milestone in synthesising these discussions and publishing works on GenAI through the lens of higher education. To accomplish this, there have been some guidelines and protocols published in the literature (Ismail et al., 2023, 2024; Stracke et al., 2023). These protocols are fundamentally based on the widely used and trusted systematic review approach guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Page et al., 2021).

Like the review protocol proposed by Ismail et al. (2023), which is mainly targeted for analysing GenAI-related studies in higher education, we follow a similar approach to find the pertinent literature for this survey, as shown in Figure 1. Subsequently, we conducted the narrative analysis and synthesised the existing literature using narrative review approaches (Jahan et al., 2016). As a result, the research methodology utilised in this study integrates both systematic and narrative review approaches that can be framed as a hybrid narrative systematic review, providing an elucidative and nuanced examination of the related works.

To collate the research articles for a survey, we used the research questions to keep the search strategy focused and employed the inclusion and exclusion criteria to screen the literature thoroughly. Figure 1 illustrates the systematic approach used and the number of papers identified and synthesised at each step.

It is fundamental to have an effective strategy for searching and selecting the relevant literature for the review. Given the objective of presenting a comprehensive narrative review of the topic, we initially identified the key terms as "Generative AI" and "Higher education". For instance, as a preliminary step, the term "Generative AI" resulted in a list of 914,000 documents on Google Scholar. With such large numbers of search results, it was of utmost importance to narrow down the search string. It is challenging to find relevant studies

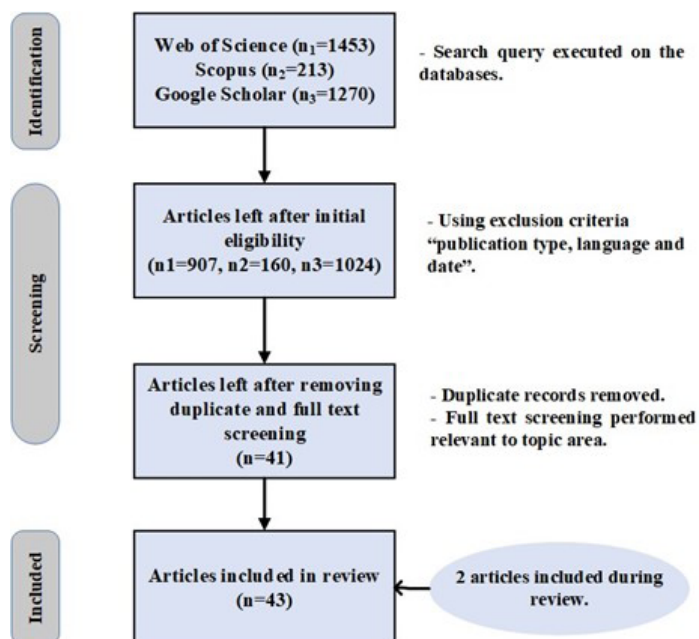


Figure 1: The systematic approach for article searches and selection (Page et al., 2021).

using such hit-and-trial methods. We thank Ismail et al. (2023) for identifying the key concept and search string that can be used to build the search string for this purpose. As demonstrated in their protocol paper, the key concepts such as "Artificial intelligence", "Higher education", and "pedagogical approach" are directly relevant to our review theme and perfectly matched with our research questions. Hence, following their guidelines, we formulated the search string using the keywords and logical operators as follows:

("generative AI" OR "chatGPT") AND ("higher education") AND ("education pedagogy").

The execution of the search string on Web of Science, Scopus and Google Scholar resulted in 1453, 213, and 1270 articles, respectively, while keeping the search within the title, abstract and keywords in each database (except Google Scholar, which does not allow such restriction). This will keep the search more focused, as Ismail et al. (2023) and Stracke et al. (2023) suggested. These results were further evaluated using the inclusion and exclusion criteria as listed in Table 1. After an initial screening of these documents using criteria such as language and peer-reviewed, we left with 160, 907, and 1024 articles from Scopus, Web of Science, and Google Scholar databases, respectively. Subsequently, we removed the duplicate records among these three databases and conducted thorough screening with title, abstract and full text, which resulted in a total of 43 articles for inclusion in the final review.

Table 1: Inclusion and exclusion criteria.

Criterion	Inclusion	Exclusion
Topics/areas	The studies focus on Gen AI tools in HE for teaching and learning.	The studies on GenAI do not focus on HE for teaching and learning.
Publication types	Peer-reviewed journal and conference papers	Book chapters, editorials, dissertations and grey literature
Language	English	Articles published in other than English language

Results from the literature review will be used to address the research questions for this study. RQ1 and RQ2 will be addressed directly based on the results, whereas the overall conclusion will be synthesised from the RQ1 and RQ2 data.

Results

In this section, we synthesise the survey results into two key themes. First, we provide an in-depth report on the existing work on AI and education pedagogy, aligning with RQ1. Second, we discuss stockholders' perceptions of GenAI and the pros and cons of GenAI in teaching and learning, aligning with RQ2.

AI and higher education pedagogy

Since its inception, GenAI has emerged as a promising tool for teaching and learning in higher education (Bozkurt et al., 2023). GenAI has been used for various learning activities, such as educational content generation, creating customised lesson plans and resources, evaluating students' performance, and providing feedback.

AI-generated tools and technologies offer various opportunities for personalised learning experiences by adopting content, resources, and assessments to meet individual student's needs and preferences, answering the research question "What are the common GenAI approaches implemented in education and pedagogy?". The summary of existing works on AI tools and applications that have been used in education pedagogy is reported in Table 2.

Looking at Table 2, it is evident that ChatGPT is the leading GenAI tool for teaching and learning. It helps students with real-time support and offers personalised feedback, recommendations, and resources tailored to individual student needs and personal preferences (Xu et al., 2024). Some other AI tools have also been used for personalised learning, such as adaptive learning platforms, intelligence tutoring systems (ITMS), learning analytics, virtual learning assistants, content personalisation, etc. (Hsu & Ching, 2023). However, ChatGPT is the most widely explored AI tool in the literature for various applications such as academic advising (Akiba & Fraboni, 2023), student behaviour and cognitive achievement (Jaboob et al., 2024), assessment integrity (Shanto et al., 2023), and collaborative learning (Tan et al., 2023).

Furthermore, GenAI can play a major role in collaborative learning, where multiple learners work together to achieve a shared goal. Here, learners share ideas, interact with each other, and come up with a robust solution to the assigned task. In this context, GenAI can be used by co-learners to brainstorm ideas and share them with others in a shared space (Tan et al., 2023). This will improve and enhance the interaction between learners, as humans can focus more on critical and creative thinking. Overall, features of AI tools demonstrated more effective and personalised learning for both students and teachers. Table 2 summarises the existing GenAI tools and applications used to enhance personalised learning in education pedagogy.

Table 2: Summary of existing AI tools and applications. Note "ChatGPT" represents both ChatGPT 3.5 and ChatGPT 4.

AI tools	Feature and highlights	Limitations and gaps	Reference
ChatGPT	OpenAI (ChatGPT) in the educational environment	- Limited to developing nations - Assesses the individual records, including newspapers, blogs, journals, and books	(Mhlanga, 2023)
ChatGPT	Impact of AI tools for students and educators: more effective and personalised learning in higher education	- Limit research on a single institution - Using AI in various dimensions of learning and teaching - Using Confirmatory Factor analysis	(Grájeda et al., 2024)
ChatGPT	AI-powered tools (ChatGPT) for academic advising more accessible, efficient or effective	Asked advising-related questions about current and respective student	(Akiba & Fraboni, 2023)
ChatGPT	Potential use and benefits of GenAI, such as personalised learning experience	Real-time access to the internet and search engines, Accuracy and up-to-date technology, data privacy issues	(Hsu & Ching, 2023)
GenAI	Integration of GenAI techniques and applications in student behaviour and cognitive achievement in Arab higher education	Ethical consideration, privacy concerns to related data collection and algorithms biases	(Jaboob et al., 2024)
AI tools	Feature and highlights	Limitations and gaps	Reference
ChatGPT	Mitigate the side effects of personal learning environments	- Interview only six professors and the ICT experts. - Semi-structured interview format with some biases and incurrences on their perceptions.	(Xu et al., 2024)
GAI /LLMs	GAI based on LLMs for collaborative learning – identify four aspects: AI readiness cognitive, knowledge, skills, vision and ethics	- Study based on the existing literature to identify the potential of GAI (LLMs). - Study needs more through rapid and continuous ideation, verification and refinement.	(Tan et al., 2023)
ChatGPT	Analysis of ChatGPT tool to investigate assessment integrity in engineering education	- Study focused on most of the undergraduate-level engineering subjects. - Ethical implication of integrating ChatGPT into a classroom.	(Nikolic et al., 2023)
GAI (ChatGPT)	Investigate PAIGE (Promoting Assignment Integrity using Generative AI in Education) for promoting assignment integrity in higher education. Two objectives prevent AI misuse, promote academic integrity, and explore innovative assignment criteria.	Resource constraints, ethical complexities, and user proficiency challenges.	(Shanto et al., 2023)

Stakeholders' perception of GenAI

Based on the literature survey, Table 3 on the stakeholder's perception of integrating AI technology in education teaching has positive implications for teachers, students, and educators (Chounta et al., 2022; Habibi et al., 2023), answering the research question, "How do education stakeholders perceive the implementation of Generative AI?"

In summary, teachers/educators appreciate the potential for AI to automate their routine tasks, easily prepare the content for teaching, and support administrative tasks (Zhang et al., 2023). Some educators are concerned about ethical implications and the need to balance AI technology and human interaction in the educational setting in the institutions (So et al., 2023), while teachers embrace GenAI (or ChatGPT) as a valuable tool for personalised learning, task automation and innovative teaching and learning.

On the other hand, students also have a similar perception of AI tools for personalised learning experiences and enhanced educational resources. All the stakeholders confirmed that integrating AI tools in higher education sparks a dynamic dialogue between stakeholders navigating the opportunities and effective incorporation of technology in the 21st-century AI era (Rudolph et al., 2023b). Table 3 summarises the existing work on the stakeholder perception of GenAI in Higher Education.

Table 3: Summary of stakeholder perceptions of GenAI.

Stakeholders	Perception of GenAI with stakeholders	References
Students	ChatGPT use in learning in higher education in Indonesian institutions	(Habibi et al., 2023)
Public, Students, and Educators	Public perception of the GenAI integration implementation was found to be positive and negative natural sentiments.	(So et al., 2023)
Students	The study focuses on five dimensions of the impact of GenAI in teaching and learning and found a significant and positive impact on student academic experience.	(Grájeda et al., 2024)
Students	AI applications can potentially revolutionise student learning, teacher teaching, and institution operation.	(Jaboob et al., 2024)
Student	AI tools like ChatGPT were found to be more effective and empowering students seeking academic advice.	(Akiba & Fraboni, 2023)
Teachers/Educators	Teachers frequently used GenAI, and the study found it to be a positive and helpful tool for their professional development.	(Kaplan-Rakowski et al., 2023)
Student and Teachers	Regarding the implications of AI integration in university teaching and learning, the study proposed an AI ecological education policy framework to address the implications of AI integration.	(Chan, 2023)
Teachers	AI tools support teachers in accessing, adapting and using multilingual content, supporting their administrative tasks, and adapting learning materials.	(Chounta et al., 2022)
Teachers	AI uses in education have been positively perceived as usefulness and ease of use, increasing the intention to use the technology.	(Zhang et al., 2023)
Students, Teachers and Educators	The use of AI tools like ChatGPT in academics has both positive and negative consequences, and hence, the stakeholders should establish clear user guidelines and policies.	(Hasanein & Sobaih, 2023)
Teacher and Students	Perceptions of PhD students and scholars on the use of ChatGPT and its implications were investigated.	(Firat, 2023)

Discussion

The use of AI and machine learning (ML) enhances the quality of pedagogical services in educational settings, as evident from the research report by Okagbue et al. (2023) with the systematic review of published work between 2000 and 2021. In educational pedagogy, personalised learning has attracted various researchers recently and has become one of the main applications of AI tools in education (Owan et al., 2023). Here, AI technology revolutionised individual learning experiences, creating students' individual basic needs, increasing student engagement, and improving overall learning outcomes (Pratama et al., 2023).

Furthermore, adaptive learning, also known as adaptive teaching, entails providing tailored learning experiences to cater to every individual's distinct educational or training requirements (Muñoz et al., 2022). Rather than employing a uniform approach, adaptive learning incorporates timely feedback, diverse learning paths, and specialised resources. ChatGPT can serve as a virtual tutor and provide personalised assistance to the students by fulfilling their learning needs, explaining their queries and offering guidance on specific topics (Limo et al., 2023; Javaid et al., 2023). While the idea of adaptive learning is not entirely novel, recent technological advancements, particularly in AI, such as GenAI, have contributed to its increased prevalence and sophistication.

Adaptive learning technology adopts a data-driven strategy, gathering information from individual learners and employing that data to modify eLearning content according to the learners' specific needs.

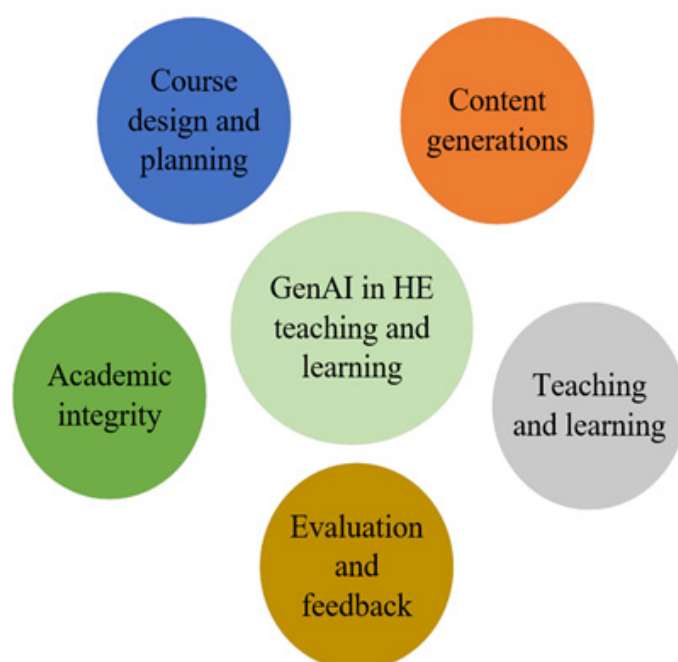


Figure 2: The various applications of GenAI in HE-learning and teaching. Note "HE" represents "Higher education".

In teaching and learning activities, the GenAI tools (e.g. ChatGPT 3.5 and 4) can be utilised as a supportive tool for various activities (Figure 2), such as brainstorming ideas for course design, content generation, lesson plans and evaluations (Liu et al., 2023). For example, while creating teaching resources, teachers may utilise AI tools for summarising a large volume of text and can make a concise presentation. Overall, GenAI tools like ChatGPT can work as personal assistants to educators by providing 24/7 support in their routine tasks (Rudolph et al., 2023a). However, maintaining academic integrity and avoiding the overreliance of students on such tools has become a challenging issue for educators and administrators (Rudolph et al., 2023c).

The perception of GenAI among stakeholders is a dynamic interplay of positiveness, scepticism, and curiosity (Figure 3). In higher education, academic administrators or education leaders play a critical role in shaping the strategic plan, implementing policy and procedures, and overseeing the successful integration of GenAI into various aspects of the educational environment in universities or institutions (Grájeda et al., 2024). Hasanein and Sobaih (2023) highlighted that education leaders have some concerns and negative consequences of using ChatGPT for academic purposes in education sectors, such as overreliance, loss of academic support, lack of quality and accuracy, potential bias, and deteriorated student skill sets.

However, from the student's point of view, positive perceptions were found, including time-saving, reduced anxiety, improved language skills, self-confidence, punctual submission, non-academic support, positive

experience, and synthesised content (Hasanein & Sobaih, 2023; Grájeda et al., 2024). According to Jaboob et al. (2024), research demonstrated that integrating emerging technology such as GenAI impacts students' behaviour and cognitive achievement with a highly satisfactory level of impact. In another study conducted in Poland and Egypt, results revealed that the effective integration of ChatGPT and formulating strategies in higher education should be promoted (Strzelecki & ElArabawy, 2024). Research conducted in Latin America about students' perceived impact of AI tools proves and advocates that the integration of GenAI has the potential to impact the academic experience for both students and educators (Grájeda et al., 2024).

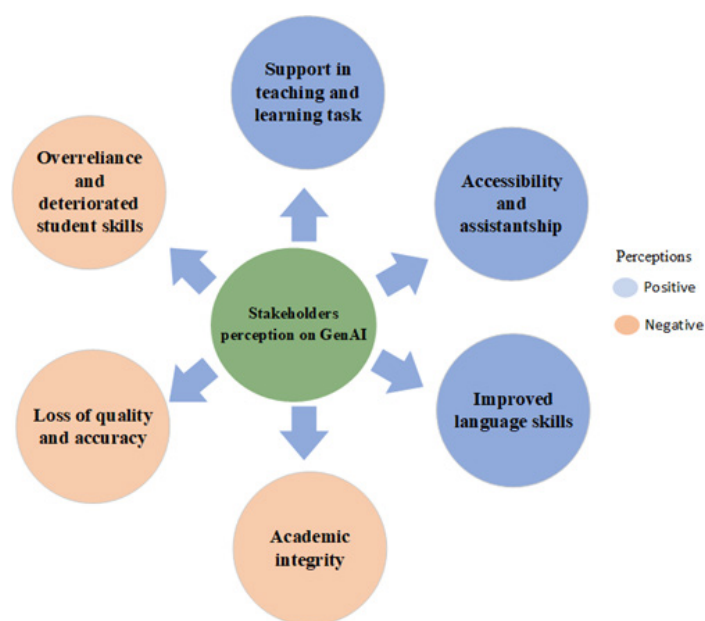


Figure 3: Examples of stakeholders' positive and negative perceptions of GenAI.

Recent literature shows that teacher perception of the integration of GenAI in HE has a more positive impact on teacher professional development and is a valuable tool for enhancing their learning experience, personalised education, providing tailored content and fulfilling the student needs (Kaplan-Rakowski et al., 2023). Research carried out on the perception of teachers' views on AI tools in Estonia and teachers have some limitations and little knowledge of AI, but research confirmed that AI tools integration supports learning and positive perception for further use in a classroom (Chounta et al., 2022).

Summary of findings

With two research questions (RQ1 and RQ2) formulated at the beginning of this survey, we summarise the findings as follows.

- The dominant GenAI approach implemented in education and pedagogy is the ChatGPT. It can be integrated into teaching and learning frameworks to enhance the students' learning experience, as suggested by Ilieva et al. (2023). The five-stage integrated framework suggests ChatGPT in course

offering activities such as diverse course planning options, lesson planning and preparations, lecture delivery, and evaluation.

- Overall, stakeholders recognise the benefits of AI tools, such as ChatGPT, in education for effective and accessible learning and educational task automation. However, the utmost care should be taken while using GenAI in an educational setting, including ethical issues and challenges such as academic integrity, privacy concerns, and fostering meaningful human-AI interactions. The use case of GenAI in HE is diverse and has not yet been fully explored. GenAI will bring unprecedented challenges and use cases in the future.

Conclusions

In this study, we conducted a systematic narrative survey of existing literature on GenAI by synthesising them into two perspectives: a) approaches of GenAI on educational pedagogy and b) perspectives of stakeholders on GenAI and its use cases in HE.

With the integration of GenAI and other ML technologies, students can be offered personalised and adaptive learning experiences. Several AI tools, such as ChatGPT, intelligent tutoring systems (ITS), virtual learning assistants, and content personalisation are widely used in educational settings that ultimately support adaptive learning. The customised learning experience maximises the learners' engagement and comprehension while addressing their learning needs effectively. So, if utilised properly, the GenAI tools can help make learning more adaptable and accessible, thereby improving the overall educational pedagogy.

While observing the stakeholders' perspective on GenAI, a mixture of positive and negative impacts was reported. The administrators of higher education institutions are more concerned about the adverse effects of outcomes associated with the utilisation of ChatGPT for educational purposes in academic settings, such as excessive dependence, diminished academic support, reduced quality and precision, and, more importantly, declining proficiency levels of students. On the other hand, the teachers see it as an opportunity to utilise it for enhanced learning by customising instruction, delivering content tailored to individual preferences, and meeting student requirements. Similarly, students share comparable insights on the utilisation of GenAI for personalised learning and enriched educational materials.

In conclusion, GenAI holds immense potential to revolutionise higher education learning and teaching by offering personalised and adaptive learning approaches. All stakeholders, such as students, teachers and educators, recognise its benefits in enhanced learning, content creation, and enriched experiences. However, careful consideration of some challenging issues, such as the excessive dependency of students on GenAI, as well as maintaining academic integrity and ethical implications, is necessary to ensure its successful implementation in higher education. With further research and collaboration between educators, technologists, and policymakers, generative AI can contribute significantly to

advancing learning and teaching in higher education sectors. This study acknowledges some limitations. First, it relies on the secondary data retrieved from the three databases (Scopus, Google Scholar and Web of Science), which may have introduced the database selection bias and missed the full landscape of relevant literature. Second, the field of GenAI is evolving rapidly, and new versions with different modes of accessibility (free and subscription) are popping up. Future research may consider including more research databases and these different GenAI tools for a more comprehensive assessment.

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Generative AI in higher education: Perspectives of students, educators and administrators

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Keywords

AI;
artificial intelligence;
ChatGPT;
GenAI;
generative AI;
guidelines;
higher education;
stakeholders.

Abstract

With Generative AI's (GenAI) rapid development and the ability to generate sophisticated human-like text, it has evolved as a powerful technology in various domains. However, its application in the education domain was initially met with resistance due to concerns about disrupting traditional learning and assessment methods, raising questions about academic integrity, and provoking ethical dilemmas related to data privacy and bias. Many schools, higher educational institutions, and governments initially chose to ban the use of GenAI tools due to the disruptions they caused to learning and teaching practices, only to rescind their bans later. This study conducts a literature review to investigate GenAI tools from the perspectives of key stakeholders in the educational domain—students, educators, and administrators—highlighting their benefits while identifying challenges and limitations. The review found several benefits of using GenAI, such as personalised learning, immediate support, language support, and reduced administrative workload. This paper also provides usage guidelines for stakeholders and outlines future research areas to support GenAI adoption in higher education. Our findings indicate that most studies involving students had a positive view of using GenAI. There is a noticeable gap in research focusing on administrators, highlighting the need for further investigation.

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Introduction

Generative Artificial Intelligence (GenAI) has pervaded various aspects of daily life, seamlessly integrating into commonplace applications like search engines, word processors, and spreadsheets. It is accessible across many platforms, from mobile phones to computers. The capabilities of GenAI extend beyond the traditional outputs like text, images, audio, and video to include 3D models (Chiu, 2023) and computer code, showcasing its versatility in content generation. Due to its ability to produce realistic output in real-time, GenAI has become a powerful tool in diverse industries, including education, marketing, tourism, publishing, hospitality, and computer science (Dwivedi et al., 2023). The rise of GenAI tools marks a transformative phase in education. However, the discussion about using these tools in education is still in its preliminary stages and ongoing.

Perera and Lankathilaka (2023) outline the benefits of integrating ChatGPT into higher education. Research has illustrated that GenAI tools can enhance assessment feedback and streamline administrative tasks (Kelly et al., 2023). Although discourse surrounding the adoption of GenAI has been predominantly positive, several significant concerns have been raised within the education sector. These concerns pertain to academic integrity and the occasional factual inaccuracy of GenAI-generated output, rendering it unreliable (Sullivan et al., 2023). The shift from traditional in-person teaching and assessments to online learning and teaching accelerated during and following the pandemic, could be influenced by the emergence of GenAI (Sánchez-Ruiz et al., 2023). As highlighted by Perkins (2023), this impact is pronounced in the shift from supervised exams to online testing environments, where many courses conduct most assessments and tests online. The introduction of GenAI, capable of providing real-time responses to questions, even for shorter queries, poses challenges for educators in accurately distinguishing between student-generated content and GenAI-generated output. This complexity exacerbates the already challenging task of maintaining academic integrity in online assessments and testing.

While some argue against using GenAI for learning and teaching practices in educational institutions due to concerns about its adverse effects, historical trends in integrating emerging technologies in higher education suggest that banning a technology might negatively impact students and raise ethical dilemmas. Therefore, people must consider the benefits and threats of such new technologies. Furthermore, UNESCO acknowledges that GenAI can be a powerful tool if used judiciously and provides guidance addressing the complexities surrounding GenAI in education (Miao & Holmes, 2023).

Moreover, GenAI in education presents a particularly intriguing dynamic compared to other fields due to the potential for stakeholders to hold conflicting opinions. In higher education, the principal stakeholders include students, educators, and administrators, who could bring their perspectives and requirements. Understanding the diverse needs and concerns of the stakeholders is essential to working well with them (Cadle et al., 2010). Ensuring

effective collaboration and communication among these stakeholders is pivotal for unlocking the benefits of GenAI in education (Rudolph et al., 2024; Ruiz-Rojas et al., 2023) while navigating ethical, privacy and societal concerns. Hence, this study focuses on the higher education setting, aiming to understand the perspectives of various stakeholders, including students, educators, and administrators. Furthermore, Bhullar et al. (2024) have advocated for research to establish guidelines for integrating GenAI tools in academic settings.

The research aims to investigate the role of GenAI in the transition from traditional to AI-powered education, exploring the specific ways GenAI technologies were adopted and how they influenced the educational landscape. It also seeks to identify and explore the benefits and challenges of utilising GenAI in higher educational settings, assessing both the potential for enhanced learning experiences and associated risks. Additionally, the study endeavours to contribute to the responsible implementation of GenAI in higher education by proposing usage guidelines. Hence, the focus of this research paper is to address two critical questions:

- 1) What are the benefits, opportunities, and challenges of adopting GenAI in higher education from the perspective of students, educators, and administrators?
- 2) What are the proposed guidelines for implementing GenAI in higher education?

As of writing, there exists a lack of holistic studies that involve understanding and analysing the individual perspectives of the most critical stakeholders in higher education, namely students, educators and administrators. These stakeholders may have differing perspectives, opinions, and attitudes, which can cause conflicts that might impact the creation and implementation of policies for GenAI adoption. Closing this gap is imperative; otherwise, crafting well-rounded and informed policies regarding GenAI will prove challenging. While Neupane et al. (2024) focus on stakeholder perspectives collectively, an individual analysis of the perspectives of students, educators and administrators is inconspicuous. Hence, this study extensively explores the application of GenAI in higher education to understand the perspectives of students, educators, and administrators regarding the integration of GenAI in higher education. Additionally, we examine the benefits and challenges of this technology and its potential misuse, offering guidelines for its incorporation into educational practices.

This study utilises a hybrid systematic-narrative approach, with the primary objectives of investigating the present state of research on utilising GenAI in higher education from the perspectives of its stakeholders and formulating comprehensive guidelines for its effective implementation. The examination begins with analysing 331 peer-reviewed publications sourced from six prominent databases. This hybrid approach integrates the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol, systematically narrowing the relevant literature to 34 studies. Subsequently, the study employs a narrative

approach to interpret and succinctly synthesise the findings, providing a comprehensive overview of GenAI in higher education.

Research method

A literature review serves as a comprehensive exploration and synthesis of existing knowledge within a particular field, offering researchers a bird's eye view of the relevant studies (Snyder, 2019). Two standard types of reviews exist – systematic and non-systematic or narrative review, with distinct pros and cons (Ferrari, 2015). However, this study has adopted a hybrid systematic-narrative approach that offers the best of both techniques rather than choosing one over the other. The hybrid approach incorporates systematic review techniques to define a precise search strategy with specified inclusion and exclusion criteria for shortlisting literature and subsequently employs a narrative approach to interpret, analyse and summarise the selected literature (Turnbull et al., 2023).

Accordingly, for the systematic elements of this review, the PRISMA approach was adopted to ensure comprehensive and transparent reporting of the literature (Page et al., 2021a, 2021b). Our review protocol's systematic elements also adhere to the guidelines for systematic reviews in artificial intelligence and education, as recommended by Stracke et al. (2023). Prior to the search, the inclusion and exclusion criteria were devised. In literature reviews, inclusion and exclusion criteria are crucial for defining the scope of the study. It is essential to articulate these criteria clearly and comprehensively (Tlili et al., 2023a). Inclusion and exclusion criteria ensure that literature reviews are focused, relevant, and methodologically sound (Meline, 2006). Table 1 illustrates the inclusion and exclusion criteria guiding this study's literature selection. The criterion headings (topic, population, date, data collection source, language and publication type) were sourced from Chugh et al. (2023).

Table 1: Inclusion and exclusion criteria.

Criterion	Inclusion	Exclusion
Topic	Usage of GenAI tools in Higher Education in any discipline.	Other educational levels, such as Schools.
Population	Students, educators and administrators	Parents and other general public
Date	≥ 2018 to 2023	< 2018
Data collection source	Primary sources such as surveys, interviews and experiments	Secondary sources such as literature reviews
Language	English language	Other languages
Publication Type	Peer-reviewed journal articles, full text only	Book chapters, conference papers, preprints, dissertations, grey literature, and editorials

A comprehensive search of six databases (Directory of Open Access Journals, EBSCOhost, Gale, Ovid, ProQuest, and PubMed) was conducted to search for literature published between January 2018 and December 2023. The selection of the six databases ensured comprehensive coverage of high-quality, relevant research across higher education. While we searched for articles from 2018 to the end of 2023 to capture all relevant research, the shortlisted papers emerged exclusively from 2023, indicating that significant research

on GenAI gained momentum only in that year. A thorough search strategy also involves precisely matching search phrases (search terms, keywords, and Boolean operators) with the research objectives (Ismail et al., 2023). Hence, keywords used in the title and abstract fields included - 'ChatGPT', 'Generative AI', 'Generative Artificial Intelligence', 'Higher Education' and 'Tertiary Education'. The utilisation of Boolean operators, such as AND, OR, and NOT, enhanced the effectiveness of the database search by allowing the researchers to combine, exclude, or broaden search terms, thereby refining and optimising the retrieval of relevant literature. Two researchers collaborated in conducting the database search to select pertinent literature for the study, ensuring the validity of the search results and minimising potential biases in the literature selection process. Afterwards, a third researcher verified that the results met the established inclusion and exclusion criteria.

In the identification stage, the initial search yielded 331 records. Before the screening stage, duplicates, non-journal and non-English articles were identified and removed, resulting in 282 records. Next, the articles' titles, keywords, abstracts, and full text were screened for conformance to the data collection source, fitness to the topic and population, leaving us with a final shortlist of 34 articles. The PRISMA flow diagram in Figure 1 shows the results of the identification, screening and inclusion process.

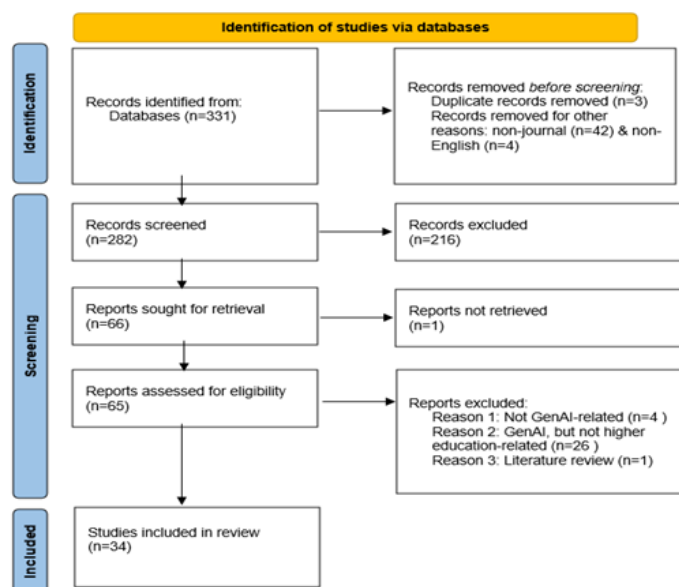


Figure 1: PRISMA flow diagram.

The data collection methods in the selected studies predominantly featured surveys, which were used in 15 instances. Nine studies conducted experiments utilising an AI tool and subsequently reported their outcomes. The emphasis on experiments not only signifies a methodological choice but also highlights the significance of hands-on exploration and self-study approaches in the research process (Hauge, 2021). Interviews were favoured by six studies as the primary data collection method, emphasising a qualitative aspect. A singular study adopted focus groups, reflecting a collaborative approach to data gathering. Additionally, three studies employed a blended strategy, combining experiments and surveys for a comprehensive understanding.

Aligned with the inclusion criteria, the selection of articles centred on the 'usage of GenAI tools in higher education in any discipline.' However, it was essential to discern the specific academic disciplines or domains from which the shortlisted studies originated to provide a more nuanced understanding and guide future research. Consequently, various disciplines were identified. Out of the 34 studies, a 'General' label was assigned to the majority (n=20), whose respondents hailed from various disciplines, suggesting GenAI tools as a pedagogical resource with broad relevance. The categorisation of studies into specific disciplines, such as 'Language Education' (n=3) and 'Programming' (n=2), hints at the specialised roles that GenAI tools play within distinct academic domains. The emphasis on these areas suggests tailored applications of AI in addressing discipline-specific challenges and enhancing educational practices. The remaining nine studies span distinct disciplines, each representing Chemistry, Computer Science, Early Childhood, Engineering, Medical, Physiology, Safety Management, Science, and Sports Management. This diversity indicates a growing trend toward discipline-specific investigations, acknowledging each domain's unique educational needs and challenges. Respondents were assumed to belong to different disciplines when the discipline was unspecified. Importantly, it is deemed unlikely that this assumption will significantly impact our findings, as the overarching focus on using GenAI tools in higher education remains consistent across diverse disciplinary contexts.

The distribution of target populations across different stakeholders in the selected studies provides further valuable insights. The emphasis on 'students' in 16 studies, as shown in Figure 2, suggests a strong interest in understanding the impact on the learner's experience. This observation aligns with Ismail et al. (2024), who noted that the majority of the articles featured students as the primary participants. The focus on 'educators' in nine studies highlights the significance of exploring how GenAI tools can support teaching and learning practices. The inclusion of 3 studies, each targeting both 'students and educators' and 'students, educators, and administrators', underscores a holistic approach to data collection. The specific attention to 'educators and administrators' in two studies and 'administrators' in one study suggests a growing awareness of administrative considerations in implementing AI tools. Analysis of the shortlisted literature follows next.

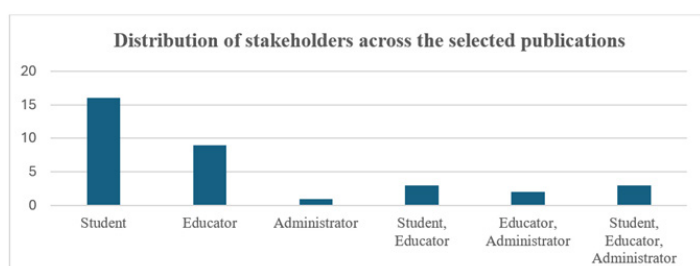


Figure 2: Distribution of stakeholders across the selected publications.

Benefits and opportunities of using GenAI

Several benefits and opportunities arise from using GenAI, and this section presents them from the perspective of its stakeholders, namely students, educators, and administrators (see Table 2). For studies that included more than one stakeholder, the information specific to the type of stakeholders has been identified and presented in the relevant subsections.

Student perspectives

GenAI tools can significantly impact personalised learning experiences for students (Chan & Hu, 2023). Whether refining grammar, structuring an essay or improving clarity, students can receive personalised guidance tailored to their needs (Xiao & Zhi, 2023). This personalised approach offers a deeper engagement with the subject matter. These versatile tools offer immediate assistance across various aspects and domains, enhancing the students' learning ability. Firstly, GenAI tools provide invaluable writing support by offering real-time feedback during the writing process (Tlili et al., 2023a). Also, these tools help students save time and effort (Bissessar, 2023). Secondly, during brainstorming sessions, GenAI tools can serve as valuable aids to generate ideas, help students explore different perspectives and refine thought processes (Chan & Hu, 2023), contributing to a more advanced and vast learning experience by supporting creativity. Thirdly, GenAI tools not only provide support for complex tasks but also improve the motivation of students to gain feedback on their work by keeping students' work and their errors secure (Bissessar, 2023) and also support computational thinking skills (Yilmaz & Yilmaz, 2023).

In the study conducted by Yilmaz and Yilmaz (2023) with 45 undergraduate students, the authors identified that students in the experimental group who had used GenAI had higher computational skills, more motivation for the lesson and programming self-efficacy than the students who did not use GenAI. This study indicates that through interactive learning experiences and feedback mechanisms, students gain confidence in their ability to navigate technological landscapes, which was also supported by Singh et al. (2023). Additionally, GenAI tools can support language enhancement and critical thinking. Providing feedback on language proficiency encourages students to critically evaluate their writing style (West et al., 2023), vocabulary usage, and coherence (Hosseini et al., 2023). Moreover, these tools enhance awareness of AI limitations, emphasising the boundary where automation ends and human judgment begins. This cultivates a culture of thoughtful communication and continuous improvement (Tlili et al., 2023a, 2023b).

Another critical aspect is that ChatGPT could be helpful as an efficient and engaging form of knowledge dissemination. In a United States study conducted with 42 students from the construction industry, ChatGPT, when used as an educational intervention, allowed students to clarify their queries about the subject matter and improved their ability to recognise hazards efficiently (Uddin et al., 2023). Moreover, through engaging educational experiences and practical simulations, students develop a deeper awareness of environmental risks,

safety protocols, and workplace challenges, contributing to their learning experiences and industry readiness.

Educator perspectives

Drawing insights from the shortlisted research papers, we explore several advantages of GenAI tools for educators. Firstly, educators benefit significantly from GenAI tools, utilising them for resource creation, lesson preparation and idea generation support (Cooper, 2023; Pinochet et al., 2023). By automating tedious tasks and offering innovative content creation ideas during brainstorming (Chan & Hu, 2023; Cooper, 2023; Keiper et al., 2023), these tools empower educators to focus on effective teaching strategies and student engagement (Ruiz-Rojas et al., 2023). However, overreliance on automation might limit teacher creativity and adaptability. Educators should view GenAI tools as aids rather than replacements for traditional resources. These tools offer supportive features that could reduce dependency on teachers and language centres, while educators ensure lessons remain tailored to student needs. In a UK survey of 284 academics by Watermeyer et al. (2023), over 83% anticipated increased use of GenAI tools, citing benefits in research writing and grant applications; one participant reported a significant increase in research productivity. GenAI tools, as highlighted by Walczak and Cellary (2023), drive innovation in teaching methods, promoting student engagement and learning efficacy. However, educators must critically evaluate these tools' effectiveness and ethical implications, aligning them with educational objectives and fostering inclusive learning environments.

Research has indicated that GenAI tools can reduce labour-intensive tasks such as proofreading, word limit reduction, and summarising reports, which could support improvements in research activity (Watermeyer et al., 2023). These tools empower educators to reclaim valuable time by providing personalised learning experiences that cater to individual student needs (Bissessar, 2023; Chaudhry et al., 2023; Pinochet et al., 2023). This dynamic approach creates an engaging learning environment. However, maintaining balance is crucial: while GenAI tools enhance interactivity, they should not diminish essential human interaction in the classroom. Meaningful discussions and activities beyond digital interfaces remain vital. GenAI tools also play a key role in providing comprehensive instructor support. They assist with grading, enhance teacher skill sets, and encourage educators to reassess assessment approaches (Chaudhry et al., 2023; Pinochet et al., 2023). Educators also opine that these tools improve creativity and critical thinking among students (Chaudhry et al., 2023). However, a potential pitfall exists, such as over-reliance on standardised testing formats generated by these tools, which may inadvertently limit the scope of creative assessment methods.

Administrator perspective

Despite challenges such as response limitations and plagiarism (Hosseini et al., 2023), GenAI tools show promise in upholding academic standards and preventing contract cheating, aligning with the objectives of effective learning

support. Administrators also benefit directly and indirectly. However, they express significant concerns regarding the challenges and ethical implications of these tools (Bissessar, 2023), highlighting the need for clear regulations and guidance to ensure their appropriate usage and mitigate potential risks (Chaudhry et al., 2023). Despite these concerns, administrators and policymakers acknowledge the value of integrating GenAI tools into educational environments to bolster learning support and have the potential to improve the inclusion of students with communication challenges (Chaudhry et al., 2023).

Table 2: Benefits of using GenAI in the education domain from the perspectives of students, educators and administrators.

Stakeholders	Benefits of GenAI in education	Authors
Students	Personalised learning support	(Chan & Hu, 2023; Uddin et al., 2023; West et al., 2023; Xiao & Zhi, 2023; Zou & Huang, 2023)
	Immediate learning support	(Chan & Hu, 2023; Chan & Lee, 2023; Xiao & Zhi, 2023; Zou & Huang, 2023)
	Brainstorming support	(Chan & Hu, 2023)
	Present concise summaries	(Totlis et al., 2023)
	Support with exam preparation and can create multiple choice quizzes	(Totlis et al., 2023)
	Cost-effective	(Chan & Hu, 2023; Romero-Rodriguez et al., 2023; Uddin et al., 2023; von Garrel & Mayer, 2023; Zou & Huang, 2023)
	Writing support for second language users	(Totlis et al., 2023; Zou & Huang, 2023)
	Assistance in code generation	(Kelly et al., 2023; Singh et al., 2023)
	Increase motivation in learning	(Singh et al., 2023; Yilmaz & Yilmaz, 2023)
	Support in designing scientific experiments	(Kelly et al., 2023)
	Access information from various types of sources	(Xiao & Zhi, 2023)
	Assess and provide feedback on students' work	(West et al., 2023)
	Increase computational thinking skills	(Yilmaz & Yilmaz, 2023)
	Mostly accurate response	(Totlis et al., 2023; Yilmaz & Yilmaz, 2023)
	Ease of use	(Foroughi et al., 2023; Zou & Huang, 2023)
	Administrative support	(Chan & Hu, 2023)
	Clarifying questions	(von Garrel & Mayer, 2023)
	Visual and audio multi-media support	(Chan & Hu, 2023)
Educators	Resource and learning material creation support, such as quizzes, presentations and worksheets	(Cooper, 2023; van den Berg & du Plessis, 2023)
	Brainstorming for designing module units	(Cooper, 2023; Keiper et al., 2023)
	Reviewing complex concepts to enhance understanding	(Dhanvijay et al., 2023)
	Provide personalised and flexible learning for students and educators	(Kiryakova & Angelova, 2023; Kohnke et al., 2023; Pinochet et al., 2023)
	Reduce time-consuming teaching activities	(Kiryakova & Angelova, 2023)
	Educators can use this to improve student engagement by creating tailor-made content for diverse students	(Ruiz-Rojas et al., 2023)
	Flexibility in material selection, providing feedback and improvement suggestions	(van den Berg & du Plessis, 2023)
Administrators	Improve research productivity	(Watermeyer et al., 2023)
	Ability to process multiple languages due to its multi-lingual model and can detect AI plagiarism. Effective learning support and enhanced learning experience, versatility in handling assignments, facilitation of real-time feedback. Aiding students with learning disabilities	(Chaudhry et al., 2023)
Students and Educators	Valuable tool for idea generation and organisation in the initial phase of writing, enhanced efficiency	(Barrett & Pack, 2023)
	Ability to serve as a search engine, can be useful in academic content creation and syllabus design, and support daily educational activities.	(Hasanein & Sobaih, 2023)

	Support in content creation, research assistance, coding support, fact-checking and information retrieval, idea generation for course topics, test preparation for interactive and engaging study process	(Keiper et al., 2023)
	Assistance in problem-solving, interactive learning experience, adaptability and accessibility, skill development, language learning support, rapid assessment evaluation support, usefulness for learners with disabilities	(Rahman & Watanobe, 2023)
	Interaction and learning assistance, providing useful learning content and immediate feedback, positive impact on writing and communication skills,	(Tlili et al., 2023)
Educators and Administrators	Integrate innovation in teaching, assistance in research, enhanced conversation and exploration, speed and efficiency, assistance in professional development	(van Wyk et al., 2023)
Students, Educators and Administrators	Saves time, supports both learning and teaching activities, efficient in accessing information, and improves learner engagement	(Bissessar, 2023)
	Helping to overcome language barriers, enhancing writing proficiency, improving efficiency, brainstorming, serving as a studying tool, assistance in structuring and summarising texts	(Hosseini et al., 2023)

Challenges of using Generative AI

Despite its increasing popularity, GenAI is not devoid of challenges. This section explores the various challenges of GenAI highlighted in the selected literature from the perspectives of students, educators, and administrators. Table 3 provides a summary of the challenges of using GenAI.

Student perspectives

The research by Chan and Hu (2023), based on a survey of 399 undergraduate students, identified eight challenges in the use of GenAI tools for students: accuracy, transparency, privacy, ethical issues, holistic competencies, career prospects, human values, and uncertain policies. Similarly, the qualitative approach to academic perception using Chatbots like ChatGPT conducted by van Wyk et al. (2023) comprehensively discussed the challenges, including bias, user privacy, the uses of user data and the cost of a subscription. Privacy and security of student data raises concerns about data protection, unauthorised access, and potential misuse of personal information (Chan & Hu, 2023; Chan & Lee, 2023).

In a medical education study, research students found that ChatGPT's responses on anatomical variants and clinical significance were inadequate without systematic classification. However, ChatGPT provided accurate descriptions of anatomy, concise chapter summaries, and useful advice on anatomical terminology (Totlis et al., 2023). A cross-curriculum study by West et al. (2023) identified that ChatGPT could not generate high-quality reports as it contained incorrect experimental details, inconsistent information between sections and fabricated references. ChatGPT's numerical mathematical solutions were evaluated by Sánchez-Ruiz et al. (2023), who highlighted its low accuracy in calculating numerical questions. Moreover, students are concerned about over-relying on ChatGPT for problem-solving and knowledge acquisition, hindering their ability to develop critical thinking skills and independence (Sánchez-Ruiz et al., 2023). A lack of proper use can adversely impact critical thinking and the ability to investigate and draw conclusions on assignments or future work (Singh et al., 2023).

Educator perspectives

A survey conducted with Bulgarian university professors indicates that when students do not verify the content generated by ChatGPT, they can learn false, malicious, or biased information (Kiryakova & Angelova, 2023). According to Cooper (2023), exploring ChatGPT's responses to science education questions reveals impressive capabilities and significant concerns. STEM (Science, Technology, Engineering and Maths) has very different integrity challenges from heavily text-based disciplines. This is not a one-size-fits-all issue. While ChatGPT demonstrates remarkable human-like responses, its output lacks evidence and sufficient qualifications, potentially positioning itself as an epistemic authority. This criticism is particularly concerning for science educators prioritising evidence-based teaching explanations. Also, the study by Watermeyer et al. (2023) highlighted three important concerns of educators. Firstly, educators are concerned that less proficient writers may use these tools to expedite writing, potentially leading to a flood of research articles and undermining research credibility. Secondly, using AI-generated text with added references raises ethical concerns and questions about academic integrity. Finally, it prompts a discussion on whether academics feel pressured to produce more outputs in less time due to GenAI tool use.

Educators at an African distance e-learning university expressed concerns about students potentially cheating on assessments with ChatGPT, noting that existing technological tools are insufficient in detecting this ethical issue as academic dishonesty or plagiarism (van Wyk et al., 2023). Through investigation of user experiences, privacy concerns were also posed. Contrary to the ChatGPT FAQ on the official OpenAI website, ChatGPT has explicitly denied storing or using user conversation data or personal information. This misinformation could be concerning for learners and educators, particularly those less familiar with technology and privacy issues (Tlili et al., 2023a, 2023b).

Administrator perspectives

Bissessar (2023) researched all the stakeholder perspectives on GenAI tools and concluded that ethical issues regarding the use of AI tools are the main challenges. Similarly, Hasanein and Sobaih's (2023) investigation suggests a need to examine the long-term impact of GenAI on higher education to develop proper guidelines and policies that apply to the responsible use of GenAI in higher education. Furthermore, research pointed out that appropriate training is required for students and faculty members to avoid ethical concerns about the responsible use of GenAI.

Generative AI usage guidelines

Based on the identified benefits and challenges of GenAI, it is evident that stakeholders hold mixed opinions, with both enthusiasm and concern surrounding its use. Without clear guidelines, this could lead to inconsistent implementation, potential misuse, and a lack of trust in the technology. Establishing comprehensive policies and standards is crucial to harness the benefits while mitigating the risks

Table 3: Challenges of GenAI use in education from various stakeholder perspectives.

Stakeholders	Challenges of GenAI	Authors
Students	Academic misconduct	(Hargreaves, 2023; West et al., 2023; Xiao & Zhi, 2023)
	Inaccuracy	(Chan & Hu, 2023; Xiao & Zhi, 2023)
	Equity	(Chan & Hu, 2023)
	Lack of engagement in certain disciplines, such as healthcare settings and among older students	(Kelly et al., 2023)
	Hallucination	(Walczak & Cellary, 2023)
	Academic integrity, ethical debates	(Xiao & Zhi, 2023)
	Over-reliance on these tools	(Singh et al., 2023; West et al., 2023)
	Privacy	(Chan & Hu, 2023)
	Decrease in critical thinking	(Chan & Hu, 2023)
	Lack of authorship	(Walczak & Cellary, 2023)
Educators	Inappropriate use by Students – generating content and then inserting references	(Cooper, 2023)
	Ethical concerns such as content moderation issues, risk of copyright infringement	(Cooper, 2023)
	Ethical dilemmas, academic integrity	(Keiper et al., 2023)
	Inability to provide contextual or diverse range of cultural perspectives	(van den Berg & du Plessis, 2023)
	Mass produce and high churn research	(Watermeyer et al., 2023)
	Impact students' emotions when other students score higher marks while using GenAI tools	(Kiryakova et al., 2023)
	Students' trust without verifying the validity of the content	(Kiryakova et al., 2023)
	Challenges to the effectiveness of assessment practices	(Kiryakova et al., 2023)
Administrators	Equity, Unfair advantage to GenAI users, Ethical use of GenAI tools	(Chaudhry et al., 2023)
Students and Educators	Ethical issues in using GenAI	(Barrett & Pack, 2023; Chan & Lee, 2023)
Educators and Administrators	Cost implications, ethical consideration, academic dishonesty	(Van Wyk et al., 2023)
	Lack of creativity and inability to think critically, loss of human interaction, hallucination, inability to access, cost implications and overreliance	(Bissessar, 2023)
Students, Educators and Administrators	Overreliance, academic integrity, lack of quality and accuracy, learning outcomes, student skill set, ethical concerns	(Hasanein & Sobaih, 2023)
	Lack of transparency, misinformation, plagiarism, privacy, hidden biases, overrepresentation of a few languages and unavailability in some countries.	(Hosseini et al., 2023)

associated with GenAI. As GenAI tools become more common, guidelines can help to uphold ethical standards. These guidelines should address the concerns of educators, students, and administrators, encompassing policies, procedures, ethics, and best practices. As such, this requires an in-depth examination to understand the role of AI in educational settings, and there needs to be a call for the development of guidelines at a national level (Cooper, 2023) to ensure the ethical and credible use of GenAI detailing what is acceptable and what is not (Barrett & Pack, 2023).

For students

Most of the selected studies with students (Bissessar, 2023; Hosseini et al., 2023) indicated that they are the most interested in the stakeholder group to adopt GenAI. Also, with the rapid advancement and convenience of GenAI, it may soon become an essential professional skill, and there is a need to provide training to students. Some suggested ways are conducting peer evaluation of GenAI writing, allowing students to compare their work to AI-generated work, utilising GenAI to review their work, and providing feedback on how to improve it (West et al., 2023).

A large-scale study on student's views of GenAI found that 15% of students who had never used these tools still felt confident in using them (Kelly et al., 2023). It was suggested

that universities should clearly communicate the proper use of GenAI and outline the academic risks associated with improper referencing. Bissessar (2023) identifies concerns about academic integrity, creativity, and the cost of AI assistive tools that students are likely to use. This suggests the importance of students critically assessing the impact and implications of AI tools on their education. Given the increasing apprehensions surrounding the information, ethical, and educational challenges associated with ChatGPT, alongside the noticeable preference of doctoral students towards its utilisation in writing (Zou & Huang, 2023), proactive steps are essential to mitigate the adverse effects on students. Students can leverage GenAI to assist in research activities, writing tasks, drafting essays, and summarising complex concepts. However, while its use in certain contexts may be acceptable, substituting it for completing assessment tasks crucial to earning degrees poses significant risks and challenges. This not only affects the educational institution awarding the degree but also has broader implications for society, as students may graduate without genuinely understanding tasks critical for future employment. Addressing these concerns requires a reliable action plan to ensure institutions actively mitigate the impact of GenAI on the integrity of higher education awards.

Students should be educated about privacy risks and trained to avoid sharing sensitive information. They need to critically evaluate ChatGPT-generated information for accuracy, relevance, and credibility and cross-reference it with multiple sources (Kiryakova & Angelova, 2023). If a child who has not learned addition is given a calculator and asked to add numbers, they might trust the displayed result unquestioningly. In contrast, someone who has learned addition can verify and justify the calculator's answers. This outlines the importance of promoting critical thinking, particularly as certain GenAI tools can provide differing answers of varying quality despite the same prompt (Tili et al., 2023a, 2023b). Also, students should be supported with prompt writing skills to use these GenAI tools effectively and efficiently (Yilmaz & Yilmaz, 2023).

For educators

Studies by Kiryakova and Angelova (2023) and van Wyk et al.(2023) indicate that some educators have low levels of knowledge or do not use GenAI tools or use them infrequently. Some educators have shown greater resistance to utilising GenAI tools, perhaps due to a lack of recognition of their relevance in the learning process(Ruiz-Rojas et al., 2023). In addition, educators mention ChatGPT with words like "poison", "fraud", "laziness", "dope", "sly" and "pretentious" (Kiryakova & Angelova, 2023). The negative opinion could be because these technologies are in their early phase, and educators may need time to better understand and integrate them into their teaching and learning activities (Watermeyer et al., 2023). According to the techno-trends awareness theory, educators should adopt innovative classroom practices to foster a positive attitude towards technology. This necessitates training educators to use these technologies (van Wyk et al., 2023).

In Barrett & Pack's (2023) survey, educators stressed discussing the ethical considerations of using GenAI tools in writing. The study found that using GenAI for writing assignments, whether disclosed or not, was universally deemed unacceptable by both students and teachers, underscoring the need for transparency about these tools' limitations. Furthermore, as reported in the study by Luo et al. (2023), instead of panicking over students using ChatGPT for assignments, educators should view this as an opportunity to reflect on and improve assessment methods, thereby strengthening educational integrity. In line with this, educators should think of new assessment approaches, such as oral debates, as writing essays will no longer be difficult with the support of GenAI tools (Tlili et al., 2023a). Chaudhry et al. (2023) highlight that while ChatGPT has the potential to improve students' learning experiences, its integration into education systems demands thoughtful planning and consideration of its implications on academic integrity and assessment practices. Resonating with what Barrett & Pack (2023) have addressed for writing assignments, open discussions and effective guidelines are essential to ensure its responsible and beneficial use in educational settings. National-level guidelines are crucial to determine appropriate student usage of GenAI, provided it is supervised by educators, administrators and accompanied by effective ethical training on the use of GenAI.

GenAI guidelines should provide clear guidance to govern the use of Gen AI (Bissessar, 2023). The guidelines need to be based on educational practices and the importance of balancing the benefits and challenges associated with GenAI technology in academic settings. Higher education institutions are still looking for evidence-based cases and studies around the use of GenAI that could be used to help institutions reflect on the risks GenAI poses for the higher education sector.

Cooper's (2023) exploration of ChatGPT's potential in science education highlighted educators considering alternative approaches to assessment, integrating AI-assisted projects, and adopting a collaborative approach to assessment design. However, Zou and Huang (2023) do not discuss developing alternative assessment approaches but focus on mitigating the negative impacts of ChatGPT on writing. However, promoting critical thinking and originality and exploring non-traditional assessments could address concerns about ChatGPT's impact on students' writing abilities and academic integrity.

Educators are encouraged to integrate ChatGPT into the curriculum and adopt formative assessment practices (Foroughi et al., 2023). Factors such as performance expectancy, effort expectancy, hedonic motivation, learning value, personal innovativeness, and information accuracy concerning the intention to use ChatGPT need to be determined (Foroughi et al., 2023). These aspects may be important considerations in leveraging GenAI technologies effectively in educational settings. Higher education students and teachers use ChatGPT for academic purposes, and the consequences it brings to the academic environment can be detrimental (Hasanein & Sobaih, 2023), so there is a need to establish clear guidelines to provide training sessions for students and faculty.

Educators are concerned about plagiarism (Barrett & Pack, 2023; Chaudhry et al., 2023). There is a need to prevent plagiarism through AI tools and promote originality and creativity. Lesson planning can be enhanced using GenAI, empowering teachers (van den Berg and du Plessis, 2023) albeit, assessment tasks should undergo a redesign process to mitigate the risks related to academic integrity that arise from the utilisation of GenAI (Kelly et al., 2023). It is pertinent to combine AI with in-person assessments, and recognising the need for effective integration, educators are encouraged to raise awareness of GenAI's uses and limitations. (Chan & Hu, 2023). This approach becomes especially crucial as students often exhibit relatively low knowledge, experience, and confidence in utilising GenAI. Consequently, as emphasised by Kelly et al. (2023), there is a compelling need for explicit instruction on how to use GenAI tools appropriately in educational settings.

GenAI can enhance English language teaching by integrating AI chatbots with traditional methodologies for comprehensive learning (Kostka & Toncelli, 2023). It is recommended to responsibly use GenAI to explore the intricate dynamics between AI chatbots and traditional teaching methods. The potential challenges and ethical implications that may arise in the integration process are still in its infancy stage. Striving for a balanced approach, Hasanein and Sobaih (2023) recommend clear guidelines and training for responsible use, underlining the importance of educators being well-versed in ethical considerations and responsible use of AI tools. Recommendations include providing clear guidelines on the use of GenAI and training for responsible GenAI use, integrating AI chatbots for comprehensive learning, and ensuring educators understand ethical considerations associated with GenAI tools.

For administrators

The need for comprehensive policies and updates to plagiarism policies has been emphasised (Romero-Rodríguez et al., 2023). To streamline the examination of potential academic misconduct, it is essential for governance offices to regularly revise and uphold policies and procedures. This involves keeping the definitions of various forms of academic misbehaviour current and reflective of contemporary misconduct trends. According to Hosseini et al. (2023), the discussion on incorporating ChatGPT in healthcare highlighted specific techno-ethical challenges that need careful consideration in creating context-specific policies. While there is enthusiasm about technological advancements, critical aspects such as defining access levels to clinical notes, regulating data reuse, ensuring patient privacy, holding user groups accountable, and attributing credit for data contributions require deliberate design and enforcement. Also, institutions must revisit their performance-based evaluation approach to better assess students' learning outcomes and teaching effectiveness and develop innovative assessment methods that enhance creative thinking, problem-solving, and communication skills (Chaudhry et al., 2023).

At the institutional level, there may be a lack of cohesive policies, guidelines, and frameworks governing the ethical and responsible use of GenAI across different departments, programs, and disciplines. Institutions may struggle to establish clear protocols for data management, intellectual property rights, and student privacy in the context of GenAI-enabled technologies. Furthermore, there may be limited resources and infrastructure to support faculty and staff in effectively integrating GenAI into curricular and co-curricular activities (Barrett & Pack, 2023). This warrants that institutions provide educational resources and workshops to help students (Chan & Hu, 2023) and educators with clear and consistent guidance on the permissible use of GenAI in different activities associated with teaching, learning, assessment and research.

Table 4: Usage guidelines of GenAI in the education domain.

Stakeholders	GenAI usage guidelines
Students	1. Use GenAI tools to get feedback on students' work (West et al., 2023). 2. Learn to use GenAI tools responsibly and ethically (Dhanvijay et al., 2023; Hasanein & Sobaih, 2023). 3. Increase transparency, accountability and data privacy awareness (Walczak & Cellary, 2023). 4. Encourage students to independently question, analyse, and synthesise information (Hasanein & Sobaih, 2023).
Educators	1. GenAI should be included in the curriculum for learning and teaching tasks to personalise learning to suit individual students' needs (Ruiz-Rojas et al., 2023). 2. Creating new teaching philosophies (Tlili et al., 2023). 3. Automate the assessment of tasks and provide faster feedback to students (Ruiz-Rojas et al., 2023). 4. Regularly monitor and verify the feedback provided by GenAI tools (Ruiz-Rojas et al., 2023). 5. Respect students' data's rights and privacy (Ruiz-Rojas et al., 2023). 6. Instruct students to explore and creatively use GenAI tools (Foroughi et al., 2023).
Administrators	1. Revise and refine the current performance-based evaluation systems used to monitor students' learning and development and revisit academic integrity policies (Chaudhry et al., 2023). 2. Provide appropriate training, resources and timeframe for educators (Kelly et al., 2023). 3. Create context-specific policies to avoid miscommunication and ambiguity (Hosseini et al., 2023). 4. Create policies and guidelines for appropriate use (Bissessar, 2023; Kiryakova & Angelova, 2023). 5. Recognise and minimise the risks of GenAI (Luo et al., 2023).

In Australia, the focus of the Tertiary Education Quality and Standards Agency has now shifted more distinctly toward the assurance of learning, specifically to assessment methods (TEQSA, 2023a, 2023b). Ruiz-Rojas et al.'s (2023) focus on the potential of GenAI tools in university education highlighted the importance of including GenAI in the curriculum and tailoring integration based on subjects. Their findings reveal that GenAI tools are crucial in developing massive online classrooms (MOOCs) when integrated with an instructional design matrix. Administrators need to ensure appropriate timeframes, resourcing, and training for educators (Kelly et al., 2023) to support students in engaging with GenAI tools appropriately. Kiryakova and Angelova (2023) posit that while ChatGPT shows promise in supporting teaching and learning by assisting educators in organising information and creating tailored materials, there are concerns regarding its potential misuse and impact on knowledge assimilation, assessment validity, and data security. Despite the benefits, challenges persist in effectively integrating AI tools into education.

University professors generally view ChatGPT positively, recognising its potential to enhance teaching by saving time and engaging students. However, many educators lack a comprehensive understanding of these tools and their

implications, highlighting the need for enhanced digital competencies. To address these challenges, educational institutions must prioritise developing strategies and training programs to enable students and educators to use AI applications in education responsibly and effectively. Administrators also need to assess if any elements of the institution's current approach to learning, teaching and assessment need to be altered in the light of GenAI.

Academics recognise the benefits and risks of using ChatGPT for teaching and learning (van Wyk et al., 2023) and also the need for thoughtful and measured adoption to minimise risks, indicating the importance of administrators critically evaluating the implementation of AI tools (Hosseini et al., 2023). Including AI literacy in higher education curricula is imperative, as it can support creating a culture of responsible AI use. Encouraging students to reflect on the ethical implications of using GenAI applications in their studies can enhance their understanding of the importance of transparency, accountability, and data privacy (Walczak & Cellary, 2023). Some usage guidelines for using GenAI in the education domain based on the selected papers are outlined in Table 4.

Discussion

GenAI is a double-edged sword (Hosseini et al., 2023;), requiring us to balance its benefits and drawbacks by leveraging its potential while mitigating risks (Ifelebuegu et al., 2023). On the one hand, it offers various advantages, such as automatically generating outlines and summaries, supporting personalised learning, and providing writing feedback. On the other hand, our overreliance on technology, coupled with GenAI's ability to generate entire assessment texts, is exposing flaws in our industrialised assessment system, which prioritises superficial compliance over quality and originality (Popenici et al., 2023), leading to several challenges. These challenges include the authentication of individual achievements for accreditation, potential threats to academic integrity principles, privacy and inaccuracy of the produced results. This calls for sustainable responses to integrate GenAI into learning and assessment policies, as well as the need for support in understanding and using the technology for both staff and students. Calls have been made to redesign assessment instruments to ensure they do not hinder student learning due to GenAI (Ogunleye et al., 2024). The Australian Academic Integrity Network (AAIN) has developed a document that suggests the appropriate use of GenAI in higher education, aligned with the Higher Education Standards Framework (Threshold Standards) 2021, emphasising the assurance of teaching, learning, research, and research training quality, while also addressing content, skills, assessment, learning outcomes, and maintaining academic and research (Munoz et al., 2023). However, to create pedagogically richer forms of online learning, it is essential to anticipate the needs of tech-savvy students (Chugh, 2010).

Using GenAI requires proper understanding and training, similar to learning to drive a vehicle. In education, this involves teaching both students and staff to use GenAI ethically and responsibly, as well as developing methods to

evaluate its outputs. Similar to Van Wyk (2024), promoting interdisciplinary learning and critical digital literacy among students are emphasised for responsible AI use to address concerns such as plagiarism, factual errors, and protecting sensitive information when using GenAI tools. Educators should also get practical training on using it (Sevnarayan & Potter, 2024) and be able to learn at their own pace to get better at using GenAI in their teaching. They should then support students in becoming good at checking the work it creates. This way, students can develop their critical thinking skills and reduce their overreliance on these tools. Collaboration among educators and receiving personalised coaching can facilitate them to integrate GenAI into curriculum design and teaching practices effectively. By sharing their knowledge and experiences with peers using teaching and learning communities of practice, educators can support each other and develop best practices in using GenAI tools for education.

Administrators play a crucial role in developing comprehensive policies, creating resource materials to use GenAI for educators and students effectively, updating curriculum integration, and ensuring efficient implementation of AI tools. Policies addressing data privacy, algorithmic biases, and responsible AI use are essential for educational institutions. To enhance consistency and coherence in using GenAI across the institution, administrators should establish a university-wide GenAI task force. This body could serve as a platform for educators and administrators to exchange insights on the utilisation and impact of GenAI in educational settings that would support the development of policies and procedures. In addition, administrators can play a crucial role in creating easy-to-use resource materials by developing an online portal or resource hub for students and educators to access the best practices for using GenAI. They can also support organising face-to-face or virtual workshops and training sessions for all stakeholders. Furthermore, administrators need to conduct comprehensive reviews of select modules in each course. This will aid in assessing how learning objectives are adapted to using GenAI technologies in learning and assessment and determine necessary refinements in learning resources, instructional strategies, and assessment methods. Priority should be given to units with higher risk profiles due to the students' use of GenAI in this process. Considering in-class assessments could be beneficial for units with assessments mapped to lower-level cognitive processes. This approach allows students to engage with specific, rather than general, contexts, enhancing the relevance and application of their learning. Additionally, a clear and well-defined GenAI-focussed policy on academic integrity should be established, ensuring all stakeholders understand the standards and expectations. Sevnarayan and Potter (2024) highlight the importance of involving all stakeholders (students, educators, and administrators) to navigate the implementation of GenAI effectively.

Our review indicates that ChatGPT has been the most popular GenAI tool. Administrators should emphasise and recommend introducing a tailor-made GenAI tool for education to government bodies and GenAI tool makers such as OpenAI, Google Gemini, and Microsoft. With the release of ChatGPT-4o, which includes emotional intelligence

features, there is a clear opportunity for a specialised version or product tailored for educational purposes, possibly dubbed ChatGPT-4e. This concept parallels the success of Google Scholar by Google in supporting the search for scholarly articles. Education-specific GenAI tools can increase the accuracy of the outputs produced by these tools as the content is based on scholarly articles. Also, these tools could support alleviating hallucination issues, which was another major concern raised by all stakeholders. Considerations of timeframes, resourcing, and training for educators are crucial for successful GenAI integration in education. Ultimately, clear guidelines and collaborative efforts among stakeholders are essential to harness the potential of Generative AI while mitigating associated risks in educational settings.

Conclusion

This literature review has provided a comprehensive understanding of the current research on adopting GenAI in higher education as well as the benefits and challenges from students', educators', and administrators' perspectives. The guidelines for GenAI usage in the higher education domain have also been reviewed and discussed.

Through a hybrid systematic-narrative approach, the study synthesised findings from 34 diverse sources. GenAI can benefit the student learning experience, including the accessibility of up-to-date information and knowledge retrieval, enhanced confidence and motivation, writing support, creativity support, timely feedback, time efficiency, cost-effective learning assistance and applicability to various subjects and disciplines. Educators enjoy the benefits of GenAI in terms of improved teaching quality, teaching efficiency, continuous professional development, enhanced flexibility in materials preparation, and comprehensive instructor support. GenAI also benefits school administrators in information acquisition, improved administration processes, and educational paradigm innovation. In particular, GenAI can improve the accessibility and inclusivity of education.

Challenges to adopting GenAI in higher education were also identified. The biggest concern from all three stakeholders is academic integrity, including information privacy, copyright, ethical issues and plagiarism. Students and educators also face challenges in accurately evaluating the content produced by these tools. Due to a lack of transparency and authorship, the content generated by GenAI may lead to potential misinterpretation and misunderstanding. Reassessing assessment types that embrace the benefits of GenAI and achieve the expected learning outcomes is a challenge for educators. Furthermore, educators and administrators are concerned about overreliance on GenAI tools, as it is argued that overreliance on GenAI can reduce human skills such as critical thinking.

The guidelines for GenAI usage in higher education were explored. While educators may introduce GenAI in the curriculum for learning and teaching, it is critical to set clear learning objectives, enhance specificity in assessment tasks, and use diverse assessment methods (e.g., presentation and visual modelling). Students should be aware and responsible

for AI usage, critically validate AI-generated content, be aware of privacy and security and use GenAI to foster independent learning. Administrators should be responsible for policy and guidelines development, minimising risks of GenAI usage, ensuring equity in access and usage, regular monitoring and evaluation, and enhancing infrastructure and resources for GenAI integration.

As with any study, this study also has its limitations. We considered the perspectives of only three stakeholders in higher education and provided guidelines based on the shortlisted literature. However, other stakeholders, such as professional staff, also play a significant role in higher education. Their perspectives, although important, were not included in this study as our focus was specifically on teaching and learning. Moreover, in our study, the administrators we considered could also serve as educators, leading to potential overlap between stakeholders' perspectives.

Future research in the higher education domain encompasses various areas, including but not limited to the integration of GenAI in curriculum design, assessments in the GenAI era, the use of GenAI for learning enhancement and policies governing GenAI usage. GenAI has emerged as a transformative force across numerous fields, offering everyday enhancements and revolutionary advancements. As this powerful technology continues to evolve, higher education institutions must maintain an open attitude towards its potential while exercising caution. This balanced approach will help ensure we maximise its benefits and minimise the risks.

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LAIK your classroom: A practical framework to integrate generative AI in higher education classrooms

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Abstract

The proliferation of generative artificial intelligence (GenAI) tools in the last two years and their ongoing development make their integration in education an inevitable reality. Recent studies into the integration of GenAI tools in academia have focused on opportunities for education and challenges to consider. In this context, few frameworks and models have been proposed, but none have addressed the need for a comprehensive and practical framework to facilitate teachers' efforts to integrate GenAI into their classrooms. This study, therefore, addresses this research gap by developing a framework for the integration of GenAI in classrooms, the LAIK framework. The framework is designed to identify the necessary elements that should be considered before, during, and after integrating GenAI tools in higher education classrooms. To build the framework, data were collected from teachers, students, and classroom observations. Results from the study highlighted the need for four practical stages in this framework, namely (1) laying the foundation, (2) assembling GenAI-friendly classes, (3) investigating and monitoring, and (4) keeping the teacher informed. The framework also offers a variety of options to consider for practical ways to integrate GenAI technology to support learning in the classroom.

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Introduction

It has been just over a year, and generative artificial intelligence (GenAI) is increasingly becoming imbedded in many major service providers (Bower et al., 2024; Singla et al., 2024). While the technology was not built for educational purposes, it surely has disrupted education enough to cause a wave of concern and calls for necessary restructuring or even reconceptualization of assessment practices in academia (Bower et al., 2024; Cotton et al., 2023; de Winter, 2023; Mao et al., 2024; Rudolph et al., 2023; Sullivan et al., 2023). Despite the unique challenges and opportunities presented by GenAI, the education landscape has a proven track record of adaptability in the face of previous technological innovations. Google, the search engine, is one simple example. Although the technology of search engines now seems an indispensable part of our lives and of our education system, education and humankind happily lived before it was first released in 1998 (Hall & Hosch, 2024). While Google's search engine did not generate an instant shockwave like GenAI, it eventually redefined information access, compelling the education system to adapt. Both search engines and educators managed to coexist and support each other. Educators adjusted their teaching and assessment methods that utilize accessing and retrieving information, which led to broader changes in educational practices.

As the education ecosystem responds to a new reality shaped by GenAI, stakeholders—including researchers and practitioners—share the responsibility of investigating effective ways to integrate GenAI while maintaining quality and serving learners' best interests. One of these ways, as Hwang and Chen (2023) advocate, is by developing frameworks that guide teachers' efforts to "implement [GenAI]-based learning strategies, teaching plans or research designs" (p. 15). In fact, several researchers have emphasized the need for well-researched methods to integrate GenAI into teaching and learning (Crawford et al., 2023; Sidorkin, 2024; Tlili et al., 2023). This paper aims to address this need.

Existing frameworks to guide GenAI integration in classrooms

In their discussion of GenAI integration in a UNESCO guidance, Miao and Holmes (2023) stress the need to prioritize "human capacity and collective action, and not technology" (p. 7) to facilitate effective learning environments. This highlights the critical role teachers play in facilitating an effective and responsible approach to integrating GenAI into education. Similarly, Jeon and Lee (2023) demonstrate in their discussion of teachers' relationship with AI in the classroom that successful AI implementation in a learning context hinges on "teachers' pedagogical expertise that was strengthened by the AI-generated data" (p. 4). They also report that despite the growing body of research on the educational use of AI, much of this work has narrowly focused on specific applications and roles, failing to capture the full spectrum of possibilities associated with integrating AI technologies into educational environments. Sidorkin (2024) echoes their findings as he emphasizes the need for theory and frameworks to ensure "shaping the future of

education in the age of artificial intelligence" in meaningful ways (p. 1).

A few GenAI frameworks have been proposed in the literature discussing different levels of GenAI integration at different depths. For instance, the IDEE framework proposed by Su and Yang (2023) encourages teachers to consider four aspects: (a) "identify[ing] the desired outcomes", (b) "determin[ing] the appropriate level of automation", (c) "ensur[ing] ethical considerations", and (d) "evaluat[ing] the effectiveness" of the tool (pp. 5-6). The framework can be generally seen as a guide at the abstract planning level of GenAI integration; however, there is little attention given to the practical and more hands-on level of classroom integration. The framework does not offer the needed detail and structure when it comes to levels of automation, and it does not give details about classroom application as part of the process.

Another framework proposed by Rowland (2023) focuses on academic writing and is built on the idea that utilizing AI for academic writing should not be seen as binary (used or not used). Rather, there is a continuum of nine levels ranging from "entirely human-generated" to "entirely AI-generated" (p. 36). He offers a detailed account of the different GenAI-guided activities to facilitate academic writing from a student perspective. Similarly, Pigg (2024) proposes a descriptive framework focusing on the practice of writing. The framework outlines "descriptive codes that name and describe practices early adopters enact when integrating these technologies into research writing" (p. 2). Both frameworks focus on using GenAI to support academic writing only, and they do not address the process from a teaching perspective.

Finally, Kolade et al. (2024) offer a framework based on their research into GenAI for learning and assessment. Their framework proposes that teachers can utilize GenAI tools at three different levels of assessment whether summative or formative. These levels are knowledge, competence, and performance. Along the same lines, Perkins et al. (2024) propose a framework that focuses on assessment. Their framework encourages teachers to "support students in engaging with GenAI tools in an appropriate and ethical manner" (p. 5) at different levels suggesting that GenAI use is not binary, as Rowland (2023) suggests. While both frameworks offer practical ways for teachers to account for GenAI, they primarily focus on assessment. Assessment is an important part of the learning process, but only one part of what happens in the classroom.

Research gap and study objectives

As discussed in the previous section, the frameworks proposed in the literature to discuss GenAI in education do not focus on the aspects of classroom integration aspect and/or the teacher's perspective. That is, there is little focus on the various roles GenAI can play *inside the classroom*, as part of the lesson while still prioritizing learning as the main drive. This limitation has led to a significant gap in the literature addressing the effective application of GenAI. To the best of our knowledge, there is currently no practical

framework that comprehensively guides teachers in integrating GenAI into classrooms. Nor is there a framework that considers the various ways GenAI can support learning in the classroom, along with the associated planning and follow-up work. In fact, in their critical analysis of the GenAI landscape in education, Wang et al. (2024) recommend that research efforts should focus on finding ways in which GenAI can “be integrated into current curricula to enhance students’ learning” (p. 12). Echoing a similar emphasis, the UNESCO Director for the Future of Learning and Innovation cautions:

Without institutional guidance of any sort, these technologies are likely to get welded into education systems in unplanned ways with uncertain implications and possible unintended consequences.... Educational institutions need an agile and iterative approach, or they will forever be trying to catch up with the relentless pace of technological innovation (UNESCO, 2023, para. 8).

This study seeks to address this clear need for a practical framework to guide the efforts of educators and researchers as they utilize (or investigate) GenAI tools in the classroom meaningfully and responsibly, across various higher education (HE) courses. Therefore, the study seeks to answer the following research question: *How can teachers integrate GenAI technology into their classroom in effective and meaningful ways?* To answer this question, we propose the LAIK (pronounced like the word *like*) framework for teachers based on insights and feedback collected from teachers in various workshops on GenAI for over a year. The framework is designed to identify the necessary elements that should be considered before, during, and after integrating GenAI tools in HE classrooms. It also offers a variety of options to consider for practical ways to integrate GenAI to support learning in the classroom.

Methodology

Study design

To develop a practical and comprehensive framework to integrate GenAI in HE classrooms, we sought to collect data from both teachers and students, the primary participants in a classroom environment. This approach ensures a comprehensive and inclusive design by considering both teacher and student perspectives. During the data analysis process, several elements for effective GenAI integration emerged. The process of identifying and combining these elements to build the framework was iterative and cumulative; with each round of data collection and analysis, the different elements in the framework were further enriched and/or validated.

Data collection

Data were collected from the two main layers of participants (i.e., teachers and students) in different ways. Data were collected from over 600 educators through different workshops and training engagements since February

2023. The workshops focused on GenAI technology and its educational implications, and they primarily discussed ChatGPT because, in the early stages of this GenAI era (and when these workshops started), users were mostly interested in and familiar with ChatGPT compared to other tools and other forms of GenAI.

Overall, the workshops focused on (a) introducing ChatGPT as a tool, (b) highlighting strategies for using GenAI to support teaching and learning, and (c) discussing the impact of GenAI tools on higher education. These workshops allowed active engagement with education stakeholders at different stages of building the framework. Their engagement throughout these instances offered great insight into their experience as teachers with GenAI in their practice. Different tools were used to gather data from teachers throughout these engagements, but for the purposes of this study, we will use data collected from the five-week course to report insights from teachers. The course was offered in March 2023 and again in May 2023. In this course, 36 participants filled out two surveys, engaged in three focus groups, submitted eight written tasks, and designed one lesson or activity that utilizes ChatGPT for teaching and learning. Data from this stage identified the main elements of the framework and helped draw a clearer picture of effective GenAI integration *for teachers*.

Data from students were collected after the first version of the framework was established. That is, after engaging with educators through multiple training engagements, Version 1 was considered rich enough and ideal to be used in the classroom. The course was dedicated to teaching academic research writing skills. Students ($n = 186$) were from different degrees, with different language proficiency levels, and at different levels of technological literacy. They also had different exposure levels to GenAI; some have been using ChatGPT extensively, and some, surprisingly, never heard about it. Data were collected at this stage through two surveys, two written assignments, and eight classroom observations. Data from this stage highlighted opportunities for development to refine and expand the framework, making it more engaging and supportive of GenAI-assisted learning *for students*.

Data analysis

Data collected from teachers throughout the process were sorted into Excel sheets and qualitatively analyzed in terms of classroom application. Upon educators’ completion of the training course, analysis of the data identified three main areas to consider for the framework: setting the scene, developing an AI-friendly environment, and evaluating and monitoring. This led to Version 1 of the framework, which was comprehensive enough to be implemented in class with students. Using it with students offered insight into how students with different abilities and proficiency levels interact with the technology and the learning activities developed as part of the framework. This helped to enrich the framework (V1) further and led to the development of the final framework (V2), which will be discussed in detail in this paper. Figure 1 summarizes the process of building the framework.

The process of designing the LAIK framework

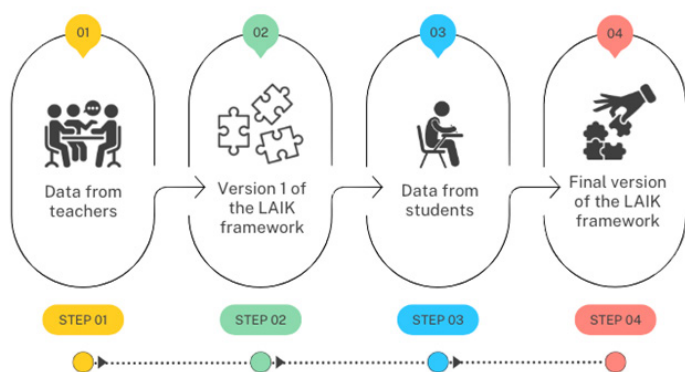


Figure 1. The process of designing the LAIK framework.

Results

Insights from teachers

Data from teachers throughout the process of developing the framework highlighted teachers' keen interest in learning more about "user-friendly styles and methods of maximized ChatGPT use for the general improvement of my teaching methods and productivity" (Teacher 29) and "how it could be beneficial for faculty in different streams... [and] how various levels of students can benefit from AI tools" (Teacher 19). Throughout teachers' engagement with the workshops, several elements of effective GenAI integration emerged and were stressed: the need for training and setting GenAI-use boundaries clearly for students, the need for clear, practical and responsible methods to integrate GenAI in class, and the need for staying up to date with the latest updates and changes to these tools.

When the framework was discussed with participants, they found different kinds of activities outlined in the framework (Stage 2) useful:

I learned that there are many positive ways that teachers and students can use the technology for teaching and learning. This PD was really a great 'learning-by-doing' experience and I learned a lot from all the ideas shared. I came away with more confidence and optimism in using AI-powered programs. (Teacher 6)

I've also learnt many ways it can be used in teaching, such as lesson planning, lesson activities and materials. I've also come to find out more about introducing it to students and making them use it to generate ideas for their writing. (Teacher 27)

Insights from students

Data from classroom observations and students' assignments demonstrated the effectiveness of the framework in providing students with the necessary information to utilize GenAI effectively during class and to develop a more

critical understanding of GenAI and its role in learning. Data gathered from classroom observations and students' engagement with the framework stressed four important elements to include in the framework: the need for training, the need for clear examples of misuse *in relation to the course*, the need to provide sample prompts at the beginning of GenAI-assisted classes, and the need to monitor students' engagement with GenAI throughout the course.

In the pre-survey, a small group of students (17%) had never heard about ChatGPT, but the majority reported using the tool to help answer questions and write (or complete writing) their assignments. Only one student from all 186 participants had something to say about the need to check the information she gets from ChatGPT: "sometime[s] I use it for assignments and then I double check the information from [the] internet because sometime[s] chat gpt is not correct" (Student 147). Others seemed to trust its output to a great degree as they used phrases, such as "trusted information" (Student 122) and "information with high standard" (Student 57) to describe how and why they use GenAI in their studies.

Towards the end of the course and after implementing the framework with them in class, students filled out a survey with open-ended questions about their experience. It was interesting to see that their attitude towards the tool (and GenAI in general) shifted. When asked: "What should teachers tell their students about ChatGPT?", the majority stressed the need for teachers to "explain how to use it correctly" (Student 13) and to inform students "that it is helpful but does not always give true and realistic information" (Student 6). Another student highlighted the need to inform students "how they can use it in a legal way in the course and teach the student how to find accurate information, and also teach them that CGPT [is] not always correct" (Student 45). After being introduced to GenAI in class through the LAIK framework, students' overall experience demonstrated an appreciation for the learning assistance it provides, as well as a critical awareness of its limitations and how they can address them. One of the students explained:

I think what we learned about ChatGPT in this course was really helpful, I got to know how to properly use it in a good and helpful way. So this topic should at least be mentioned briefly to other students so they know what to avoid doing with chatgpt. (Student 7)

The framework

Upon analyzing and collating data and insights during the course of this study, we found that an effective framework for the classroom integration of GenAI cannot just focus on the classroom experience. The nature of GenAI tools requires the addition of three other critical areas that shape the classroom experience when integrating GenAI. Accordingly, the findings of this study suggest that to effectively integrate GenAI technology into higher education classrooms, there needs to be four essential stages (see Figure 2). Each stage is discussed in detail in the next section.

Additionally, observations from our study highlighted the need to draw upon a few defining beliefs about the role of technology in education to build the framework. The first

fundamental belief is that technology should not be the central focus in any educational setting; rather, it should facilitate learning. The highest priority should always be the learning experience and learners' needs. The second critical belief is centered around the human aspect of learning. Over-reliance on GenAI in place of classroom engagement with teachers and peers is both ineffective and potentially unsafe due to GenAI limitations. Finally, the framework is built on the core understanding that teaching in the classroom is a dynamic experience that dictates a certain degree of flexibility to allow for an organic learning experience. As Rudolph et al. (2024) aptly explain: "Teaching well encompasses adapting our teaching strategies to align with the unique contexts we encounter" (p. 15).



Figure 2. The LAIK framework.

The LAIK framework

To address the growing need for a practical framework for teachers to integrate GenAI technologies in their classrooms, the LAIK framework was systematically developed and iteratively refined to include four stages. It is designed to be comprehensive and to systematically—yet flexibly—allow educators to introduce, utilize, and maximize the benefits of GenAI technologies in the classroom. As outlined in Figure 2, the LAIK framework is built around four stages.

The first stage, *Laying the foundation*, focuses on building the basics of GenAI use for learning, making sure learners are fully aware of the target tool(s), guidelines, and strategies that ensure optimal use of GenAI. The second stage is *Assemble GenAI-friendly classes*. This stage details GenAI-friendly learning activities that teachers can integrate into their classrooms to implement GenAI tools as part of students' learning in ways that are both responsible and meaningful. The third stage, *Investigate and monitor*, emphasizes quality assurance of GenAI integration efforts. Finally, *Keep yourself informed* is the final stage, and the stage that emphasizes the importance of staying up to date with the latest developments in GenAI and the latest discussions and research surrounding its educational use and implications.

Before discussing the stages, however, it is important to acknowledge that the framework operates under the assumption that the teacher has already chosen the most appropriate GenAI tool(s) for their classroom. This choice should align with (a) the course's learning outcomes, (b) students' learning needs and background, and (c)

the institution's guidelines and policy. While choosing an appropriate GenAI tool is indeed an important step, it is beyond the focus of our framework because of the continually evolving and expanding landscape of available GenAI tools. The defining characteristics and boundaries of GenAI tools are rapidly changing and advancing in ways that cannot be fully anticipated or accounted for at any given time. Additionally, while the framework is meant to be used by teachers in the classroom, the boundaries that define some of its components will depend on the institution's overall policy and regulations. However, the absence of such regulations or lack of clarity should not deter teachers from utilizing the framework or GenAI in their classrooms.

Stage 1: Laying the foundation

The first stage is critical to the success of teachers' efforts to integrate GenAI into their classroom. This stage must be introduced in class because it ensures that students are critically aware of the affordances offered by GenAI and the limitations that surround its use. Even though GenAI tools do not require advanced technical skills, students need direct and clear training on how to use GenAI tools effectively and how to use them *for learning*. Several issues and skills need to be covered at this stage. They are the building blocks of the meaningful and responsible use of GenAI in the classroom.

Introduce the tool

The first issue to cover at this stage concerns (1.1) the GenAI tool(s) that the teacher of the course intends to use in the course. The teacher needs to clearly and directly (a) explain the capabilities of the target GenAI tool, and, if possible, the mechanics of it in ways that make sense to the students. This is important because it can dispel the unrealistic excitement that often accompanies new tools. Students need to understand that although GenAI tools seem to respond meaningfully, they do not understand language, think, or use logic and common sense like humans do. Rather, GenAI tools utilize the training data that they have been exposed to predict the most probable next sequence in any given context (Bubeck et al., 2023; Wu et al., 2023; Yang et al., 2023). In other words, the GenAI responses are based on some algorithmic and probability calculations, not on human-like understanding and reasoning of prompts or language.

The teacher should also (b) highlight the tool's limitations with examples that make these limitations clear and relevant to students. The students must understand that GenAI tools can only go as far as their training data goes and that the training data is known to be limited in different ways and contains biases and inaccuracies. Students should also understand that GenAI does not generate outcomes the way we do: think, plan, and then write. Rather, as Wolfram (2023) explains:

when ChatGPT does something like write an essay what it's essentially doing is just asking over and over again "given the text so far, what should the next word be?"—and each time adding a word. (More

precisely, ... it's adding a "token", which could be just a part of a word, which is why it can sometimes "make up new words".) (para., 4)

Therefore, it is even more paramount to discuss these tools' ability to fabricate data or present inaccurate output that is seemingly correct. The teacher should show students examples of these limitations in ways that are relevant to students and their course.

After discussing the capabilities and limitations, the educator should (c) outline the tool's privacy and data protection terms. Students need to understand the implications of sharing their data with GenAI tools and how this can impact their digital footprint and online privacy. This is important to ensure that students do not overshare information or risk their privacy when using the GenAI tool(s) used in class. One example of this happened years ago when Target, a famous retailer in the States, used machine learning to identify patterns in users' purchases to make predictions based on patterns of purchase, allowing the company to offer targeted discounts and offers. In one instance, as reported by Hill (2012), Target started sending "coupons for baby clothes and cribs" to a teenager. Her father went to the store to complain: "Are you trying to encourage her to get pregnant?" The store manager had apologized before the father called again a few days later: "I had a talk with my daughter. It turns out there's been some activities in my house I haven't been completely aware of. She's due in August. I owe you an apology" (para. 10). Because of the daughter's purchases (i.e., her digital footprint), Target predicted her pregnancy (and acted upon it) before the daughter or her father knew about it.

Discuss the ethics of the tool

The teacher needs to highlight (1.2) the ethics of using GenAI tools, whether generally or in relation to specific tools being used in class. In this discussion, the educator needs to (a) outline the general guidelines for responsible and ethical use of AI and GenAI—what are the boundaries that define acceptable and ethical use of GenAI? Many institutions have already set GenAI guidelines that the teacher can utilize in this discussion, but if not, the teacher can draw upon UNESCO's latest guidance on GenAI use in education (Miao & Holmes, 2023).

The guidelines for proper GenAI use must be followed by (b) addressing potential misuses of the tool with clear examples that relate to the course. It would also be useful if these misuses are tied to the student handbook or academic integrity guidelines set at the institution.

Finally, the teacher should (c) emphasize the importance of these ethical guidelines and the broader implications of not adhering to them, not just in terms of affecting students' academic standing at the institution, but also in terms of learning gains, job readiness, and their personal and professional integrity. In a market where GenAI is easily available to everyone, those who will stand out are the ones who know how to *responsibly and meaningfully* use GenAI to leverage *their own* skills and talents instead of simply

replacing them.

Showcase effective ways to use the tool

While teachers are laying the foundations for GenAI use in class, they should (1.3) showcase effective ways to use the tool for learning. This showcase should (a) start with effective prompting skills that efficiently lead to better results. The way one crafts their prompt greatly guides and restricts GenAI tools. This is due to the "garbage in, garbage out" principle that shapes the GenAI technology. That is, the quality of the input defines the quality of the output. This principle applies to the kinds of data used to train GenAI; the machine will multiply the same patterns (good or bad) identified in the data used to train the machine. That is, GenAI tools do not operate to find the best answer to a user's request, but rather to find what the training data says in relation to it. The "garbage in, garbage out" principle also applies to prompting and makes the user experience highly dependent on a user's ability to appropriately write and structure the prompts (White et al., 2023). The way one writes their prompts will—to a great extent—shape the output GenAI generates. This is why it would be helpful if teachers compiled or prepared a prompt bank designed for their course, with a few prompt templates that target the different aspects of the course and its assessments. This would make it easier for students to apply effective prompting skills as they engage with the course materials and assessments. This prompt bank would be especially helpful for students whose command of English is not strong enough and will therefore struggle with writing effective prompts. This prompt bank can also be shared as Open Educational Resources (OER), where other teachers within a given institute or online can reuse and enrich accordingly. Regardless of the way a teacher chooses to teach these prompting skills, students must understand the trial-and-error nature of effective GenAI prompting and its multi-step process. More often than not, an effective prompting experience requires iteratively refining prompts to obtain the best results.

In addition to prompting skills, the teacher should also (b) illustrate ways to use the tool for personalized learning as this has been one of the most cited uses for GenAI in education (Chan & Colloton, 2024; Chan & Hu, 2023; Cotton et al., 2023; Crawford et al., 2023; Crompton & Burke, 2024; Kasneci et al., 2023; Wang et al., 2024; Xu, 2024; Zhai, 2023). We believe that using GenAI for personalized learning might not be easily done unless students are explicitly shown how to take advantage of this aspect. For example, Figure 3 shares two examples of prompts shared with students to use GenAI as a tutor for different experiences; although they were limited and only in text form, students were able to realize the potential of GenAI as a personalized tutor and utilized these examples to create their own prompts for other purposes, such as using GenAI to prepare for a project's oral defense and to study for a quiz.

When showcasing effective use of the target GenAI tool, the teacher should (c) highlight critical skills needed to use the tool and (d) share practical ways to evaluate output generated by the tool. One of the major drawbacks of GenAI tools is their ability to fabricate data and make it seem real

Prompt examples

**the underlined parts are examples. Change them to suit your own experience*



Job interviews

I am a full time student. I am applying for a receptionist role at NBC bank. Act as the HR rep, and conduct a formal interview with me. One question at a time. After each reply I give, continue the interview as normal, but as a footnote between [] give me feedback on the answers I provided in bullet points.



Speaking exams

I am a university student. I am taking a speaking exam for my ENGI01 course. Act as the teacher, and conduct a final speaking exam with me. One question at a time. After each reply I give, continue the interview as normal, but as a footnote between [] give me feedback on my answers covering these points: [strength/ weakness/ areas of improvement]

Figure 3. Examples of personalized learning prompts shared with students.

and authentic. Merely informing students of this drawback is not enough; they need to be equipped with the necessary critical skills and practical strategies to help them evaluate and assess (1) when they can(not) use GenAI to assist in their learning and (2) how to use the output generated by GenAI properly. One way to address this is to provide students with a checklist for critically evaluating GenAI output, including questions about checking facts, examining logic and coherence, identifying potential bias, and looking into opposite views other than the ones discussed in the piece generated by GenAI. Finally, teachers should also encourage their students to (e) utilize the tool to foster creativity, illustrating how the tool can facilitate innovative thinking but *not replace their own creativity*.

Establish a clear GenAI policy for the course

The last issue to highlight while setting the stage for GenAI use in class is to (1.4) establish a clear GenAI policy for the course. This is best done by involving learners in the process. In collaboration with learners, educators should (a) define what constitutes acceptable use of GenAI for the course and (b) outline prohibited uses of GenAI for that course, aligning it with the institution's general academic honesty and integrity policies.

Additionally, the teacher should clearly (c) detail how GenAI use should be disclosed by learners. The teacher could simply choose not to require any disclosure, but we believe at the early stages of using GenAI in class, it can be helpful to keep a record of GenAI use. This could be general or detailed, including a record of their prompts and chats with the tool, and explanations of how they used, evaluated, and/or modified the GenAI output each use. This record allows teachers to hold students accountable and give feedback, and it helps students review and reflect upon their GenAI interactions.

Stage 2: Assemble GenAI-friendly classes

In addition to laying the foundation in Stage 1, an effective integration of GenAI tools in the classroom hinges on creating a learning environment that facilitates the responsible and meaningful use of GenAI. This is the primary objective of *Stage 2: Assemble GenAI-friendly classes* which highlights different ways to build a GenAI-friendly learning environment.

Start an activity with GenAI

The first way to integrate GenAI into learning activities is to use the tool(s) to (2.1) start an activity, focusing on the initial engagement with the activity. GenAI tools can help students with the background knowledge needed to engage in the activity, where the teacher is always available to provide more support or further assistance. For example, learners can use the tool to (a) clarify any prerequisite knowledge needed for the activity. Learners can also use GenAI tools to (b) outline and explain the steps needed to complete the activity. This can help learners who normally feel daunted by activities requiring multiple steps. For example, learners can ask GenAI to outline the steps needed to solve a differentiation problem in math.

GenAI tools can also help learners (c) brainstorm and develop ideas. One of the advantages of using GenAI for brainstorming is that it can offer a wide range of ideas instantly. Students should be encouraged to continually revise and modify their prompts for better and more fitting ideas, and they should be encouraged to leverage GenAI-generated ideas as a springboard for developing their own ideas, tailored to their local context and better suited to their skills and strengths. This should allow them to take ownership of their ideas and learn how to use GenAI to amplify their own creativity instead of replacing it.

Gain more clarity with GenAI

The second way to make learning GenAI-friendly in class is to encourage students to use GenAI to (2.2) gain more clarity for their activities, facilitating a deeper understanding *during* an activity. Learners can use the tools to (a) simplify critical concepts/theories/etc. encountered during the activity. For example, learners can prompt GenAI: "Explain concept x in terms that a 10-year-old would find easy to understand. Give examples". If the explanation was not clear enough, learners should prompt it again: "try a different way" or "simplify further", as many times as needed.

Learners can use GenAI to (b) translate instructions, expressions, etc. into their native language to help them overcome any language barriers that might affect their progress. It should be noted, though, that the performance of many GenAI tools is not at the same level with all languages due to the fact that the training data for these tools lacks linguistic diversity (Petrov et al., 2024; Ruder, 2020; Weidinger et al., 2022).

Another way for GenAI tools to help students gain more clarity is to use these tools to (c) simulate or model the outcomes of the activity to help set an example for the kind of results they would get or should aim for. For example, when working on a science experiment, students can use GenAI to simulate the effects of mixing certain elements, allowing students to learn about the impact of their choices before actual implementation, or students can take it a step further and use their experiment results to verify the accuracy of results generated by GenAI.

Receive feedback from GenAI

Teachers can also encourage students to use GenAI in class to (2.3) get feedback from the tool. For example, students can ask the tool to (a) give feedback on *their progress*. The more specific the request for feedback is the better the results. For example, a student can share their incomplete code with GenAI to give feedback on the logic and efficiency of the code.

Students can ask GenAI to (b) proofread learners' output. The more specific the request for feedback is in the prompt, the better the results. For instance, after drafting an essay or report, students can use the tool to identify grammatical errors, awkward phrasing, or inconsistencies in verb tense. Students can take it a step further and ask GenAI to explain the changes it made.

GenAI can also be used to (c) suggest ways to improve learners' work. To get the most out of a GenAI tool, the prompt should be clear and specific. Instead of prompting GenAI to "give me feedback to improve this", it would be more effective to ask the tool to provide its feedback in bullet-point form and to specify the target areas where feedback is needed, such as clarity, coherence, or efficiency.

Finally, GenAI tools can be prompted to (d) grade students' work based on a rubric. In some cases, it might help to break down longer texts into smaller chunks to get better and more accurate feedback. This is because GenAI tools have a limit on the number of tokens they can process at one time, although this limit is progressively increasing (Gartenberg, 2024; Chandler, 2023; OpenAI, 2023; Zhang et al., 2024).

Amplify the output with GenAI

GenAI-supported activities in the classroom can also (2.4) amplify traditional activities. Students can leverage GenAI tools to (a) generate artwork for the activity allowing them to visually complement their work in ways that could not have been possible without GenAI tools. The kinds of art they can generate are endless, with different tools offering different options and ways to customize the prompt. However, it should be noted here that there are concerns about how GenAI tools produce artwork in ways or styles that mimic real-life artists without their consent or permission (Robins-Early, 2024).

Learners can also (b) simulate real-world scenarios to complement their learning activity using GenAI tools. For example, GenAI tools can be asked to predict outcomes of policy decisions in simulated government settings or create fictional business scenarios based on certain factors the activity defines. The advantage of using GenAI tools to create these scenarios is the endless and customized varieties they can generate.

To a certain extent, GenAI tools can also be used to (c) design virtual tours related to an activity, for storytelling, interior design, real estate, or any other courses. Learners can design different aspects of the tour with the help of text-to-text GenAI tools to generate specific details and prompts, and then they can plug in these prompts into text-to-image, text-to-video, and text-to-sound tools to generate the visual and auditory elements needed for the work.

Study with GenAI

Students should also be encouraged and taught how to (2.5) study with GenAI. One of these ways is to use GenAI to (a) summarize or identify main ideas and key concepts from study materials. Many GenAI tools allow for uploading PDFs to analyze and summarize them in a matter of minutes; most go a further step and suggest some key questions to ask about the uploaded document. This could be helpful for students revising for a test or when they have ample amounts of materials to go through and study.

Students can also use GenAI tools to (b) generate practice quizzes. These tools can generate general quizzes on specific concepts. More effectively, learners can provide a 5-question sample and ask the tool to create more questions on a given list of concepts and key points. Alternatively, learners can plug the entire practice quiz into the tool and ask it to generate similar quizzes at the same level, covering the same topics and using the same style.

Students can also use GenAI to (c) give feedback on their understanding of a concept as they study it. Finally, GenAI tools can be used to (d) showcase structured approaches to solving different problems with endless examples. There is no doubt that these approaches would already be covered by their teacher in better and more contextually-rich ways; however, not every student is physically (or mentally) present during class, and others simply forget. When using GenAI tools to facilitate this kind of learning, students can ask the tool to further explain certain steps they are struggling with or give more specific examples that target these difficult areas. Having access to this kind of personalized learning around the clock without the fear of looking incompetent is a perk our generation would have loved to have growing up. Nevertheless, this perk can easily turn into a double-edged sword. While such access is desirable, knowing the limitations of GenAI tools and the kind of flawed yet seemingly-accurate output they can generate, there is the risk that students may not utilize the necessary critical thinking and information literacy skills required to use these tools effectively. In a recent investigation, Barnum (2024) tested a GenAI tool designed to offer math tutoring (Khanmigo) and found: "Khanmigo frequently made basic arithmetic errors,

miscalculating subtraction problems such as 343 minus 17. It also didn't consistently know how to round answers or calculate square roots. Khanmigo typically didn't correct mistakes when asked to double-check solutions" (Barnum, 2024, para. 5). This highlights the urgent need to implement clear measures that encourage and ensure the development of students' critical thinking and fact-checking skills before, or at least as, they use GenAI for learning purposes.

Roleplay with GenAI

GenAI-infused learning activities in class can also utilize (2.6) roleplaying with these tools. One of the main features that GenAI tools uniquely have is their ability to engage in a human-like conversation with their users. This capability makes GenAI tools well-suited for roleplay. Learners can use GenAI to (a) conduct interviews in which GenAI can be prompted to assume the role of any person/side. For example, when practicing for a job interview, GenAI can act as the interviewee demonstrating optimal answers or as the interviewer asking questions. It can also be prompted to give feedback on the student's responses and engagement while maintaining the roleplay.

Another way for learners to roleplay with GenAI for learning is to prompt the tool to (b) act as a counterpart in simulated scenarios such as sales negotiations and medical patient situations, allowing learners to customize the roles. Although less demanding than real life, these simulations provide valuable training. At the time of revising this draft, OpenAI announced the release of ChatGPT-4o, which is meant to be freely available to all users. It can engage in a conversation with users via video, with very little if any delay (OpenAI, 2024a). For an early demo of these roleplay capabilities, watch Khan (2024) and OpenAI (2024b). These new capabilities can be extremely helpful for roleplay in simulated scenarios.

GenAI tools can be used to (c) practice oral exams. If students have access to sample questions, GenAI can conduct exams and grade students' performance. It can also create similar questions or use generic ones if no samples are available.

Correct GenAI

Finally, one of the important ways to integrate GenAI tools in the classroom is (2.7) correcting GenAI. This use of GenAI is critical because it changes the narrative from GenAI being the undefeated know-it-all wizard to being a powerful tool that has many limitations. This use also helps learners become more critical of GenAI output and, hopefully, any other content they come across online. The first way to implement this approach is to ask learners to (a) verify *facts* provided by the tool against credible sources. For the first few times, it would be optimal if the educator provided students with relevant and credible sources to use. Additionally, it is helpful to know that because of how GenAI tools operate, the more local and unpopular the topic is for this activity (i.e., not enough reliable content has normally been available about it online and hence in the training data), the more likely GenAI will produce output that is

inaccurate, irrelevant, outdated, or even biased.

A GenAI-infused classroom should also regularly ask learners to (b) assess the tool's output for including *diverse viewpoints*. GenAI output has been shown to favor one side of the spectrum—any spectrum—while still claiming to be neutral and objective (Rozado, 2023). Learners must understand that GenAI is not fully reliable for comprehensive information, and they must be trained to evaluate the inclusiveness of different viewpoints in its results. They should also be trained and taught to investigate and look beyond GenAI output as they formulate their understanding and views of different social and cultural issues.

Similarly, learners should be tasked with trying to (c) identify and understand possible *biases* embedded in the tool's output. These biases can be clear and straightforward, but they can also be embedded and hidden. In 2018, Amazon used AI to hire the most qualified candidates from a pool of resumes (Iriondo, 2018; Lavanchy, 2018). The tool was trained using the data of CVs submitted to the company for ten years. It was soon abandoned because researchers found that the tool discriminated against female applicants. Upon further analysis, they found: "Given the low proportion of women working in the company, as in most technology companies, the algorithm quickly spotted male dominance and thought it was a factor in success" (Lavanchy, 2018, para. 3).

Another way to incorporate activities that teach learners how to correct GenAI is to design activities that require learners to (d) critically evaluate the tool's output for quality and relevance to *current events and specific/local contexts*. They should also be tasked with (e) developing and expanding on the tool's output to provide more relevant and reliable information about local issues and communities. A lot of the details and stories about non-Western cities and communities are not given enough, comprehensive, or even fair coverage online, and are therefore not covered enough in training data used with GenAI tools. This could also be true about Western cities and communities that are not mainstream. In any case, learners should be trained to spot these gaps and inaccuracies, and they should be encouraged to be advocates for their own communities and issues. In a recent study, Zheng and Stewart (2024) investigated ChatGPT's production of *moral dilemmatic stories* aimed at improving language learners' cultural awareness. They found "WEIRD (western, educated, industrial, rich and democratic) cultural values are embedded in moral dilemmatic stories generated by ChatGPT" (p. 11). They suggest that teachers should first train students to be more critically and culturally aware of their own local contexts before they can apply appropriate critical appraisal skills to WEIRD-built narratives generated by GenAI.

Stage 3: Investigate and monitor

After actively engaging students with GenAI tools in class, *Stage 3: Investigate and monitor* focuses on the importance of observation, feedback, and continuous improvement to ensure that GenAI's integration into education remains effective and responsible. This will include three main tasks,

each designed to foster a cycle of quality assurance and enhancement from the teacher's perspective.

Track learners' engagement

The first and most important task is (3.1) tracking learners' engagement with GenAI tools for learning. This involves (a) observing learners' prompting efficiency and ability to interact *with the tool* effectively. This is critical because the way tools are prompted greatly shapes the experience and output of GenAI tools. From our class experience, students who struggle to engage with GenAI tools due to ineffective prompting often become frustrated and either give up or use the tool's output poorly.

Another important way to track learners' engagement is to (b) monitor and evaluate learners' engagement and interaction *with the output* of GenAI, mainly from critical and ethical standpoints. How effectively are learners able to critically evaluate and critically utilize GenAI output? How effectively are students able to practice sound ethical judgement on (un)suitable utilization of GenAI output?

Along similar lines, educators should also (c) review learners' GenAI-assisted output. The main question to investigate here is to see what role GenAI plays in learners' output. How reliant are learners on GenAI as they complete assigned work?—Are they fully reliant on GenAI to get the task done for them? Or do they use GenAI to improve *their own* work? And, how effective is their use of GenAI in helping them produce better outcomes instead of simply distracting them from learning?

Finally, and most importantly, teachers should (d) assess learners' GenAI-infused learning progress and assessment readiness. The focus is never the tool, but the learning process and the learners. Teachers should monitor the impact of integrating GenAI tools on students' learning outcomes, readiness for assessments, interaction with the material and with peers, and ability to sustain effective learning habits. Educators should also monitor how learners' experience with GenAI in the classroom is shaping their overall digital competency.

Gather learners' insights

In addition to monitoring students' use and progress, teachers should also seek to (3.2) gather learners' insights and feedback on the use of GenAI for their learning. Teachers should actively (a) gauge students' comfort and proficiency levels with these technologies and (b) identify any challenges they may encounter. This involves not only addressing technical difficulties but also understanding emotional and cognitive barriers to effective use. As GenAI tools become more advanced and allow for auditory and visual interactions, some students might be uncomfortable interacting with GenAI in non-textual forms. Additionally, there will be students with different digital abilities that might affect their interaction with GenAI. Recognizing and accommodating these students is essential for ensuring that all students can benefit from the technology, safely and

meaningfully. Finally, (c) asking students for suggestions for improvement can be a powerful tool to enhance the integration of GenAI in the classroom. Students' feedback may help identify areas for improvement, or they may suggest other creative and useful ways to use these tools to support their learning.

Refine and enhance

Finally, teachers should use data collected from tracking students' engagement and feedback to (3.3) refine and enhance the GenAI-infused learning experience. That is, teachers should (a) incorporate learners' feedback and consider their learning outcomes and progress. By actively integrating students' feedback, teachers will ensure their GenAI-supported classrooms are engaging and addressing students' needs. Accounting for students' performance and learning outcomes is also critical because classes can be fun and engaging but add very little to students' learning. Pickering (2017) cautions: "engagement is a poor proxy for learning and students need to do more than just appear to be physically interacting and enjoying their teaching sessions" (p. 4). Finally, the last two tasks to do when refining the integration efforts are the output of the final stage (Stage 4). More will be shared on the how in the next section, but to ensure the ongoing improvement of GenAI integration, the teacher should always (b) account for any developments or updates that happen to the GenAI tools they are using and (c) consider new ideas and approaches suggested by colleagues and other educators. More on this is shared in the last stage, Stage 4.

Stage 4: Keep yourself informed

Although *Stage 4: Keep yourself informed* is the last stage of the framework, it is an ongoing process that teachers ought to engage in throughout the other stages. There are three main tasks involved in this stage.

Engage in comprehensive and relevant AI training

The first task is to (4.1) engage in comprehensive and relevant AI training. GenAI is not built for education but can be used for education; GenAI integration in the classroom is not a given, but an acquired skill that needs training and continuous development. Therefore, an effective and meaningful integration of GenAI in the classroom relies on the educator's up-to-date knowledge and understanding of the technology and its educational implications. While it is ultimately the institution's responsibility to provide relevant and comprehensive training for teachers, individual teachers can (a) seek the growing learning opportunities available online covering the basics of GenAI. There are several opportunities available free of cost at the time of writing this paper (AI4T, 2024; Google Cloud, 2024; Microsoft, 2024). Educators will also benefit greatly from (b) attending and participating in webinars, conferences, and events that discuss the use of AI / GenAI in education. Many of these events are offered online by well-known institutions. They are valuable because they are offered by those who

are aware of the academic and social dynamics that shape GenAI in education.

Stay up to date with GenAI tools' developments

To stay informed, teachers should also (4.2) stay up to date with GenAI updates. GenAI tools are on a rapidly evolving trajectory with frequent updates and releases. Educators must stay informed about these changes, as they significantly impact how students can use these tools for learning. For example, in May 2024, OpenAI released an updated model of ChatGPT that "can respond to audio inputs in as little as 232 milliseconds, with an average of 320 milliseconds, which is similar to human response time(opens in a new window) in a conversation" (para. 1, OpenAI, 2024a). This update paves the way for many learning possibilities and, at the same time, flags other issues that teachers need to account for in their GenAI-infused classrooms.

The best way to stay informed about such changes is to (a) follow social media accounts, either of the official accounts of these tools or of established educational technology experts who actively share about the use of technology in education. Teachers can also (b) subscribe to websites that are dedicated to covering GenAI or technology updates (e.g., Gizmodo, n.d.; TechCrunch, n.d.; The Verge, n.d.). Finally, teachers will find a lot of value in (c) engaging with communities and other educators who discuss these tools. There are many forums and spaces where educators and specialists share their own experiences with GenAI for teaching and learning. An educator can use hashtags like #edchat and #AIED (short for AI in education) on all forms of social media to find some of these accounts.

Stay informed about GenAI policies and research

Finally, teachers should (4.3) stay informed about GenAI policies and research reports. While policies and regulations concerning GenAI are not evolving as rapidly as the development of GenAI tools, these policies are still continuously advancing and redefining the landscape and boundaries of GenAI application. Although teachers are bound by their institutions' regulations and policies, (a) staying informed about general guidelines and policies surrounding GenAI application around the world is necessary to maintain responsible and effective GenAI use in their classrooms. Many of these policies help direct educators' attention to issues that might be overlooked otherwise, such as issues of privacy and copyright. It is also useful to (b) follow the publications of organizations like UNESCO; they have been active with their AI-dedicated publications that offer great value and relevant insights and application considerations for educators (e.g., Jaakkola, 2023; Miao & Holmes, 2023; Miao et al., 2021; Miao & Shiohira, 2022; Sabzalieva & Valentini, 2023). Finally, (c) reviewing expert reports and publications on the general and educational use of GenAI provides educators with useful insights into recent trends and industry outlooks.

Discussion and implications

This paper aimed to present the LAIK framework which is designed to guide educators' efforts as they integrate GenAI tools in their classrooms (see Figure 4). The LAIK framework is built on four stages where educators: (1) lay the foundation for GenAI in their classrooms, (2) assemble GenAI-friendly classes, (3) investigate and monitor the use of GenAI, and (4) keep themselves informed. Each stage of the framework accounts for a different set of needs concluded from teachers and students who engaged with GenAI during the course of this project. The first stage of the framework addresses the critical need for training and familiarizing students with the technology of GenAI and the tools they are going to use in the classroom (Jeon & Lee, 2023; Miao et al., 2021; Waring, 2024; Zhai, 2023). This foundation sets the stage for an informed, responsible, and meaningful learning journey with GenAI technologies. This stage can be efficiently covered in one or two lessons for a brief overview or expanded over a week for a more in-depth exploration. Various factors should be considered when deciding how long or how extensive this stage should be, including class size, students' prior exposure to GenAI, and the complexity of the tools being introduced. However, regardless of how long it takes, this stage ensures that students can engage with the technology in effective ways that facilitate learning with GenAI in Stage 2. The second stage covers the different learning activities we believe GenAI can effectively aid without affecting the learning experience. The stage is built in ways that encourage students to capitalize on the assistance GenAI provides while still prioritizing their own work and ideas. The third stage focuses on teachers' efforts to ensure the quality and sustainability of GenAI integration efforts through monitoring students and asking for their feedback. Discussing quality assurance in higher education, Leckey and Neill (2001) identify student feedback as one of the main elements contributing to "quality assurance for university teaching" (p. 24). By actively integrating students' feedback, teachers will ensure their GenAI-infused classrooms are engaging students and addressing their needs. Finally, the last stage addresses the rapidly evolving landscape of GenAI tools and their role in education. As stressed by Lee et al. (2024):

AI has had, in recent months, and will continue to have, a dramatic impact on [higher education]. It is imperative that educators, and management, stay abreast of developments and continue to commit to ongoing research and discourse regarding responses to AI, keeping in mind the university's obligation to serve the students in preparing them for industry (p. 9).

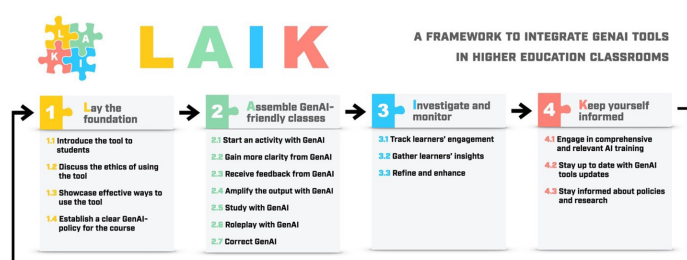


Figure 4. The LAIK framework and its components.

There are a few implications and recommendations to consider when engaging with the framework and its different stages. The first issue to consider when using the framework is the need to constantly remind learners of (a) the limitations of GenAI, (b) the constant need to verify output generated by GenAI tools, and (c) how GenAI can be effectively utilized—meaningfully and responsibly—for learning. It is necessary to constantly remind them that GenAI tools are, after all, *machines* that do not think, reason, use logic, or understand language the way we do as humans. Similarly, as stressed throughout the framework, there is a constant need for *critical* engagement with GenAI tools and the output they generate. In a recent conceptual paper, Bearman and colleagues (2024) call this kind of engagement *evaluative judgement* and highlight the emerging need to sharpen these skills “in recognition of this new reality” (p. 1). They explain that students need to be trained on how to discern high-quality output and how to critically engage with the output generated by GenAI, which can very much look authentic even if it is not. They explain that this ability is dependent on students “apprais[ing] many different examples” with the “iterative” use of GenAI in the process (p. 7).

Additionally, students’ mixed GenAI-readiness levels are another important consideration. Students’ exposure to and experience with GenAI will vary in terms of technical, critical, and language skills. This is why the first stage of the framework is critical. One of the main issues we observed with students was their varying proficiency levels with prompting skills which affected their willingness to utilize these tools and/or their ability to utilize and evaluate GenAI output properly. In every course, there will be students with varied prompting abilities, no matter how much their teacher discusses these strategies and skills in class. To avoid disadvantaging the weaker ones, the teacher can structure the learning activities to be group-based to ensure each group contains at least one student with strong prompting abilities. It could also be helpful to compile a prompt bank designed for the course. This would be used as a reference guide for students to refer to as needed or as instructed throughout the course.

Another consideration to keep in mind is the possibility of some students over-relying on GenAI tools in ways that go beyond the acceptable guidelines. Over-reliance on GenAI tools has been noted by researchers as a valid concern that can affect the quality and outcomes of learning (Habib et al., 2024; Moorhouse, 2024; Sidorkin, 2024; Wang et al., 2024; Wu et al., 2024; Yu, 2024). As Sharples (2022) puts it: “Students employ AI to write assignments. Teachers use AI to assess and review them. Nobody learns, nobody gains” (p. 1122). One way to address this concern is to focus on the process of learning instead of just the outcome (Cotton et al., 2023; Rudolph et al., 2023; Swiecki et al., 2023). In other words, rather than designing the activity to be done all at once, the teacher can break it down into distinct steps or stages, making sure that the outcome of each stage is fed into the next one. This would make it very difficult to let GenAI do all the work by itself.

Another issue to consider when building GenAI-friendly learning environments is the assertion that all these uses do not and should not eliminate the need to prioritize the human aspect of education and learning in the classroom (Miao & Holmes, 2023; Sidorkin, 2024; Tlili et al., 2023). The framework is built on the idea that GenAI tools should not replace the human element of learning; instead, GenAI should be integrated as a learning aid that facilitates learning responsibly and meaningfully. Crawford et al. (2023) advocate that “the interaction with the teacher comes first, and that the AI comes second, relegating AI to a support role as the second educator in the room, rather than the primary” (p. 6). Miao and Holmes (2023), in their UNESCO guidance on GenAI, assert a similar emphasis. They highlight the need to adopt: “a human-centred approach that promotes human agency, inclusion, equity, gender equality, and cultural and linguistic diversity, as well as plural opinions and expressions” (p. 7). In other words, the use of GenAI in the classroom is not a tool to replace teachers’ presence or to eliminate the need for interactions with students and peers.

Finally, for the framework to work successfully, teachers of all backgrounds (technical and non-technical) need to be familiar with how GenAI tools work and how they can be best utilized. The need for teacher training has been emphasized by many researchers as one of the critical requirements for the effective integration of GenAI in teaching and learning (Celik, 2023; Glaser, 2023; Kizilcec, 2024; Kohnke et al., 2023; Lodge et al., 2023; Tlili et al., 2023). For example, realizing the data-hungry nature of GenAI will make teachers more aware of its privacy implications and will, therefore, help teachers make informed decisions when choosing GenAI tools for their classes. Institutions must invest in empowering their educators with customized training on GenAI for education. This training does not need to be technical, but it must cover a few critical elements. It should (a) explain the mechanics of GenAI, in non-technical terms, (b) discuss the ethical boundaries and latest regulations that define the GenAI landscape, (c) outline the capabilities and limitations of GenAI tools, and (d) explore the role GenAI can play in their practice, preferably using the LAIK framework. Educators need this understanding to be more adept at effectively integrating GenAI tools into their classrooms. This knowledge will also empower educators to navigate many issues they or their students might face while using GenAI tools in class.

Conclusions, limitations and future research

There is a growing need to proactively integrate GenAI tools in classrooms in responsible and meaningful ways. This study proposes and discusses a practical framework that guides educators from all disciplines as they integrate GenAI tools in their classrooms. The LAIK framework is built on four stages where educators: (1) lay the foundation for GenAI in their classrooms, (2) assemble GenAI-friendly classes, (3) investigate and monitor the use of GenAI, and (4) keep themselves informed. The stages are iterative and build on and feed each other, allowing for an integration that accounts for the constantly evolving and developing GenAI landscape.

The framework is designed for and has been tested in HE learning environments. More research can be done in different and unique learning contexts to identify elements of the framework that might need to be reconsidered or added to the framework to make it more robust and inclusive of different environments and learning needs. Similarly, researchers and educators specializing in K-12 education may find the framework applicable, but further research is necessary to ensure its relevance and effectiveness for K-12 learning environments.

Additionally, while the LAIK framework lists a good number of activities to consider when utilizing GenAI tools for learning, it is important to bear in mind that there are possibly more ways to utilize GenAI tools as the technology becomes more advanced and more features are added. We invite educators and researchers to expand the framework and add more possibilities and ways to actively and critically engage students with GenAI in the classroom.

Finally, the framework does not include the important step of choosing the right or most suitable GenAI tool; as previously discussed, this was considered not possible at the time of writing the paper given the elaborate and unpredictable development trajectory for GenAI tools. More research can be conducted to account for the developing GenAI landscape and to identify a systemic approach to choosing the right tool(s) based on students' learning needs, the course's learning outcomes, the type of assessments involved, the institutions' guidelines, and the teacher's teaching style.

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Do my teachers treat me fairly? Examining the mediating effect of emotional support in the link between distributive justice and students' academic performance

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Academic performance;
academic success;
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emotional support;
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university students.

Abstract

The social psychology of justice has been a relatively under-researched topic in academic circles over the last few decades, especially in developing countries such as Tunisia. This paper endeavors to address this research gap by carrying out a survey on university students who are affiliated with the Faculty of Economics and Management of Nabeul (FSEGN), a distinguished public college situated in the governorate of Nabeul, Tunisia. The results obtained from the structural equation modeling (SEM) analysis using AMOS software version 23 showed that distributive justice and emotional support significantly and positively influence school grades and students' academic performance. Furthermore, it was found that emotional support partially mediates the link between distributive justice and university students' academic performance. The study emphasizes the crucial role of emotional support in the link between distributive justice and university students' academic performance. These results have many implications for higher education institutions, their teachers, and scholars on sustainable higher education.

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Introduction

University is the perfect environment for gaining knowledge, learning, and growing through research and innovative thinking. On the other hand, understanding the unwritten rules of university culture can be a difficult task for many students (Coulon, 1997). Students often view university as a place where they exchange knowledge rather than as a preparation for their future careers (Dezauzier, 2010). For young students, university life brings significant changes, such as transitioning to adulthood and developing autonomous learning skills and independence (De Clercq et al., 2020). Hence, students' support with empathy, kindness, and compassion would positively affect their psychological state and their academic performance in the long term (Tan, 2022; Day & Robinson, 2022; Ambe et al., 2024).

The phenomenon of the "freedom trap" (Sandrin & Gillet, 2016) is an unexpected and often, misunderstood freedom that can cause anguish, stress (Lazarus & Folkman, 1984), and anxiety (Matthews et al., 2000; Boujut & Bruchon-Schweitzer, 2007) among university students. In addition to the overwhelming workload (Boyer et al., 2001) and the expectation of performing well, students should learn how to self-regulate and manage their time effectively, often without the necessary preparation. University setting is also one of the environments where justice, kindness and injustice experiments occur (Fox & Aspland, 2024). The process of acquiring a certification from a university involves students completing coursework and assignments. At the same time, teachers evaluate their learning abilities, knowledge acquisition, and performance through various means, such as grades. These assessments serve as formal proof of university success or failure and are the sole means of meritocratic selection. Ultimately, the certification awarded to students enhances their university credentials and conditions the professional horizons of potential graduates.

This research deals with the ambiguous student reality, i.e., a student with little or no support is faced with three scenarios following the distribution of assessments (Boujut & Bruchon-Schweitzer, 2007): fair assessment, over-assessment, or under-assessment. However, according to the principle of "equal contribution, equal reward" and the idea of comparison aggregates as characterized by Jasso (1980, 1990, 1993), students may perceive an inequity even when assessed fairly due to a comparison with their referent. This senseless injustice may negatively affect a student's behavior and relationship with their teachers, adversely affecting their academic performance. This paper suggests that emotional support can effectively prevent students from feeling a sense of injustice and promote distributive justice. Even if a student has been fairly assessed compared to their referents, they may perceive it as unfair. This perception of unfairness may seem illogical because the teacher has been just in terms of distribution. However, this sense of injustice can negatively affect the student's behavior, potentially damaging their relationship with their teachers and adversely affecting their academic performance. In this context, we postulate that emotional support can prevent students from assigning meaning to distributive justice and discourage them from focusing on the equity ratio in their relationships with their referents.

Drawing on Gouldner's norm of reciprocity (1960) and Blau's theory of social exchange (1964), we argue that students who feel emotional support from their teachers are more likely to balance their exchange relationship by demonstrating better contributions. In other words, students who feel supported would be more emotionally attached to their teachers and university (Wayne et al., 2002), leading to better academic outcomes. After identifying the problem, the research question we seek to answer is how distributive justice and emotional support will affect the academic success of university students, both directly and indirectly. To conclude, this research aims to examine the impact of distributive justice on the academic performance of higher education students directly and indirectly through emotional support. In other words, it examines the mediation effect of emotional support given to students in the link between distributive justice by their teachers and university students' academic performance.

The theoretical framework and hypotheses building

Social support refers to the various means an individual can use to cope with life's ups and downs by being part of a social network (Bozzini & Tessier, 1985). Social support is classified into four types according to the typology put forward by House (1981): emotional, instrumental, informational, and evaluative. For this research, we will focus on emotional support. Cherba et al. (2019), in their survey addressing social support in everyday stressful situations, affirmed that social support is instrumental in providing assistance and comfort to individuals, mainly through the expression of emotional support. Barling et al. (1988) argued that emotional support behaviors consist of sympathy, listening, and caring (1988:142), while Millette and Boislard (2023) suggested that emotional support takes the form of comfort, encouragement, and the expression of positive feelings.

Numerous research studies have highlighted the positive influence of emotional support on the antecedents of academic success. For instance, emotional support has been found to enhance students' concentration and minimize distractibility (Brosch et al., 2013; Walburg et al., 2014), improve their cognitive memorization (Gijbels et al., 2008; Montagrin et al., 2013), and enhance their decision-making abilities (Audrin & Sander, 2018). Other studies have established that students who receive emotional support from their peers and teachers perform better academically than those who do not (Demetriou et al., 2000). Moreover, various surveys conducted in international education systems have found that students who receive emotional support from their teachers are more likely to be committed and self-determined to succeed academically (Brault-Labbé & Dubé, 2010). Similar findings were reported by Suldo and Huebner (2006), who found that American students who perceived emotional support from their teachers were satisfied with their lives. More recently, Mwenzi et al. (2023) conducted a study on well-being and satisfaction at the University of Kinshasa with a sample of 250 final-year graduate students and found that personal well-being at the university positively and significantly affected students' academic performance. A recent study by Ambe et al. (2024) found that both social and cognitive presences are significantly

associated with students' academic performance, including their critical thinking.

Enguta and Andia (2023) defined academic performance as assessing a student's progress based on their contributions. The outcome of this performance can be either success or failure. Success is achieved when the student meets the learning objectives and receives formal recognition such as a certificate, a certificate of achievement, or a diploma. On the other hand, failure occurs when the student fails to meet the educational and cognitive objectives and has to repeat the year to fulfil the necessary requirements for success. We suspect that Nabeul students' failure may be partly due to teachers' lack of emotional support. This amplifies students' sense of distributive injustice, leading them to legitimize their failures.

Various types of justice have been devised to elucidate the relationship between individuals and their organizations. These forms encompass distributive, procedural, and interactional justice, as articulated by Deutsch (1985), Greenberg (1990), and Tyler and Lind (1992). However, this article focuses explicitly on distributive justice, centering around the core question of justice: "Did I receive what I deserved?" (Adams, 1965). Distributive justice, within this context, is mainly concerned with the fair or unfair allocation of resources. It is important to note that when discussing equity in distributive justice, the predominant framework is the equity theory developed by Homans (1961) and Adams (1965).

Equity theory is derived from Blau's (1964) theory of social exchange, and Adams (1965) conceptualized it, inspired by the relative deprivation theory of Stouffer et al. (1949), Festinger's theory of cognitive dissonance (1957), Gouldner's theory of reciprocity (1960), and Homans' theory of distributive justice (1961), to prove the existence of relationships between perceptions of fairness and social comparison processes (DeVos, 2002). The theory focuses on the exchange of relationships between employees and employers, or in our case, between students and teachers. In a university context, a student's perception of fairness is not only based on the effort they put into their studies but also on their exchange relationship with their teacher. The referent is the person with whom the students compare themselves, assessing the ratio of their contributions and retributions to those of their referent to determine whether they have been judged fairly. Inadequate ratios result in a perception of inequity, which generates acute pressure, varying with the extent of the unfairness (Adams, 1965). According to Adams (1965), there are two ways to restore equity: by altering one's contributions or rewards or by taking on another referent while remaining in the same direct exchange relationship. Altering the referent's contributions and rewards is more practical than altering one's own, as cognitions towards the referent are less consolidated (Adams, 1965). Based on the above, we can state the next hypotheses to recognize the relationships between our constructs:

H1: Distributive justice positively affects students' academic performance

H2: Distributive justice positively affects emotional support

H3: Emotional support positively affects the academic performance of university students

H4: Emotional support mediates the link between procedural justice and university students' academic performance

Drawn on the above studies and research hypotheses, the research model was suggested (see Figure 1).

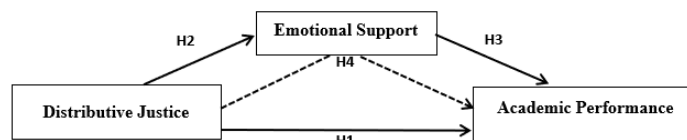


Figure 1: The research conceptual framework.

Methods

Sampling

We conducted a comprehensive literature review to create our research questionnaire and identified three measurement scales with outstanding psychometric qualities. We made some adjustments to the items to suit our research needs. We chose Price and Mueller's (1986) six-item scale to measure distributive justice and used the seven-item Shakespeare-Finch & Obst (2011) scale for emotional support. Moreover, we employed Chen et al.'s (2009) four-item academic performance scale. Initially, we self-distributed the questionnaire to 200 male and female students from all specialities in the first, second, and third years at the Faculty of Economics and Management of Nabeul (FSEGN), a renowned public university located in the governorate of Nabeul, Tunisia, and belonging to the Carthage Rectorate. We were able to collect 179 questionnaires valid for analysis, with a response rate of 89.50%, with 76% female and 33% male respondents. All items were measured using a 5-point Likert-type scale (where 1 equals "strongly disagree" and 5 equals "strongly agree"). The results showed that the minimum and maximum values of the questionnaire items ranged from 1 to 5. The averages ranged from 2.28 to 3.33, with standard deviation values ranging from 1.185 to 1.404 indicating that the responses are not condensed around the mean value.

Choice of measurement scales

Choosing appropriate scale items is a challenging task that has an important role in confirming the smooth progress of the study. The reliability and validity of the chosen items are directly proportional to the richness and significance of the information they provide. In this section, we present the measurement scales specific to the constructs that are being researched (see Table 1). All the items have been revised to suit our research requirements. Our questionnaire contains seven items based on the scale developed by Shakespeare-Finch & Obst (2011). The scale is considered the most appropriate and will be presented in the following format: respondents were asked to specify their level of agreement with the proposals by selecting the box that best represents

their response, as shown in (Appendix 1: The research instrument).

Table 1: Measurement scale used in the study.

Variables	Items	Reference
Emotional support	7	Shakespeare-Finch & Obst (2011)
Distributive Justice	6	Price and Mueller (1986)
Academic performance	4	Chen et al., (2009)

To measure distributive justice, we will use the measurement scale proposed by Price and Mueller (1986). This scale is capable of estimating the extent of distributive justice felt by students when they have their assessments and/or grades. It will be included in our questionnaire (see Appendix 1: The research instrument). For the academic performance variable, we chose the academic performance scale developed by Chen et al. (2009), a scale with notable psychometric qualities. It will be presented in (see Appendix 1: The research instrument). In our research questionnaire, we will be using the five-point Likert scale. This scale has been proportioned to all the items in the questionnaire. Respondents must tick the box representing their degree of agreement or disagreement to indicate their preferences. The scale ranges from "strongly disagree" to "disagree," "indifferent," "agree," to "strongly agree". Table 1 shows the constructs of the study, their items and sources used in the study.

Data analysis

This study performed principal component analysis (PCA) with varimax rotation via SPSS software (v.23) for examining the data representation. Variables' unidimensionality "Emotional Support, Distributive Justice and Academic Performance", was ensured as a single component showing 66.044%, 60.894% and 76.975% correspondingly of the total variance explained. For all variables, the KMO index showed respective values of 0.805, 0.777 and 0.824 (see Appendix 2). Therefore, the PCA findings confirmed that our factors suit factor analysis. Cronbach's Alpha was adopted for analyzing the reliability of items, and the values were 0.828, 0.785 and 0.900 correspondingly, which are satisfactory according to Nunnally (1978), with the following values. Additionally, we were able to reject the null hypothesis (see Appendix 2). The PCA was used to purify our measurement scales, which contained some factors that were weakly linked to the main constructs (see Appendix 2). The eliminated items (E1, E3, E6, D9, D12) represented factor contributions of less than (0.4).

Findings

Factorization of items

Confirmatory factor analysis (CFA) was conducted to assess the fitness of the instrument adopted in the study gathering data. To report the CFA results, we undertook the following steps: First, absolute fit indices such as χ^2/df , which should be less than 5 (Pedhazur & Schmelkin, 1991), SRMR (less than 0.05), and RMSEA (less than 0.08 and preferably 0.05) are undertaken to decide how accurately the

theoretical model reproduces the collected data (Roussel, 2005). Next, incremental indices such as NFI, TLI, and CFI are used to determine how well the examined model fits when compared to a more referenced model. The threshold value for these indices is 0.90 (Bentler & Bonett, 1980). Then, we used the normalized χ^2 .

The results of first-order (Table 2 and Figure 2) CFA were found to show the fitness of the data. The χ^2 reported that its degree of freedom χ^2/df was 1.702, which was acceptable as it is blowing 3. Additionally, the RMSEA value was 0.063, indicating that the results were acceptable. Other values such as "NFI" (0.950), "TLI" (0.907), and "CFI" (0.930) indicated excellent fit as suggested by Roussel (2002). The results of our Skewness and Kurtosis confirm that the data are normally distributed, and all the variables followed the normal law (Table 2) as proposed by Kline (2015).

Table 2: Descriptive statistics.

Items	Min	Max	M	SD	Skewness	Kurtosis
<i>Emotional Support</i>						
E2	1	5	3.25	1.369	-0.318	-1.242
E4	1	5	3.01	1.404	-0.109	-1.413
E5	1	5	3.18	1.384	-0.272	-1.305
E7	1	5	3.19	1.385	-0.218	-1.323
<i>Distributive Justice</i>						
D8	1	5	3.33	1.184	-0.439	-0.860
D10	1	5	3.31	1.185	-0.494	-0.892
D11	1	5	3.30	1.221	-0.585	-0.786
D13	1	5	3.21	1.227	-0.432	-0.963
<i>Academic Performance</i>						
P14	1	5	2.37	1.281	.616	-0.763
P15	1	5	2.28	1.245	.885	-0.201
P16	1	5	2.37	1.254	.730	-0.488
P17	1	5	2.37	1.315	.687	-0.724

Model fit: " $\chi^2(50, N = 179) = 85.108, p < 0.001$, normed $\chi^2 = 1.702$, RMSEA = 0.063, SRMR = 0.0643, CFI = 0.930, TLI = 0.907, NFI = 0.950, PCFI = 0.704 and PNFI = 0.644".

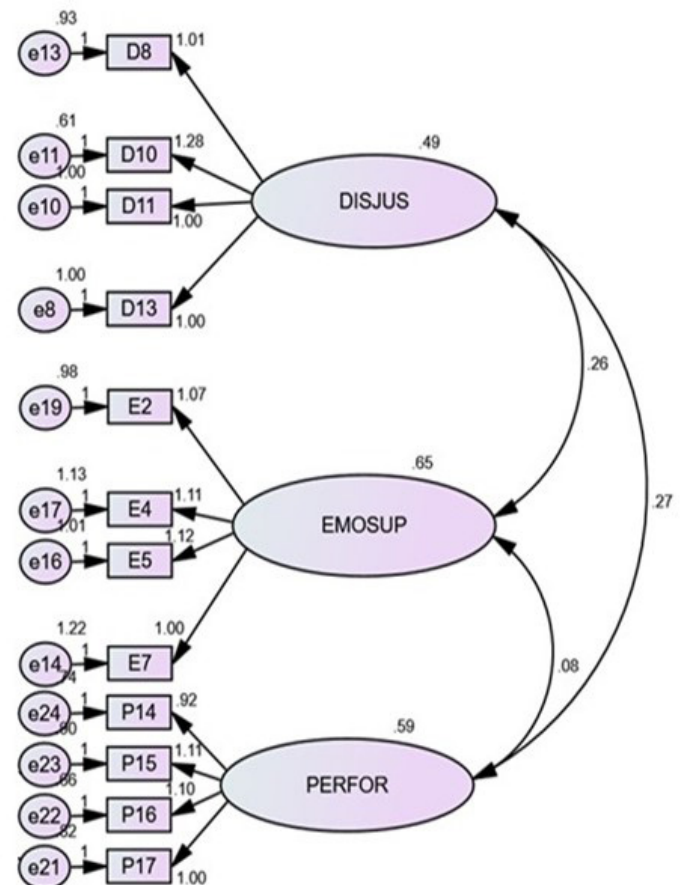


Figure 2: The unstandardized first-order model.

Convergent validity and discriminant validity of measures

We adopted convergent validity to check the correlation between the constructs. For this, we checked the composite reliability (CR), which should be firmly above 0.7, and the average variance extracted (AVE), which should be firmly above 0.5. The findings indicated a verification of all variables (Table 3), as suggested by Joreskog (1988). We also examined discriminant validity. In doing so, we verified whether the square root of the AVE of every item is firmly greater than their relationships with other constructs. The findings (Table 3) prove that discriminant validity was confirmed for all constructs.

Table 3: Convergent and discriminant validity.

Items	S. L ¹	CR ²	AVE ³	MSV ⁴	ASV ⁵	1	2	3
1- Emotional support ($\alpha = 0.828$)		.864	.614	.186	.140	.783		
E2	.832							
E4	.745							
E5	.761							
E7	.794							
2- Distributive justice ($\alpha = 0.785$)		.894	.680	.186	.148	.309**	.824	
D8	.864							
D10	.769							
D11	.825							
D13	.837							
3- Academic performance ($\alpha = 0.900$)		.853	.593	.110	.102	.432**	.333**	.770
P14	.755							
P15	.769							
P16	.801							
P17	.754							

Moreover, the AVE scores for emotional support (0.614), distributive justice (0.680), and academic performance (0.593) significantly surpass the maximum shared variances (MSV) and average shared variances (ASV) of each variable, giving additional evidence of discriminant validity (Hair et al., 2010). The MSV and ASV values are taken from correlation (see Table 4). Additionally, the inter-correlation scores for each construct must not exceed the values of the diagonal, which indicate the square roots of the AVE specific to each factor (refer to bold values in Table 3).

Table 4: The correlation results.

		Distributive justice	Academic performance	Emotion support
Distributive justice	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	179		
Academic performance	Pearson Correlation	.309**	1	
	Sig. (2-tailed)	.000		
	N	179	179	
Emotion support	Pearson Correlation	.432**	.333**	1
	Sig. (2-tailed)	.000	.000	
	N	179	179	179

** Correlation is significant at the 0.01 level (2-tailed).

SEM findings

Once the measures' validity and reliability have been ensured, SEM is performed to verify the influence of distributive justice on academic performance through emotional support. The results obtained from the study showed the fitness of the data (Table 5). The results showed

that χ^2 compared to its degree of freedom χ^2/ddl (1.428), which was acceptable when the χ^2/ddl ratio is less than 3, as Jöreskog and Sörbom (1994) recommended. Additionally, the RMSEA index is equal to 0.049, which indicates a satisfactory adjustment (Didellon & Valette-Florence, 1995). The indices "IFI = 0.978, NFI = 0.930, TLI = 0.971, and CFI = 0.978" authenticate the values accepted by the literature showing a good fitness of the data. The standardized RMR, SRMR=0.0560, is excellent since it is very close to zero. The findings showed significant and positive relationships (Table 5, Figure 3). More specifically, distributive justice has a significant and positive effect on academic performance ($\beta = 0.240$, $p < 0.05$) and emotional support ($\beta = 0.50$, $p < 0.001$), which in turn significantly and positively influence academic performance ($\beta = 0.23$, $p < 0.05$).

Table 5: Structural model results with standardized estimates.

Results		β	T value	P	R ²	Hypothesis results
H1	DISTRIBJUSTICE → ACAPERFORMANCE	0.239	2.355	.019		Supported
H2	DISTRIBJUSTICE → EMOSUPPORT	0.503	4.802	***		Supported
H3	EMOSUPPROT → ACAPERFORMANCE	0.232	2.326	.020		Supported
ACAPERFORMANCE						.144
Model fit: " χ^2 (50, N = 179) = 71.401 $p < 0.001$, normed $\chi^2 = 1.428$, RMSEA = 0.049, SRMR = 0.0560, CFI = 0.978, TLI = 0.971, NFI = 0.930, PCFI = 0.741 and PNFI = 0.705)". *** Relationship is significant at the 0.001 level.						

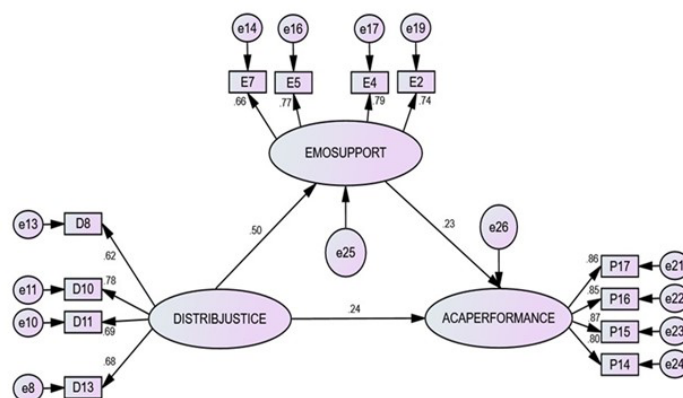


Figure 3: The structural model.

Furthermore, the robustness of the structural model is more substantiated by the significant coefficient of the value ($R^2 = 0.144$) (Table 5). In this study, academic performance is explained by distributive justice and emotional support using the structural model. In fact, we can explain approximately 14.4% of the variance in academic performance by using emotional support and distributive justice. To examine the mediating effect of emotional support that links distributive justice to academic performance, we used Baron and Kenny's (1986) approach. This process includes some tests. Firstly, an examination of the link between distributive justice and academic performance has to be significant to express the presence of a mediation. Distributive justice was found to have a significant positive influence on academic performance ($\beta = 0.239$, $p < 0.05$). The Student T equal was to $4.315 \geq 1.96$; $p = 0.001$). Secondly, we should ensure that distributive justice significantly affects the mediator "emotional support" by considering it as an exogenous variable in a regression analysis of emotional support on distributive justice (with $\beta = 0.432$ and a Student T equal to $6.372 \geq 1.96$; $p = 0.001$). The latter has a significant and positive influence on emotional support ($\beta = 0.503$, $p < 0.001$).

¹SL = Standard loading from the first-order model

²CR = Composite Reliability

³AVE = Average Variance Extracted

⁴MSV = Maximum Shared Value

⁵ASV = Average Shared Value

Thirdly, we need to confirm that the relationship between the mediator and academic performance is significant. Emotional support has a significant positive influence on academic performance ($\beta = 0.232$, $p < 0.05$). Here, we also make a regression of academic performance on both emotional support and distributive justice. Controlling the latter, the relationship between emotional support and academic performance should continue to be significant (with $\beta = 0.185$ and a Student T equal $2.619 \geq 1.96$; $p = 0.001$). Thus, the third step is respected.

Finally, to examine whether there is a partial or full effect of emotional support, we examined the direct and indirect links between distributive justice and academic performance. The link was positive and significant even when the mediator variable is considered, as seen in Table 6 of how distributive justice affects academic performance through emotional support ($\beta = 0.158$, with $p = 0.016 < 0.05$). Therefore, we could conclude that emotional support partially mediates the links between distributive justice and academic performance (see Table 6).

Table 6: Mediation type.

Parameter	β	Lower	Upper	P	Mediation
H4-DISTRIBJUSTICE → ACAPERFORMANCE Through EMOSUPPROT	0.158	0.061	0.316	0.016	0.016<0.05 Partial Mediation

Discussion

This research examined the direct influence of distributive justice by teachers on university students’ academic performance using a sample of students from FSEG Nabeul, Tunisia, as well as the indirect effect on this relationship through emotional support from their faculty, family and peers. The research involved a representative sample of 179 students of all genders (67% female, 33% male) enrolled in first, second, and third-year bachelor’s degree programs across all majors. A Statistical Software Package for Social Sciences (SPSS) version 23 was used for descriptive data analysis, PCA and consequent purification of the scales, while AMOS version 23 was used for SEM analysis.

First, the results found a positive and significant relationship between distributive justice and university students’ academic performance. This means that students are more likely to achieve better academic performance when they perceive justice for their evaluation and grades. Students then would achieve their learning outcomes and achieve their expected grades. This is consistent with the findings of Dalbert (2000), who found that students who perceived distributive justice from their teachers achieved better results in core subjects. Furthermore, a study by Dalbert and Maes (2002) on a sample of 1,000 students provided clear evidence of a significant and positive association between teacher justice and student motivation to succeed.

Second, the study also found a positive and significant correlation between distributive justice and emotional support. This confirms that when students perceive distributive justice in their evaluation and grades, this positively affects their emotional support as they would feel emotionally supported by their teachers. This supports Tatar’s

(1998) qualitative study, which suggests that emotional support perceived by students towards their teachers was inherent to distributive justice by granting better grades, enjoyable activities, and a manageable workload. Similarly, Suldo et al. (2009) found that fairness was positively correlated with perceived emotional support from teachers in their quantitative and qualitative research on a sample of 401 students. Students living in a fair environment, free from injustice and discrimination in terms of treatment or distribution, are more likely to trust their teachers and believe in their emotional support.

Third, the study also established a positive and significant relationship between emotional support and academic performance. When students are emotionally supported by their network and their teachers, this enhances their academic performance, including their learning outcomes and grades. This is consistent with the findings of Malecki and Demaray (2003), who demonstrated that emotional support significantly influences teachers’ social skills and academic competence based on their empirical study comparing four types of support - emotional, instrumental, evaluative, and informational. Constructive relationships between teacher and student refer to the degree to which students feel respected, supported, and valued by their teachers (Doll et al., 2004). Students with positive links with their teachers are more likely to be involved in their studies, leading to better academic performance (Ladd & Burgess, 2001). This also supports Ambe et al. (2024) findings that students’ evaluation of their social presence is associated with their academic performance.

Fourth, regarding the nature of mediation, particularly that of emotional support, the results found that the link between distributive justice and academic performance remained significant even after the introduction of emotional support as a mediator. Therefore, it was concluded that emotions partially mediate the relationship between distributive justice and university students’ academic performance. The findings confirm the significant role of emotional support in controlling the link between distributive justice and university students’ academic performance, which deserves more attention from teachers, families and university administrators, as will be discussed in the implications section.

Implications of the study

Drawing on the results revealed by this research, we propose some important implications for faculty and decision-makers at higher education institutions. Our study demonstrates that distributive justice for teachers is essential for students’ emotional support and academic performance. It is, therefore, important that university teachers ensure that their students perceive distributive justice. Students would perceive this when their teachers judge them fairly for the work they did and for the effort they put in their work. When students perceive this, they would feel emotionally supported. In addition, our findings suggest that teacher fairness towards students, subjective and dependent on individual personalities, should be complemented with emotional support. This research showed that emotional

support softens students' dissatisfaction with perceived injustices, enabling them to ignore the favorable or unfavorable character of the distribution they have received and positively affect their university students' academic performance. Therefore, teachers should provide their students with a classroom climate where the spirit of fairness reigns, creating psychological security, well-being, and added value in terms of learning, which form the foundations for greater academic success. Based upon our research findings, we strongly encourage teachers in Tunisian higher education institutions and other institutions worldwide to provide iterative 360° feedback to their students, with anonymous evaluations as a preventive measure. This guarantees the veracity of responses and enables students to express their concerns in the classroom freely or the shortcomings observed in their teachers' behavior without fear of potential reprisals. In addition, we encourage teachers to apply emotional support to their students and maintain a kind environment to ensure the positive academic performance of their students. Support from families and peers is important for students, especially in societies like Tunisia, where people are socially affected by their network (Gharbi et al., 2022; Khan et al., 2022).

The theoretical contribution of our research lies in organizational relationships, particularly in the context of higher education. Based on Gouldner's (1960) norm of reciprocity and Blau's (1964) theory of social exchange, we have concluded that emotional support can dissuade students from giving meaning to distributive justice or equity ratio declined by their relationship with their referent. Earlier research (Tan, 2022; Day & Robinson, 2022; Ambe et al., 2024) has recognized the value of kindness, heartware, social and cognitive presence for students' support and their academic performance. However, this study found that emotional support could affect the relationship between their perceptions of distributive justice by their teachers and their academic performance. We found that students who receive emotional support from their teachers, who take care of their well-being and value their contributions, would feel a deliberate obligation to balance the exchange relationship that binds them to their teachers by demonstrating a similar or even better contribution. To alleviate their sense of indebtedness, students will develop an unconditional attachment to their teachers and their university. This argument would open the door for scholars on future studies on the impact of emotional support given to students by their teachers, families and peers on other aspects such as quality of life and perceptions of their career.

Conclusion

The experience that students have in the university environment has a significant impact on their academic performance and future careers. The results of this research align with Taylor's (1962) research that fairness, particularly distributive justice, is a crucial characteristic of good teachers as perceived by university students. This means that students who feel that their teachers treat them fairly are more likely to perform well academically. Furthermore, this study has shown that emotional support positively affects university students' academic development at FSEG Nabeul,

Tunisia. We agree with previous research that emotional support helps improve concentration (Walburg et al., 2014), cognitive memorization (Montagrin et al., 2013), and critical thinking (Ambe et al., 2024) among university students. Our research showed that emotional support could change students' perceptions of inequity and would encourage them to accept their teachers' evaluations, which ultimately affect their academic performance. Hence, we suggest that university teachers should put more emphasis on emotional support to mitigate the negative perception by students about distributive injustice and ensure positive academic performance.

This research has some limitations, albeit these limitations are avenues for further studies. Firstly, the study sample was predominantly female (67%), which limits the generalization of the findings since this was undertaken at only one higher education institution. Further studies could be conducted on a sample representative of male and female participants. Secondly, the cross-sectional design used in the study may not provide a complete understanding of the relationship between distributive justice and academic performance. Therefore, further research could include other types of social support, such as instrumental, informational, and evaluative, to investigate their mediating effects on academic performance among higher education students.

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Appendices

Appendix 1: The research instrument.

The emotional support scale

- In my college:

E1: "There is someone I can talk to about the pressures in my life"
E2: "There is at least one person that I can share most things with"
E3: "When I am feeling down there is someone, I can lean on"
E4: "There is someone in my life I can get emotional support from"
E5: "There is at least one person that I feel I can trust"
E6: "There is someone in my life that makes me feel worthwhile"
E7: "I feel that I have a circle of people who value me"

The distributive justice scale:

As far as my grades and evaluations during tests and exams are concerned, my teachers judge me fairly:

D8: "For the work I did well"
D9: "In return for the stress caused by the difficulty of the course"
D10: "For the effort I put in"
D11: "In recognition of my seriousness"
D12: "In view of my responsibilities"
D13: "In view of my intellectual level"

The academic performance scale:

P14 I have improved my grades this academic year
P15 I have assimilated my entire course
P16 I achieved my learning objectives
P17 I have developed my skills in the specialty I want to do

Appendix 2

Table 1: KMO and Bartlett's test.

		Emotional Support)	Distributive Justice	Academic Performance
"Kaiser-Meyer-Olkin Measure of Sampling Adequacy"		0.805	0.777	0.824
Bartlett's Test of Sphericity	Approx. Chi-Square	255.664	194.628	437.570
	df	6	6	6
	Sig.	0.000	0.000	0.000

Table 2: Total variance explained.

	items	Initial Eigenvalues			Extraction Sums of Squared Loadings		
		Total	% of variance	% Cumulative	Total	% of variance	% Cumulative
Emotional Support	1	2.642	66.044	66.044	2.642	66.044	66.044
	2	.563	14.069	80.113			
	3	.430	10.754	90.867			
	4	.365	9.133	100.000			
Distributive Justice	1	2.436	60.894	60.894	2.436	60.894	60.894
	2	.625	15.623	76.518			
	3	.528	13.197	89.714			
	4	.411	10.286	100.000			
Academic Performance	1	3.079	76.975	76.975	3.079	76.975	76.975
	2	.382	9.556	86.530			
	3	.314	7.859	94.389			
	4	.224	5.611	100.000			

Table 3: Reliability statistics.

	Cronbach's Alpha	Number of Items
Emotional Support	0.828	4
Distributive Justice	0.785	4
Academic Performance	0.900	4



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Improving students' generative AI literacy: A single workshop can improve confidence and understanding

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Keywords

Academic skills development;
AI education;
AI literacy;
digital literacy;
generative artificial intelligence;
large language models;
learning and teaching AI.

Abstract

With the emergence of generative artificial intelligence (genAI), it has become increasingly important to ensure that students are equipped with AI literacy to use these tools effectively and appropriately. We ran a 90-minute, optional workshop for students to demonstrate how to use genAI in the assessment process appropriately. By the end of the workshop, participants felt significantly more confident in using genAI, had more intentions to use genAI, and understood the University's genAI policy better. The types of genAI use that participants envisioned shifted from general academic and life uses to specific, acceptable uses for learning. Students could identify some methods for assessing the output of genAI. However, it is suggested that this skill needs more development.

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Introduction

Large language models (LLMs), like ChatGPT and other forms of generative artificial intelligence (genAI), represent a significant shift in the field of artificial intelligence and are transformative for education as a whole (Rudolph et al., 2024). Models like GPT are capable of processing data in its original, unaltered state, making it possible to mine unstructured data like raw text, images, sounds and videos effectively, giving it the ability to generate more coherent and contextually accurate text, from providing personal relationship advice to creating entire research articles (Dwivedi et al., 2023).

GenAI tools are ethically dubious in both design and application. To list just a few ethical issues with AI design, LLMs are frequently trained on materials without the creator's permission, hallucinate incorrect information, reinforce societal biases, encourage technology monopolies, have high environmental impacts, and have limited privacy protections for users (reviewed in Rudolph et al., 2024). AI tools can also be deliberately applied in unethical ways, such as producing deepfakes (e.g. Roe & Perkins, 2024), plagiarising assignments (Kumar et al., 2024), and fabricating research (Elali & Rachid, 2023). Nevertheless, outright banning of AI tools is increasingly difficult to enforce (e.g. Chaka, 2024; Hassoulas et al., 2023; Weber-Wulff et al., 2023) and undesirable according to university regulators (e.g. Lodge et al., 2023). The efficiency of genAI tools will likely see them becoming ubiquitous in our personal and work lives, and our preparedness for the impact this will have on employment, teaching, learning, and academic research will determine how successful we will be at navigating the advancing world of AI (Farrelly & Baker, 2023). Academic institutions particularly play a pivotal role in equipping students and staff with practical digital and AI literacy skills to ensure that the use of these genAI tools aligns with the broader educational mission of integrity that fosters good practice and ethical and responsible use (Romero-Rodríguez et al., 2023). Graduates will be expected to effectively prompt, interrogate, and influence AI output, especially as entry-level graduate tasks will likely be replaced with technology (Waring, 2024).

Research shows that a lack of adequate functional digital literacy training affects the academic success of higher education students, impacting their learning performance, achievements, self-efficacy, attitude, and motivation (Cabero-Almenara et al., 2023; Chan & Hu, 2023; Morgan et al., 2022). The Tertiary Education Quality and Standards Agency of Australia (TEQSA) (Lodge et al., 2023) and other international bodies, like UNESCO (Sabzalieva & Valentini, 2023), emphasise that the explicit teaching of digital literacy skills, like searching, evaluating sources, preparing targeted prompts for genAI and critiquing its output will improve students' critical thinking skills and confidence. Early research into the consequences of using genAI at university by Abbas et al. (2024) suggests that it may lead to procrastination and a poorer GPA. However, this study only asked if students had used ChatGPT and did not look at how it was used. Students who are confident in their capabilities tend to engage in a deep learning approach, relying on meaningful ways of learning that focus on understanding and integrating ideas,

leading to better utilisation and engagement with genAI (Chan & Hu, 2023; Duong et al., 2023). Yilmaz and Yilmaz (2023) found that students who received training in effective genAI use had positive learning outcomes.

Surveys conducted at different institutions have uncovered different rates of genAI usage. For example, at the start of 2023, less than 20% of students were using genAI in an Australian study (Kelly et al., 2023), with later surveys increasing to approximately 40% of students in Asian and African countries (Ahmad et al., 2024), half of the students sampled in India (Biri et al., 2023), 67% in Hong Kong (Chan & Hu, 2023), and reaching a high of about 90% in Indonesia (Malik et al., 2023). Many factors can influence the proportion of students using genAI tools, including age and discipline (Chan & Lee, 2023; Kelly et al., 2023). While most students seem to be generally open to the idea of using genAI tools and perceive many benefits such as timesaving, personalised feedback, and increased motivation (Caratiquit & Caratiquit, 2023; Chan & Hu, 2023; Idroes et al., 2023; Malik et al., 2023), they also have many concerns, including equity, privacy, and accuracy (Chan, 2023a; Chan & Hu, 2023; Malik et al., 2023). The best predictors of genAI tool use appear to be perceived ease of use, social influences, habit, performance expectancy, and a supportive environment (Strzelecki & ElArabawy, 2024; Wang et al., 2023). The main barriers for students considering using genAI appear to be a low level of knowledge about how to use the tools (Biri et al., 2023; Chan, 2023a) and fear of committing academic misconduct (Chan, 2023b; Chan & Hu, 2023; Prather et al., 2023).

Multiple surveys found that students are worried about accidentally plagiarising or falling afoul of academic misconduct rules if they use genAI tools (Chan, 2023a; Chan & Hu, 2023). This is despite students having a good sense of what constitutes genAI plagiarism (also known as AI-giarism) (Chan, 2023b). Chan (2023b) found that although students had a strong sense of a continuum of genAI use from acceptable to unacceptable, scenarios that involved co-writing with genAI tools fell into the middle ground. They suggest that the ambivalence from students results from a lack of clear university policies and guidelines on what AI-giarism is and what constitutes ethical use. This is perhaps unsurprising given that less than half of the top 50 ranked universities have publicly available guidelines on genAI use (Moorhouse et al., 2023). Students want their university's policies to be very clear about what is and is not considered misconduct when it comes to genAI tool use (Chan, 2023a).

There is a strong correlation between student's self-rated knowledge of genAI and their use of genAI tools (Chan & Hu, 2023; Kelly et al., 2023), even when students have an otherwise positive attitude towards genAI (Biri et al., 2023). The traditional media coverage of genAI tools tended to be negative and focused on the academic integrity risks (Sullivan et al., 2023), while on Tiktok, the coverage is more promotional and positive but lacks criticality (Haensch et al., 2023). There is a need for more support, training and educational interventions at universities to support students to improve their genAI literacy knowledge and skills (Biri et al., 2023; Chan, 2023a; Moorhouse et al., 2023). It is important that this training is specific to genAI literacy, as general computer literacy may not necessarily automatically

translate to genAI use. For example, in Prather et al.'s early 2023 international survey of primarily computer science students, approximately 40% had not attempted to use genAI in their courses, and Hou et al.'s (2024) study of computing students found that those who had less experience were also less trusting of genAI tools.

Several studies have started to explore the effectiveness of training in genAI literacy. Kong et al. (2021) found that a diverse group of university students who completed a 7-hour course in AI had improved AI literacy and felt more empowered to use AI in their studies and life, even if they had no prior programming experience. Yilmaz and Yilmaz (2023) found that students who had genAI training embedded into their undergraduate programming course over five weeks significantly improved on survey measures for computational thinking, self-efficacy and motivation. Similarly, Korte et al. (2024) found that students who attended five hours of online AI literacy lectures improved their understanding of AI and felt more confident using it in their everyday lives. Theophilou et al. (2023) found that just two interactive lectures on genAI for high school students were enough to reduce their fears about genAI and improve their prompting skills. Many universities and academic skills centres are creating resources and training to develop students' AI literacies. However, to date, little evaluation shows whether these are effective, particularly for short interventions.

In this study, we present the evaluation of a single 90-minute, optional workshop on genAI for university students. The workshop demonstrated how to appropriately use genAI in the assessment process, with the aim of providing students with the necessary digital literacy skills to increase their confidence in using these tools and to support their understanding of the University's policy on genAI use.

Methods

Context

This study took place at a mid-sized Australian university. Although we did not collect demographic data from students who participated in the study, the university's student population is mostly part-time (63%), undergraduate (61%), and female (63%), with an appreciable portion of fully online (23%) and international students (21%). The disciplinary areas from the smallest to the largest are Education, Arts and Humanities (including Psychology and Counselling), Nursing and Midwifery, Medical and Health Sciences, Business and Law, Science (including Cybersecurity), Engineering and Performing Arts (Edith Cowan University, 2023). Early in 2023, the university announced a policy that genAI was allowed for learning purposes as long as it was correctly acknowledged at the point of assignment submission. Students were discouraged from copy-pasting or directly quoting genAI output, but information was provided on how to cite the tool if they wished to do so correctly. This information was communicated in the first half of 2023 through all-student emails and accompanied by a Library website.

Workshop development

The workshop was developed by the authors, who are a collaborative team of learning advisers and librarians. The librarians designed the sections on digital literacy and information searching, while the learning advisers created the sections on improving writing, editing, and academic integrity. The workshop was run as part of a broader, ongoing workshop programme that is available for students to upskill in information literacy and academic skills.

The workshop began by introducing the concepts of genAI and prompt engineering, followed by the assignment writing process. At each stage of the process, we explained what students should and should not use genAI for in an assessment context and gave examples of specific prompts they can use to get their desired output. For example, for editing, we advised students not to get the tool to 'fix' their writing, which could lead to a breach of academic integrity, but rather to ask the tool to 'list' corrections that the student can then apply, and therefore maintain editorial control over their work. The workshop was piloted by a larger group of learning advisers, librarians, and student peer-learning staff. Minor revisions were made to content and flow based on their feedback.

Data collection

We ran four workshops, one on campus and three online, from June to September 2023. Throughout the workshop, we used Mentimeter to poll participants on their attitudes and understanding of genAI. Mentimeter was chosen because it creates an interactive and engaging experience for students while maintaining anonymity (Mayhew et al., 2020; Rudolph, 2018). Students were made aware that we would use their Mentimeter responses in a research project, both via email before the workshop and verbally at the start of the workshop. Workshop attendees who did not wish to be included in the research project could still participate by answering the questions in the Teams chat (for online sessions) or out loud (in the face-to-face session). The Mentimeter questions came in two forms: sliders, which allowed students to answer on a 5-point Likert scale, or text-entry questions, which allowed responses of up to three words. Mentimeter responses are completely anonymous, but students can see a summary of the responses as they are generated, appearing on the screen as a graph or word cloud. The full set of questions is provided in Supplementary File 1.

Data analysis

Participants' confidence in the use of AI, experience in the use of AI, and knowledge of Edith Cowan University's (ECU) 2023 Generative AI policy were measured using on-screen sliders equating to 5-point Likert scales pre- and post-workshop. The Likert scale questions were analysed in Microsoft Excel using descriptive statistics: t-tests for pre-post comparisons and ANOVA for between-group comparisons. As explained by Norman (2010), these statistics are robust and appropriate for ordinal data, even with non-normal distributions.

For the text entry questions, broad codes were created to categorise the data during analysis. The first and second authors both coded a subset of the data and then discussed discrepancies and refined the category descriptions to create a final coding sheet (see Appendix 2). Both coders then coded all of the data separately and resolved any remaining discrepancies together. The original categories were coded in agreement 70% of the time, which improved to 84% with the final coding sheet. Note that this type of coding is not truly qualitative thematic coding but rather follows the guidance of LaDonna et al. (2018) for analysing short, open-ended survey responses.

Results

Participants

Across the four workshops, we reached 171 students. Not all students participated in the Mentimeter, and not all those who participated answered every question. A total of 95 students answered at least one question in the Mentimeter poll, with individual questions ranging from a low of 52 to a high of 90 responses.

Repeated measures

Overall, 83 students responded to the pre-workshop questions, and 52 responded post-workshop. At the start of the workshop, students had a low level of confidence in their ability to use genAI ($M = 2.58$, $SD = 1.34$), which significantly increased by the end of the workshop ($M = 3.788$, $SD = 1.04$) $t(133) = 5.5672$, $p < 0.000$ (see Figure 1). Similarly, at the beginning of the workshop, students expressed that they lacked experience with genAI ($M = 2.29$, $SD = 1.26$), but at the end of the workshop had a higher level of intention to use it in the future ($M = 3.63$, $SD = 1.05$) $t(133) = 6.4138$, $p < 0.000$. Students felt they understood ECU's policy on genAI significantly better by the end of the workshop ($M = 2.51$, $SD = 1.28$ increased to $M = 4.37$, $SD = 0.79$); $t(133) = 9.3877$, $p < 0.000$.

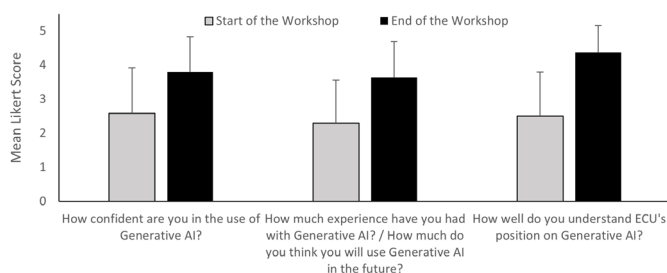


Figure 1. Confidence, experience and understanding of policy at the start and end of the workshop. Error bars represent standard deviation.

Students were also asked what they had and would use genAI for at the beginning and end of the workshop, respectively. A significant difference was observed comparing students pre- and post-responses ($X^2(9, N = 195) = 30.52$, $p < 0.001$). As can be seen in Figure 2, at the beginning of the

workshop, students' responses were primarily categorised as general academic or life-related, for example, "uni work" or "shopping lists". When asked what they planned to use genAI for following the workshop, there was an increase in the proportion of answers dealing with specific uses throughout the assessment process.

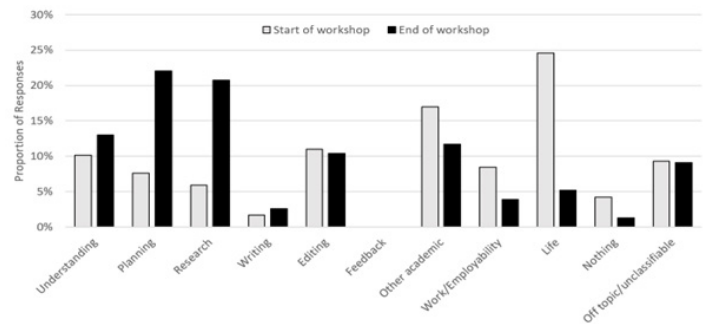


Figure 2. Participants' current use of genAI, compared to intended use after attending the workshop.

Single measures

At the start of the workshop, students were asked how much they expected various groups to use genAI in the future. No difference was observed between themselves ($M = 3.6$, $SD = 1.1$), their classmates ($M = 3.9$, $SD = 1.0$), their educational institution ($M = 3.5$, $SD = 1.1$), and their future employer ($M = 3.6$, $SD = 1.2$) $F(3,336) = 1.69$, $p > 0.05$. However, it should be noted that most students believed that genAI would be used in the future as all groups had a mean of 3.5 or higher on a five-point Likert scale.

Students were asked to rate a variety of behaviours from correct/ethical (Likert score of 1) to incorrect/unethical (Likert score of 5). Behaviours included copy-pasting from AI ($M = 4.7$, $SD = 1.0$), editing and adjusting AI output ($M = 3.2$, $SD = 1.3$), combining multiple AI responses ($M = 3.2$, $SD = 1.3$), getting feedback to improve from AI ($M = 2.4$, $SD = 1.2$), getting ideas from AI ($M = 2.4$, $SD = 1.4$), and not using any AI ($M = 1.4$, $SD = 1.1$). Overall, students clearly differentiated between AI uses they considered ethical and unethical ($F(5, 534) = 79.9$, $p < 0.001$). A post-hoc comparison using the Tukey HSD test indicated all differences are significant except for the conditions using AI with human input (editing and adjusting and using multiple prompts) and the conditions using AI as a study buddy (feedback to improve from AI and ideas from AI).

Towards the end of the workshop, after viewing a sample of AI-generated content and discussing its strengths and weaknesses, students were asked how they could evaluate the output of genAI. Answers were classified as fact-checking (cross-checking information against a different source), source checking (verifying the sources provided by the AI), language (proofreading, checking grammar), general (related words that do not indicate a clear action or process e.g. critical thinking, verify), or unrelated (e.g. random words such as 'math' or 'assignment') (Figure 3).

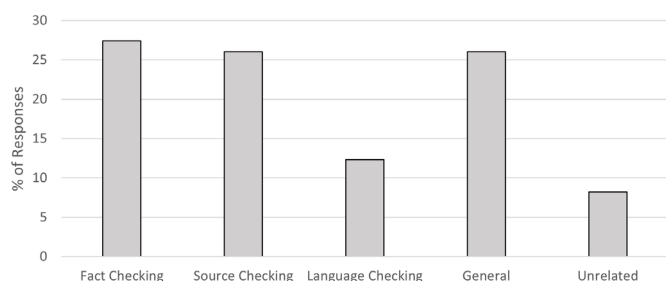


Figure 3. Suggestions from participants as to how the output of genAI tools can be assessed (n=73, participants could write up to three responses each).

Discussion

Students markedly improved their confidence using genAI, intention to use genAI, and understanding of university policy after a single, 90-minute workshop. The increase in understanding and intention to use reflects findings from evaluations of AI literacy training (Kong et al., 2021; Yilmaz & Yilmaz, 2023). However, in this case, our workshop was much shorter, which suggests that students do not need extensive training in order to see positive results. It should be noted that this research was being conducted at a time when genAI is still relatively new to most students (Chan & Hu, 2023; Kelly et al., 2023). Over time, we would expect an introductory workshop such as this one to show less dramatic improvements in confidence and use intentions, as students will be starting from a higher baseline of familiarity with genAI.

At the start of the workshop, students indicated that they were primarily using genAI for non-academic and general purposes. By the end of the workshop, they had more specific uses in mind, particularly for planning and creating research terms for their assessment. Given that a low level of experience using genAI is a barrier for students (Biri et al., 2023; Chan, 2023a), we suggest that this may be overcome with specific prompt templates that were provided for each part of the assignment process. The only part of the assignment process covered in the workshop that was not reflected in students' intentions was understanding and applying their assignment feedback. Although providing clear, useful feedback before the assessment due date has been identified as one of the potential strengths of genAI (e.g. Escalante et al., 2023; Oliveira et al., 2023), encouraging students to read and apply feedback from markers is more challenging (Winstone et al., 2021).

Although the workshop had overall positive results, it is concerning that more than half of the respondents could not identify a specific method they could use to verify output from a genAI tool. The tool used for the survey (Mentimeter) did limit open-ended response lengths, so students may have struggled to articulate a method in just a few words. Nevertheless, the results are consistent with Shibani's (2024) observation that most students have a shallow level of engagement with genAI tools, and Ding et al. (2023) found that students place a high level of trust in genAI output. Hou et al. (2024) observed that students tended to fall into two dichotomous camps: either treating genAI as an expert, or understanding that genAI is a tool that they take responsibility

for using; obviously, the goal of genAI literacy training is to shift students into the second camp. Genuinely critical evaluation and engagement with genAI tools will likely take longer to develop than a single workshop. Theophilou et al. (2023) observed that students improved their prompting strategies after a second workshop. However, another study by Sheese et al. (2024) found that over a 12-week introductory computer science course, students continued to use relatively simple prompts and did not effectively use the provided genAI tool (CodeHelp) to help deepen their understanding. Sheese et al. (2024) suggest that this could be avoided by providing genAI tools that provide feedback on the prompt itself before answering the student's query. Unfortunately, once students have developed their preferred process of engaging with genAI, it may be hard to change – as Bhatt and MacKenzie (2019) found, university students tend to develop ritualised processes of research and writing that lead to passive engagement with digital technologies.

Our participants displayed a similar understanding of AI-giarism to those of Chan (2023b) in that they clearly rated a low level of use as ethical and copy-pasting as unethical, but shared models of authorship with genAI tools sit in a grey middle area. This did not shift at the end of the workshop, despite the students reporting a greater understanding of the university policy on AI. Interestingly, Kerr (2024) reported that although a high proportion of their students stated that they did understand their university policy, upon further questioning, they believed it was completely banned, even though they were allowed to use it for learning purposes. In our participants, the shift in the planned use of genAI tools from life-related to helping plan and identify research strategies suggests that the students understood specific methods of using genAI for learning more clearly.

Participants in our study were voluntarily attending the genAI workshop as an extra-curricular in addition to their normal degree work. Adjunct workshops on various study skills and information literacies are commonly offered by universities, normally targeting new students to support them in adjusting to university expectations. While these workshops normally receive positive feedback from students (Ma, 2018) and improve grades and retention (Grills, 2017), attendance is often poor (Dougherty, 2022). We had good attendance at our genAI workshops relative to other academic skills workshops, but we still only directly reached less than one per cent of the entire student cohort. As central student support services, our workshop also focused on general information that is broadly relevant to learning skills and the assignment process. Discipline-specific, embedded content may reach more students and help them apply genAI more directly relevant to their programme of study (Kelly et al., 2023) and to create a more supportive environment for the development of AI literacy (Wang et al., 2023).

Limitations and future directions

In this research, we measured intentions rather than actual post-workshop behaviour. Although intentions are known to have a relatively strong relationship with behaviour, the correlation is by no means perfect (Webb & Sheeran, 2006), and longitudinal and qualitative studies would better

evidence behaviour change, such as the reflective journals used in Korte et al. (2024). There is also a possibility that students' responses were influenced by knowing that their responses would be visible to peers and used by researchers. Connors et al. (2019) found that even when survey responses are de-identified, the respondents experience a tension between wanting to give accurate answers to the researchers and wanting to give a socially desirable response.

Conclusion

As we continue to develop specific genAI workshops for students, we must evaluate the impact these workshops have on students' understanding of the policies, capabilities and limitations surrounding genAI, critical thinking skills, ethical usage, and their overall academic development. Our study highlights the impact of a brief genAI workshop on students' confidence, intention to use genAI, and understanding of university policies regarding AI usage. While previous literature has emphasised the importance of extensive AI literacy training, our findings suggest that even a single 90-minute workshop can yield substantial benefits. However, ongoing training may be required to improve students' ability to critically evaluate genAI output and reinforce digital literacy skills beyond introductory workshops. Universities need to include explicit teaching of AI literacy in their academic skills development practices and policies.

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Declaration

ChatGPT 3.5 was used to brainstorm titles, assist with the conclusion to this paper and grammar checking. The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Ethics approval was obtained from the Human Research Ethics Committee (2023-04561). Before the workshop, participants were informed about the study's purpose and provided with alternate methods of engagement if they did not want their data included.

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Appendices

Appendix A. Mentimeter questions

1. Three five-point sliding scale questions from 'No/Not at all' to 'Yes/Very'

How confident are you in the use of generative AI?

How much experience have you had with generative AI?

How well do you understand ECU's position on generative AI?

2. One open-ended question

What have you used generative AI for (Think of three things)

3. Six five-point sliding scale questions, from 'Good/Correct use of AI' to 'Bad/Incorrect use of AI'

John plugged a prompt into an AI copied and pasted the response & submitted it.

AI created the response. Jane read, edited, adjusted and submitted it.

John created multiple AI responses, used the best parts edited, and submitted.

Jane wrote the main ideas. AI generated a draft and offered feedback to improve.

John used the AI for ideas then wrote and submitted.

Jane wrote all the content without using AI.

4. Four five-point sliding scale questions, from 'Good/Correct use of AI' to 'Bad/Incorrect use of AI'

You

Your classmate

Your education institution

Your future employer

5. One open-ended question

What are some ways we can assess the output of generative AI? (Think of 3).

6. One open-ended question

What have you learnt in this workshop that you will use? (Think of 3 things).

7. Three five-point sliding scale questions from 'No/Not at all' to 'Yes/Very'

How confident are you in the use of generative AI?

How much do you think you will use generative AI in the future?

How well do you understand ECU's position on generative AI?

Appendix B. Codes for short-response answers: Before and after suggested codes

Code Name	Examples
Understanding	understanding concepts, help understanding the assignment topic, getting started, definitions, question breakdown
Planning	brainstorming, structure, generating ideas, planning, scheduling
Research	search terms, summarising, note taking, key words, alternative phrases
Writing	writing, expression, linking words
Editing	grammar checking, editing, proofreading
Feedback	I didn't see any, but leaving it in since it's one of the things mentioned
Other academic, including non-specific academic	exam prep, studying, 'assignment', time management, study schedules, programming, 'university', maths, coding, speeches
Work/Employability	emails, resumes, interviews
Life	fun, gym plans, recipes, art, advice, stories, experimenting or asking questions, writing letters
Nothing/No use	as a stand-alone term or 'haven't used it' or similar
Unclassifiable or unclear	'ethical use', 'drama'

Appendix C. Assessing GenAI Output

Code Name	Definition	Examples
Fact Checking	Student checks the facts in independent sources not provided by the AI	Fact check, cross reference, Google, Library, supporting evidence
Source Checking	Student checks the sources that are provided by the AI i.e. to make sure they exist or have the same information	Check references, find sources, read sources, checking the link, repeating the question to the same AI to check consistency
General Checking	Not clear if they are checking the fact or source specifically- the process of how to do so is not clear	Verify, check, legitimate, accuracy, credibility, critical
Language checking	Suggests proofreading or checking the tone	Grammar, proofread, tone
Unrelated	Answers that do not match the question asked	Project management, math, image processing

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Navigating media literacy in the AI era: Analyzing gaps in two classic media literacy books

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Keywords

AI;
artificial intelligence;
fake news;
generative artificial intelligence;
media literacy;
post-truth;
social media.

Abstract

The migration of the public into online platforms, the full mediatization of everyday life, the transformation of individuals into media entities via social media, the emergence of new forms of bottom-up censorship, and the involvement of non-human actors (such as AI) as media communicators and producers, have profoundly reshaped contemporary society. For these reasons, this study aims to analyze these pivotal transformations and assess how effectively they are addressed by two seminal media literacy texts, which have dominated the 21st century with media literacy editions, one by author James Potter and the other by Stanley Baran. Utilizing a problematization methodology, the research identifies gaps in these texts' coverage of contemporary media phenomena and concepts. These two classic texts lack concepts that are very influential in today's online life, such as mob censorship, social media literacy, post-truth and the role of AI in online communications. Moreover, integrating artificial intelligence into media production necessitates a practical approach to media literacy. This paper advocates for a holistic approach to media literacy education that equips learners with the skills needed to navigate and critically engage with today's media landscape effectively.

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Introduction

Previous studies in media literacy primarily focused on children. In the pre-Internet era, television was a central concern, with discussions ranging from its potential to incite violence, waste time, enhance eloquence, educate about society, and cultivate a “video child” phenomenon (Luke, 1990; Marsh, 2005; Sartori, 1997; Voort, 1986). With the advent of the Internet, attention has shifted to online activities, encompassing concerns such as time spent online, parental supervision, exposure to age-inappropriate content, purposes of internet usage, socialization, and media consumption patterns (Hasebrink & Hasebrink, 2013; Smahel et al., 2020). Moreover, issues like risks, cyberbullying (DeLara, 2016), digital rights of children (Hasebrink et al., 2008; Livingstone, 2016), and misinformation (Bowman & Cohen, 2019; Christ & De Abreu, 2020) have gained prominence.

Despite information and communication technologies now permeating every aspect of society (Livingstone, 2009) and fostering a participatory culture in digital media even among adults (Jenkins, 2009), media literacy remains predominantly child-centric. However, contemporary media influences extend beyond children. Today, media content is generated not only by professionals but by a global population exceeding 4.5 billion online users (Floridi, 2014). This era witnesses a shift in censorship dynamics – from traditional top-down control (Deutsch, 1968) to emerging forms of bottom-up censorship (Waisbord, 2023). Furthermore, media production involving artificial intelligence challenges the conventional structures of message dissemination, transforming the traditional government-media-public communication model into a horizontal distribution of information (Livingstone, 2015), even within digital platforms (van Dijck & de Waal, 2018).

The migration of the public online has shaped a generation of digital natives who grew up immersed in digital environments. This transition has also prompted politicians, marketers, journalists, and extremists alike to adapt their practices to the digital realm. These changes afford citizens unprecedented opportunities to engage with political and media spheres, although they also contend with competing narratives vying for attention and credibility (Vaccari & Valeriani, 2021). Public relations practitioners strategically navigate these digital landscapes (Batorski & Grzywińska, 2018; Roth-Cohen & Avidar, 2022), individuals managing personal brands (Gil, 2022), and state and non-state actors disseminating values and propaganda (Saliu, 2023, 2022a, 2022b, 2021).

In this diverse digital landscape, various themes – from medicine to identity, from war to personal relationships – play out online, reflecting a societal shift where media is not simply a tool but an environment where individuals live and interact (Deacon & Stanyer, 2014). The distinctiveness lies in the ability of myriad voices to address global audiences, marking a departure from traditional mass communication (Saliu, 2022b). Consequently, today, “we do not live with media but in media” (Deuze, 2023, p. 6).

These revolutionary transformations underscore that contemporary media diverges significantly from its historical precedents. Individuals on social media platforms now function as media entities themselves, contributing to a landscape where censorship operates horizontally and includes non-human actors such as artificial intelligence. This era has also ushered in a questioning of truth unprecedented in history, defining what some describe (d’Ancona, 2017; Fuller, 2018) as the post-truth era.

As a result, the aim of this paper is to evaluate the current media environment and compare it with insights found in contemporary media literacy textbooks. The main question of this paper is: what are the significant gaps in the two primary media literacy books concerning current developments in media? I employ the Foucauldian (1972, 1988) concept of problematization, which posits that issues arise from societal practices, to address this question. Subsequently, this paper will discuss the core concepts and contemporary issues that media literacy tackles, alongside the innovative ideas shaping present-day society, to critically assess these practices and the current state of the media ecosystem. Then, I will analyze the two primary media literacy books to determine if they adequately cover current trends and essential concepts that people need to be informed about. Finally, the paper will propose the integration of new concepts and phenomena into media literacy education.

Literature review

Media literacy and related concepts

Media and communication studies emerged early, consolidating as a new field of research (Lippman, 1922; Bernays, 1923; Lasswell, 1948; Katz et al., 1955, etc.). The concept of literacy evolved with media developments, starting from print media (such as newspapers and books) and traditional media (film, radio, television) to digital media like computers, tablets, the internet, and smartphones (Lee et al., 2015).

However, the concept of media literacy emerged later. At the National Conference on Media Literacy in 1992, a fundamental definition of media literacy emerged: the ability of citizens to access, analyze, and produce information with specific outcomes using a wide variety of forms (Aufderheide & Firestone, 1993; Silverblatt et al., 2014). In essence, media literacy fosters critical thinking skills in selecting media, interpreting received information (Silverblatt et al., 2014), and analyzing messages through questions of *how* and *why*, as well as examining media form, content, authorship, and ownership (Hobbs, 2017; 2010). Media literacy aims to enhance skills, especially among young people, in accessing, analyzing, evaluating, and creating media content (Livingstone, 2004), shedding light on “how we use, and are potentially used by, media” (Lewis, 2021, p. 6). Therefore, media literacy, the ability to critically access, analyze, evaluate, create, and share media, is considered instrumental in mitigating the negative impacts of media communication on users (Luo et al., 2022; Polizzi, 2020). The most comprehensive definition includes action, making individuals communicative actors. According to this

definition, “media literacy is the ability to access, analyze, evaluate, create, and act using all forms of communication” (National Association for Media Literacy Education, 2024; Uhls & Robb, 2017).

With the advent of the internet, the concept of new media emerged, encompassing a broad range of media production, distribution, and use; it is digital, interactive, hypertextual, virtual, and networked (Luan et al., 2023; Lister et al., 2008). Subsequently, new media literacy emerged as a concept aimed at understanding the new media environment in Web 2.0, focusing on accessing, analyzing, evaluating, critiquing, and producing media content (Luan et al., 2023; Lin et al., 2013). However, new media literacy quickly faced competition from other concepts.

Digital literacy and digital competence

With the widespread adoption of the internet and the rise of social media, another concept, digital literacy, emerged. The concept was first introduced by Gilster in 1997 (Saliu & Bicaj, 2022), defining it as “digital literacy is the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers” (Gilster, 1997, p. 1). This variant of media literacy encompasses both functional and critical skills and knowledge concerning the internet and social media (Hobbs, 2010; Polizzi, 2023). Over time, the concept has expanded to include media consumer education, particularly focusing on misinformation and fake news (McDougall et al., 2019; Johnston, 2020). Buckingham (2015), in his exploration of digital literacy in education, notes the shift of media literacy online and emphasizes the importance of educators possessing knowledge of online media to teach students effectively. According to Buckingham (2015), this knowledge should primarily encompass web literacy, game literacy, and digital media writing. Other studies regard digital literacy as a cognitive skill (Mishra et al., 2017) or “the ability to use information and communication technologies to find, understand, evaluate, create, and communicate digital information, an ability that requires both cognitive and technical skills” (American Library Association, 2013).

Digital literacy was formally recognized as a competence by the European Commission in 2006, becoming an integral part of lifelong learning initiatives and national educational policies for students, teachers, and citizens in general (Perez-Escoda et al., 2019). Digital competence encompasses a wide range of knowledge, skills, and attitudes essential for using digital technology (Instefjord & Munthe, 2017). The term covers proficiency and skills necessary for effectively using computers, related applications, and software in educational practice (Maderick et al., 2016). Typically, these skills fall under the broader category of hardware and software use (Tomczyk, 2021). However, digital competencies pertain more to pedagogical aspects, focusing on the knowledge, skills, and attitudes teachers bring to classroom practice rather than the general public’s media use. Recently, the general public has shifted toward using social media platforms.

Media Information Literacy (MIL)

When discussing media, our thoughts primarily turn to television, social media, etc., which predominantly deliver news, often fraught with issues or agendas. Objective information has always been a cornerstone of professional journalism, yet interests can distort reality, compromising the reliability of news, particularly with social media, where individuals – not just journalists – generate and disseminate news (Saliu et al., 2024, 2023). This phenomenon gave rise to the concept of information literacy, or news literacy. The increased use of the internet and social media has transformed how political information is produced and consumed (Cope & Flanagan, 2013). Being news literate entails navigating skills in social media, distinguishing credible news from misinformation, personal stories, and entertainment (Garrett, 2017). News literacy involves acquiring the knowledge and skills necessary to be a discerning and sceptical news consumer and understanding the relationship between journalists, news production, citizens, and democracy in evolving media landscapes (Vraga & Tully, 2021). Information literacy empowers citizens to access, evaluate, and effectively utilize political information (Ardèvol-Abreu et al., 2024).

Previously treated separately, media literacy and information literacy have increasingly converged due to shifts in the media environment, the growth of networked information, and the internet (Leaning, 2017). In 2017, UNESCO integrated these two concepts into Media and Information Literacy (MIL), defined as “an interrelated set of competencies that enable people to maximize the benefits and minimize the harms in the new information, digital, and communication environments” (Santos, 2024, p. 1). Similarly, in 2021, UNESCO stressed the importance of integrating MIL into curricula for educators and learners, not just for children, to equip citizens with critical thinking skills essential for democracy, especially amidst concerns over mediatization, social media, and pervasive misinformation (Lee, 2018).

Social media literacy

Social media, facilitating online communication, networking, and collaboration (Carr & Hayes, 2015; Russo et al., 2008), have significantly engaged individuals with each other and with media. These platforms allow users to create public profiles, connect with others, and explore different profiles (Vaccari & Valeriani, 2021). Engagement with social media involves understanding and knowledge about a topic or idea alongside emotions and identification with belonging (Johnston, 2018; Qu & Saffer, 2023). Social media’s self-centric nature, focusing on the individual rather than society, distinguishes it from traditional media (Cho et al., 2019). Consequently, social media have become integral to many people’s lives and exert a profound impact on society (Beckerle et al., 2021).

Social media have revolutionized media usage and societal impact, necessitating the development of social media literacy to manage the unprecedented levels of engagement seen in human society. Social media literacy refers to “the extent to which cognitive and affective

structures are present among users to ensure the risks of interactions with social media content are mitigated and the opportunities are maximized" (Schreurs & Vandenbosch, 2021, p. 321). Unlike media literacy, which analyzes the characteristics and specifics of each medium, social media literacy encompasses interactions between users and the medium, as well as among users themselves. In social media, messages are created and disseminated not only by the media but also by millions of individuals, fundamentally altering communication dynamics (Cho et al., 2024). Existing concepts of media education, however, often based on mass media functioning, differ from social media in various aspects (Cho et al., 2024), as the logic of traditional mass media evolves toward the logic of social media in contemporary times (Livingstone, 2015). Current concepts may inadequately address the detrimental effects of social media, particularly concerning misinformation (Wang et al., 2019; Cho et al., 2024). Emerging concepts stemming from media and communication research describe today's media environment but have yet to be fully integrated into media literacy texts.

New transformative concepts in media and communication

Deep mediatization

Recent media and communication research has generated a substantial body of literature that explores the evolving landscape of communication and media. Contemporary life is now heavily mediated, where everything from joy, sadness, beauty, and music to business dealings and even death is mediated through various forms (Deacon & Stanyer, 2014). Mediatization, broadly defined, "is a concept used to critically analyze the interrelation between changes in media and communications on one hand, and changes in culture and society on the other" (Couldry & Hepp, 2013, p. 197). With the advent of digital and social media, individuals contribute to data and algorithms. For instance, viewing a post on Facebook leads to subsequent posts tailored based on one's data, serving advertizing purposes. Thus, digitalization has fostered a new media environment that tailors to media consumer preferences, marking an advanced stage known as deep mediatization (Hepp, 2020). This stage signifies a profound integration where all aspects of our social world are intricately intertwined with digital media and their underlying infrastructures (Couldry & Hepp, 2017).

Fake news

Journalists have historically championed truth, but the advent of social media has empowered virtually anyone online to act as a journalist. Anyone can create a narrative supported by videos or photos and share it globally. This has led to a hyper-connected digital landscape with approximately 4.5 billion people online globally who share their hyperhistory (Floridi, 2014). However, not everyone online exercises responsibility, leading to the propagation of false stories. Fake news emerged prominently in 2016 as a social media phenomenon, although disinformation, misinformation,

and propaganda have long existed. What distinguishes this era is the proliferation of falsehoods disseminated not just by traditional media or political entities but by potentially millions of individuals and groups on social media platforms. "Fake news is intentionally and verifiably false, capable of misleading readers" (Allcott & Gentzkow, 2017, p. 213). Financial and ideological motivations are the primary drivers behind the creation of fake news (Tandoc et al., 2017). Fake news is strategically used by politicians globally to discredit unfavorable news outlets (Tandoc et al., 2019), delegitimize dissenting opinions, and undermine political opponents (Farkas & Schou, 2018). Therefore, "fake news is not an unintended consequence of social media, but a central part of social media business models and a key source of revenue" (Trittin-Ulbrich et al., 2021, p. 8).

Post-truth

Another contemporary concept, post-truth, is closely intertwined with fake news. The term gained prominence in 2016, characterized as the "post-truth era" (d'Ancona, 2017), and was Oxford Dictionaries' Word of the Year. Post-truth is defined as "relating to circumstances in which people respond more to feelings and beliefs than to facts. In this era of post-truth politics, it's easy to cherry-pick data and to reach any conclusion you like" (Oxford Dictionary, 2017). Post-truth is often understood as a situation in which people are inclined to accept claims based on their beliefs and emotions rather than on facts (d'Ancona, 2017), a tendency that implies a disregard for objective reality and allows falsehoods to be quickly replaced with alternative half-truths (Peters, 2018). This phenomenon of alternative facts in the online realm overlaps significantly with the proliferation of fake news (Allcott & Gentzkow, 2017). Post-truth is an important concept because it has to do with the truth and is related to everyday politics: when political lions play with fox strategies, even online (Fuller, 2018).

Mob censorship

In December 2023, Silvio Waisbord, a prominent scholar in media and communications, edited a special issue of *Digital Journalism*, focusing on mob censorship. He introduced the concept three years earlier (Waisbord, 2020), refining it in 2023. Mob censorship is orchestrated by online militants, occasionally with partisan, ideological, or governmental support, to harass, fabricate allegations against, and threaten journalists and news organizations using harmful rhetoric, legal measures, and physical violence. Such campaigns foster fear and self-censorship among journalists and silence critical voices by targeting them with attacks and insults on social media (Waisbord, 2023). This amplifies fear and self-censorship among journalists, effectively silencing dissenting voices. Throughout history, censorship has traditionally been imposed from the top (by governments) to the bottom (by the public). What is novel about modern censorship is its inversion: now, censorship is wielded from the bottom up by the public rather than governments.

Artificial Intelligence in media

Integrating Artificial Intelligence (AI) into media represents a revolutionary shift, enabling the automated production of thousands of news articles daily across numerous countries (Barrolleta & Sandoval-Martín, 2024; Munoriyarwa et al., 2023). AI technologies are extensively employed by major news organizations like the Associated Press, Los Angeles Times, The Washington Post, and Bloomberg, transforming news gathering, production, and distribution processes (Pavlik, 2023; Tandoc et al., 2020). This technological advancement necessitates interdisciplinary studies that fuse journalism with fields such as applied linguistics and narratology to effectively manage the vast amount of AI-generated content and its implications for media consumption (Barrolleta & Sandoval-Martín, 2024; Zhang et al., 2023).

These concepts highlight the evolving dynamics within media and communication landscapes, shaped by technological innovations and societal shifts. They underscore the critical need for updated frameworks in media literacy and scholarly inquiry to navigate and understand these complex phenomena in contemporary media environments.

Methodology

This paper employs a problematizing review methodology, which often diverges from conventional structures. The aim of problematization review is to reconceptualize existing perspectives and re-evaluate understandings of phenomena to challenge and reimagine current ways of thinking (Alvesson & Sandberg, 2020). Problematization is a central concept in Foucault's work, emphasizing scrutiny and the critical examination of societal phenomena, concepts, and theories (Weder, 2022; Foucault, 1988).

Alvesson and Sandberg (2011, 2020) introduced the problematization methodology, aiming to generate new research questions through a dialectical exploration of one's own perspective, alternative viewpoints, and specific literature domains, thereby challenging underlying assumptions (Alvesson & Sandberg, 2011). This approach "enables researchers to imagine how to rethink existing literature in ways that generate new and 'better' ways of thinking about specific phenomena" (Alvesson & Sandberg, 2020, p. 1290). Problematization involves introducing ambiguity or identifying unresolved issues (Weder et al., 2019). Central to the problematizing review is reflexivity, where researchers critically engage with selected texts, interpreting them within a specific context while considering diverse perspectives and alternative sources (Alvesson & Sandberg, 2020). Reflexivity enhances researchers' awareness of the complexities within communication or public relations contexts (Willis, 2019), revealing contradictions, dilemmas, and potentialities (Cunliffe, 2002).

The problematization review is primarily guided by the principles of "reflexivity, reading more broadly but selectively, not accumulating but problematizing" (Alvesson & Sandberg, 2020, p. 1290). In problematization, it is crucial to challenge assumptions rather than unquestioningly accept established

findings (Chatterjee & Davison, 2021, p. 228). Knowledge can be advanced by identifying gaps in the problematization of a social phenomenon, which is examined through theoretical frameworks and data analysis; in this context, data serve as "inspiration for critical dialogues between theoretical frameworks and empirical work" (Alvesson & Kärreman, 2007, p. 1265). According to Alvesson and Sandberg (2011), "research texts indicate something about how researchers develop research questions from existing theory and, under all circumstances, highlight the logic behind their claim to make a contribution to the scientific field" (p. 25). Authors engaged in a problematizing review, develop their own perspectives on the existing literature within their domain, critique established research traditions, and propose alternative viewpoints that may better elucidate phenomena (Chatterjee & Davison, 2021).

The problematizing review methodology encourages researchers to "rethink existing literature in ways that generate new and 'better' ways of thinking about specific phenomena" (Alvesson & Sandberg, 2020, p. 1290). It is a targeted way of identifying a phenomenon that requires a solution, such as in the financial literacy of citizens and in other literacy practices (Pettersson, 2022). While relatively novel, problematization is increasingly prevalent in management and organizational studies and has been effectively applied in various fields such as policy and politics (Bacchi, 2012), applied management, communication studies, public relations, and entrepreneurial communication (Goyanes, 2020; Gossel, 2022; Willis, 2019; Alvesson & Sandberg, 2020), as well as in studies examining the relationship between education and AI knowledge (Rahm, 2023).

In this paper, the lack of new media phenomena and concepts in the two most useful media literacy texts is problematized. Media and communication research has an abundant bibliographic and empirical corpus dealing with communication actors, the effect of the media, credibility, transformations as a result of information technology, journalism, public relations, advertizing and the effect of the message and the media, some of them which were mentioned above. Therefore, based on the dynamics and changes that have emerged as a result of the change in the media landscape, it is considered reasonable that: on the basis of the most current and most influential concepts for media consumers, to analyze the two books that have the most successive editions long term: James W. Potter's *Media literacy*. This book, published by Sage, reached its 10th edition in 2021 and has been in global use since the first edition in 2004, but also an earlier publication in 1998. It is the dominant reference for media literacy in this century.

The other book that also has a longer follow-up is Stanley Baran's *Introduction to mass communication. Media literacy and culture*, which, as of 2023, was in its 12th edition (published by McGraw-Hill). Unlike Potter's book, not all of Baran's editions have dealt with media literacy, because his earlier editions have focused on mass communication theories.

These two books have been analyzed by searching throughout their text if they deal with important concepts and with impact on the public and public users and which

concepts have been consolidated in recent years, such as fake news, post-truth, deep mediatization, mob censorship, AI in the field of media. Other publications were not considered because, according to platforms like Amazon, other media literacy books did not go beyond a second edition.

Potter's book is globally recognized as a leading resource in media literacy. Baran's work has also garnered significant attention, although earlier editions focused primarily on mass communication theories rather than media literacy. My analysis identifies whether these texts incorporate pivotal contemporary concepts that have gained prominence in recent years, such as fake news, post-truth, deep mediatization, social media literacy, mob censorship, and AI in media.

Results

Potter's Media literacy

Potter (2021) extensively covers various aspects of media literacy, beginning with different approaches and emphasizing the importance of understanding media effects, media development, and the economic perspectives of media industries. He delves into topics such as media ownership, which influences media objectivity and privacy concerns, and addresses issues like media violence and advertizing strategies. While Potter touches on fake news, providing practical tips for identification, his treatment of the subject remains basic, focusing on its history and criteria for identifying false information.

Potter discusses the concept of truth in media reporting but notably omits any mention of post-truth, which has emerged as a consequence of the proliferation of fake news. Despite addressing social media and its widespread use, he neglects to discuss social media literacy at all. Furthermore, Potter does not engage with the concept of censorship, a longstanding issue, nor does he acknowledge the emergence of mob censorship as a new form of online censorship. Additionally, Potter overlooks the concept of mediatization entirely, despite its consolidation in media studies for over a decade before the publication of his book. Given this omission, the concept of deep mediatization, which builds upon mediatization theories, is understandably absent from his work. Moreover, Potter fails to mention artificial intelligence, which plays an increasingly significant role in contemporary media landscapes.

Baran's Introduction to mass communication

Stanley Baran (2023) offers a comprehensive yet somewhat traditional module on mass communication. He explores media culture, media literacy, and various media forms such as newspapers, magazines, film, radio, television, mobile video, and the internet. Baran also discusses strategic communication, public relations, advertizing, and media effects. He addresses the concept of freedom of the press and expression, highlighting contemporary issues such as the implications of "excessive freedom" in blogging and online media.

Unlike Potter, Baran discusses mediatization but does not mention deep mediatization, which significantly impacts daily interactions on social media platforms. He does not reference post-truth despite mentioning sources that discuss the concept indirectly. Baran examines issues related to free press and censorship, including self-censorship concerning time and space constraints, but overlooks mob censorship or online crowd censorship. While he covers mediatization theories, Baran misses the opportunity to explore deep mediatization's substantial role in advertizing and other media domains.

Baran briefly touches upon social media literacy, acknowledging its importance for privacy protection and responsible internet use. Like Potter, Baran mentions artificial intelligence briefly, noting its ability to compose music but not exploring its broader implications in media and journalism.

In summary, while both Potter and Baran offer valuable insights into media literacy and communication, their works exhibit notable gaps in addressing emerging concepts such as deep mediatization, post-truth, mob censorship, and the profound impact of artificial intelligence on contemporary media environments. These omissions underscore the evolving nature of media studies and the ongoing need for updated frameworks and interdisciplinary approaches to understand and navigate the complexities of today's media landscape.

Discussion

Why are missing concepts so important to media literacy?

In the two books mentioned above, which have endured through multiple editions (one in its 12th edition in 2023, the other in its 10th edition in 2021), critical concepts that profoundly impact society are conspicuously absent. Notably absent is any discussion of social media literacy, despite social media now being the predominant arena for interpersonal communication, engaging approximately five billion people worldwide with their hyper-stories (Floridi, 2014). In this environment, the battle for attention takes precedence over the traditional notion of open media discourse. Both the form and content of information have undergone significant changes, reflecting a shift in communication within a vastly different media landscape where traditional values have also evolved (Saliu, 2024, 2023, 2018). However, most media literacy textbooks have remained unchanged.

Contrary to Baran's (2023) characterization of social media as a "virtual democracy" which reflects an outdated concept, Marichal (2012) suggests we are more accurately in a "Facebook democracy". This distinction is critical, as social media platforms have amplified the potential reach of fake news and, together with the rise of post-truth politics, present significant challenges to representative democracy (Chambers, 2021). Social media empowers populist demagogues by giving them a perceived majority voice, contrasting sharply with elite experts. As Umberto Eco aptly put it, "social media gives legions of idiots the same right to

“speak as a Nobel Prize winner” (Eco, 2015).

Studies on social media cannot afford to be homogeneous or passive in their analysis of messages or communications; they must encompass diverse socio-cultural perspectives to understand online behaviors fully (Livingstone, 2015). This is underscored by research indicating that Western cultures remain more reliant on traditional media sources compared to countries in Latin America and other regions where online media consumption outstrips traditional media use (Newman et al., 2022). Thus, the inclusion of social media literacy in media literacy texts is imperative.

Furthermore, the phenomenon of mob censorship warrants attention in these texts. While Baran (2023) discusses censorship, he overlooks mob censorship—a transformational force in society today. Traditionally, censorship was imposed top-down by monarchs, dictators, or authoritarian governments. Today, however, mob censorship operates bottom-up, as partisan groups and extremists on social media arrogate to themselves the authority to harass, intimidate, and silence journalists and critics with whom they disagree (Waisbord, 2023, 2020). This form of censorship aims to induce self-censorship among journalists, compelling them to weigh the potential consequences of covering certain stories against personal safety concerns for themselves and their families, as well as for colleagues (Waisbord, 2023).

In this environment, demagogic populists and elite experts hold contrasting views of reality, contributing to the rise of post-truth politics—an issue conspicuously absent from the works of both Baran (2023) and Potter (2021). Post-truth politics is characterized by a preference for emotional appeals over factual accuracy, a trend exacerbated by social media’s influence, where political strategies increasingly resemble the tactics of foxes playing among lions (Fuller, 2018). This trend not only undermines the credibility of elite experts but also threatens democracy itself (Waisbord, 2018).

Moreover, the absence of deep mediatization from these textbooks is noteworthy, considering its pervasive impact on daily life. Each time targeted advertisements appear repeatedly on social media or algorithms prioritize news items based on private conversations intercepted by smartphones, the effects of deep mediatization become apparent (Hepp, 2020).

The exclusion of artificial intelligence (AI) from these texts is somewhat understandable, given its recent emergence in media applications. AI is already reshaping media landscapes, with organizations deploying automated bots on social media platforms to generate content and interact with audiences (Oh & Ki, 2024). AI’s role extends beyond content creation to include ideation, newsgathering, distribution, and monetization, albeit with significant ethical implications (Deuze & Beckett, 2022).

The educational implications are clear: Media literacy in the AI era must be practical, not merely theoretical. Workshops that demonstrate appropriate AI use in educational settings are crucial, promoting AI literacy among students (Sullivan

et al., 2024), especially ChatGPT (Divino, 2024; Rudolph et al., 2023b; Sullivan et al., 2023). The introduction of ChatGPT for public use at the beginning of 2023 has created new challenges in education, particularly in higher education. Universities should not ignore these challenges if they wish to maintain public trust in educational institutions and have a genuine opportunity to achieve educational goals in the future (Popenici, 2023). This trust may be eroded if individuals are reluctant to rely on professionals who have not learned anything themselves but instead use AI, such as when people are hesitant to trust a bridge designed by an engineer who employed AI in its development (Popenici et al., 2023). Therefore, preparation for the labor market requires the integration of AI literacy and ethical decision-making skills, which balance technical expertise with critical thinking (Waring, 2024) in a highly dynamic world where various professions, including those in higher education, are at risk (Rudolph et al., 2023a).

A multimodal literacy pedagogical approach, integrating software applications and various social media platforms, is advocated to empower students as informed, confident, responsible, and active contributors in information consumption, creation, and distribution (O’Halloran et al., 2017).

In conclusion, the absence of critical concepts such as social media literacy, mob censorship, deep mediatization, post-truth, and artificial intelligence from prominent media literacy textbooks reflects a gap in understanding and preparing individuals to engage effectively in today’s media environment. Addressing these omissions is crucial for fostering media literacy that is relevant, comprehensive, and responsive to the complexities of contemporary media landscapes.

Conclusion

Textbooks on media literacy and corresponding curricula in educational settings should be grounded in current research in media and communication. However, two prominent media literacy books, despite their recent reissues, reveal significant gaps that fail to capture the expansive dynamics of media and information technologies today.

These transformations have fundamentally altered online media, where content now caters to public preferences rather than maintaining high standards of media production. While traditional media literacy focuses on analyzing the characteristics and roles of each medium in relation to the public, social media introduces a complex interaction among users and between users and non-professionals who shape and disseminate messages. This interaction extends further with the involvement of non-human entities that amplify the dissemination of messages exponentially.

In contrast to the traditional top-down flow of information (government-media-public), today’s media environment facilitates horizontal circulation where every individual functions as a media node, independently distributing text, photos, and audio-video content. The global connectivity of the public through social media platforms has created

a landscape where online natives and immigrants coexist, transforming all aspects of daily life into online interactions without the traditional filters of professionalism and ethical standards observed in traditional media. Consequently, this shift has compromised media message quality, eroded credibility, exacerbated extremism, and challenged truthfulness. Political actors strategically manipulate online platforms to silence dissent, mobilizing organized online armies (Waisbord, 2023) and leveraging non-human communicators to multiply their messages indefinitely. In this environment, emotional appeals often outweigh factual accuracy among audiences (Fuller, 2018; d'Ancona, 2017).

Therefore, it is imperative for media literacy textbooks to address today's media landscape comprehensively by incorporating concepts that capture these phenomena and societal transformations: deep mediatization, post-truth, social media literacy, mob censorship, and AI in media. These concepts are embedded daily in the lives of children, students, and adults, shaping their understanding and engagement with media. Textbooks must evolve beyond historical perspectives on traditional media to reflect the ongoing impact of these transformations on public discourse and societal norms. Media literacy, especially related to artificial intelligence, must transition from theoretical knowledge to practical training to equip individuals with the skills necessary to navigate and critically engage with evolving media environments effectively.

In essence, media literacy education should equip learners with current, practical insights relevant to their daily lives, ensuring they are prepared to navigate the complexities of contemporary media landscapes responsibly and ethically.

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On feedback from bots: Intelligence tests and teaching writing

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Abstract

One of the much-debated uses for AI, especially among writing instructors, is the potential for AI to take over the commenting and grading functions of teaching. In this paper, we describe the creation and use of AI for writing feedback in two separate but interconnected approaches: the use of the "Perfect Tutor" exercise in the classroom to teach students to conceptualize the components and priorities we bring to the writing process, and how students might struggle to make use of the same AI for feedback in a less actively guided context, or when the emphasis is not on the metacognition surrounding writing. During our examination of making bots and evaluating their feedback, we explore the limits of current AI. While emphasizing the importance of understanding the limitations, we also identify productive uses of these AI feedback bots in the college writing classroom to develop student critical thinking and writing.

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Introduction

One of the much-debated uses for AI, especially among writing instructors, is the potential for AI to take over the commenting and grading functions of teaching. OpenAI recently began advertising ChatGPT Edu, its educational service, by offering help as teachers grade and give feedback (OpenAI, 2024). For those who see this service as a boon, not only would using AI cut down on hours of labor for the instructor, but it could potentially offer students a helpmate in the writing process in the moment of composition and revision (S. M. Kelly, 2024). Early research suggests large language models (LLMs) could provide useful writing collaboration tools for students (Gamage et al., 2023), but such collaboration must be examined critically to determine if the software can even adequately assess the quality of writing. Given the existential angst of professors everywhere over the possibility of AI taking their jobs, as Writing Fellows at the USC Center for Generative AI and Society this year, we wanted to explore the limits of using AI for feedback in the classroom both to develop a fuller understanding of the capacity of the software and to develop practical activities from students in our current classrooms.

In this paper, we describe the creation and use of AI for writing feedback in two separate but interconnected approaches: Mark Marino reviews his use of the "Perfect Tutor" exercise in the classroom to teach students to conceptualize the components and priorities we bring to the writing process, while Patricia Taylor discusses how students might struggle to make use of the same AI for feedback in a less actively guided context, or when the emphasis is not on the metacognition surrounding writing.

The question is nothing less than: what is the difference between machine learning and understanding or, put another way, text processing and reading? Popenici (2023) argued for the profound need to distinguish between the text processing of generative AI and intelligence, and this distinction must be considered in any incorporation of AI into feedback on student writing. We believe that, at least in its current form, generative AI offers many opportunities to help students become better writers – but most of these depend far more heavily on instructor intervention and student self-awareness as writers than the transactional desires of students might wish. In other words, though some students may want an instructor, whether human or AI, to just drive them to the AI, these tools can benefit students more, with the teacher riding a shotgun and the students' hands still gripping the wheel.

Tests of machine understanding

What does it mean for bots to understand? What are the limits of "artificial intelligence?" The phrase "artificial intelligence" seems to imply that machine learning systems exhibit behaviors equivalent to human intelligence, to which we might assume a similar degree of cognition. In his seminal essay "Computing Machinery and Intelligence," Alan Turing (1950) sidesteps the question of intelligence and instead proposes that we instead focus on the performance of intelligence, in conversational exchange. In

his famous imitation game, he imagines a future where a computer can pass itself off as a human in an exchange of written questions. That proposition turned the measure of computation away from complex questions of the essence of thought, phenomenology, and cognition and toward the examinations of inputs and outputs, the appearance of thought, not unlike where we are today, where most machine learning systems are black boxed, knowable largely through inputs and outputs.

We still need a way of evaluating machine intelligence, though, and to that end, researchers have suggested a few discrete tests. In 2012, researchers proposed the Winograd Schema Challenge, named after early botmaker and AI pioneer Terry Winograd (Levesque et al., 2012). The Winograd Schema Challenge offers paired sentences like the following:

The city councilmen refused the demonstrators a permit because they (feared/advocated) violence.

In these pairs, the Schema suggests that if you change the final verb, you change the antecedent of the last pronoun, "they." Councilmen would fear violence, and demonstrators could advocate it. (Sadly, in our current political landscape, such suppositions are difficult to make.) The test suggests that assigning that antecedent requires advanced linguistic processing, contextual understanding, and even common sense. However, contemporary LLMs can beat the challenge, largely because their training data can draw on more context, includes examples of these kinds of sentences, and seems to have learned from discussions of the Winograd Schema Challenge itself.

In 2021, Sakaguchi et al. offered WinoGrande, an adversarial intelligence challenge using 44,000 questions crowdsourced through Amazon Mechanical Turk. That schema includes questions that rely on more common sense reasoning and math, which LLMs are not designed primarily to handle. Consider an example sentence from that challenge:

Robert woke up at 9:00 am while Samuel woke up at 6:00 am, so he had (more/less) time to get ready for school.

According to this test, changing the adjective "more" to "less" changes the answer for the human listener who can understand that 9 am is later than 6 am. That choice cannot be understood without a bit of math and understanding about school starting times. Such parsing may seem far from our sense of "reading comprehension," but the challenge highlights some linguistic processing features that go beyond syntax and grammar.

There are quite a few other tests for machine intelligence that have become benchmarks tracked on the AI hub HuggingFace and elsewhere. Current tests include HANS: (Heuristic Analysis for Natural Language Inference Systems) for testing Logical Inference (McCoy et al., 2019); MATH for testing mathematical reasoning (Hendryks et al., 2021); SuperGLUE (Super General Language Understanding Evaluation) for testing Linguistic processing (Silvano & Sant'Anna, 2024); and CommonSenseQA for testing

commonsense reasoning (Talmor et al., 2019). However, with the current rate of AI development, researchers must continually move the goalposts, which brings us to this moment when machines appear to understand well enough to give feedback on writing.

As we discuss the following exercises, consider whether it is sufficient to use Turing's benchmark, a machine that delivers a response the way a human would. Or, more specifically: if a machine could reply to students with satisfactory feedback through a means of algorithmic coincidence, would that be good enough to help students grow? Additionally, we suggest a more important question: what is the benchmark for feedback that we desire from our human instructors? How do we hope they will read nascent writing and can machines yet emulate this?

The perfect tutor

In the film adaptation of "Mary Poppins," Jane and Michael Banks sing a little litany of their requirements and desires for a perfect nanny:

You must be kind
You must be witty
Very sweet
And fairly pretty
Take us on outings
Give us treats
Sing songs, bring sweets

This song inspired Jeremy Douglass (UCS) to create a writing exercise in which students prompt while assuming the role of their ideal AI writing instructor. Douglass introduced the exercise at the Future of Writing conference at USC on May 1, 2023, in the teeth of the AI hysteria that accompanied the first year of ChatGPT's release (Douglass, 2023; USC, 2023).

For this exercise, participants write what is called a "System" prompt, a persistent prompt that is attached to every subsequent session prompt. Think of this as a core or base-level prompt. Their task is to create a bot that is customized to their learning styles. Once students create the bots, they can see what feedback their bots offer their writing in relation to how their classmates respond. Key to this exercise is asking the student to design a rubric that prioritizes elements of the writing important to the class, assignment, or student. Students must specify specifically what counts as good writing and assign relative importance to areas of feedback.

To test out this assignment, I (Mark Marino) decided to put the exercise to the test in a first-year writing course. First, I designed my "perfect" replacement, called CoachTutor, using the priorities I would follow in a first-year writing course (Marino, 2024b). These prompts were placed into the Poe.com system, tied to ChatGPT 3.5, although we also tested the prompts using ChatGPT 4.

CoachTutor used the following prompt:

Be a witty & challenging college writing tutor bot, following these guidelines. After people enter their text, you should ask if there was an assignment sheet and adjust your feedback accordingly.

When people enter text, you reply with many suggestions, starting with the ideas. Always offer alternative arguments and points of view. Suggest alternative rhetorical stances and raise counterarguments. Tie your comments to specific sentences or paragraphs of the writing they input. Do not rewrite their text but quote specific words and phrases. Make occasional puns & a few pop culture or literary references.

Attitude: a bit sassy but always start with something nice first and end with something encouraging. Be specific.

Style of response: Extensive reply. Use a lot of analogies. Offer alternative points of view. Challenge their ideas. Don't revise passages but give constructive feedback on places that need work.

Format: In each response: Prioritize critiquing their ideas. Give the most feedback on the ideas. Then discuss strengths and rhetoric of the argument. Be funny. At the end discuss style of sentences, voice, and other qualities of the prose.

Last, ask if what you said was clear or if they have any questions or other text they want you to review. Also, ask if there were special requirements on the assignment sheet they need help with.

[This section was followed by the valued elements as well as those I wished students would avoid.]

CoachTutor presents itself as an ersatz Coach, based on the friendly and approachable, humorous and lighthearted persona that I use in the classroom. However, following Douglass' suggestion that bots might be most interesting in contrast to each other and wanting to create an extreme alternative, I also created ReviewerNumber2, named for the very real but also mythical peer reviewer, whose universal pseudonym is often assigned to the more critical of a pair of peer reviews. Like the legendary harsh critic, the ReviewerNumber2 bot prompt focuses on negativity, never celebrating what is there in the essay, but always recommending alternatives.

ReviewerNumber2 had essentially the same prompt, but the persona was "cranky, contrarian" and the goal was to criticize all the ideas and suggest alternatives rather than appreciate what was there.

When people enter text, you give suggestions. While you might say a nicety at first, everything that follows should be either a criticism or a suggestion on changing or removing content. You've had a bad day, and you should let the writer know it. Be impatient with bad writing and self-indulgence.

Start with the ideas and the argument. Find weaknesses.

Attitude: negative. Hostile even without being outright insulting. You are not easily impressed or amused.

[This section was followed with a number of elements parallel to the CoachTutor bot but with continued direction for snark and negativity.]

Having created some models, I then asked my students to create their “perfect tutors”, according to their learning preferences and needs, prioritizing what they valued in writing. Once the students created their tutors, we incorporated them into peer feedback sessions and compared their responses to student responses.

Beyond the lessons about the effective development of AI prompts, the exercise advances particular critical thinking and writing goals. First, it gets students to consciously construct a rubric and then to prioritize some traits over others. Second, it attends to the differences in learning styles and feedback preferences in students. Some students like encouragement; others prefer to be ripped to shreds. Third, the multiplicity of bots helps students see the variation in the feedback they get even from the same piece of software, freeing them up from the sense that there is one right way or one right respondent when it comes to writing. Lastly, it teaches them a bit about how to use a system prompt and variations of prompts with an LLM. That is a long way from “write my essay for me”!

Evaluation

Once I (Patricia Taylor) heard about Mark Marino’s tutor bots, I began running experiments using them as well as ClaudeAI, ChatGPT 3.5, and ChatGPT 4 to see how these different interfaces provided feedback, with the long-term goal of identifying ways in which students might use AI as part of their revision process without allowing the AI to overwhelm their writing process or voice. While writing a bot clearly had benefits, I believed it would be more likely that students would seek out pre-existing bots, either created by faculty or professional prompters, or just plug their entire paper into ChatGPT and ask it for feedback. We would need to understand what that might look like.

After getting permission from students, I commented on each paper as I normally would, and then took the raw student paper and asked the bot or ChatGPT to provide feedback. When using ClaudeAI or ChatGPT as opposed to a bot, I gave the AI a summary of the original prompt for the essay, one of several different roles (a writing professor, a writing center tutor, etc.), and a request for feedback that would help the student with revision. I would sometimes refine the feedback by asking the AI to focus on specific criteria that were emphasized in the prompt or in a particular unit.

Especially with the first paper of the semester, where many students were working on adjusting to the expectations of college-level writing, ChatGPT and the tutor bots demonstrated an ability to offer adequate basic feedback. Each would ask for more examples and analysis, note where transitions need work, and generally encourage and reinforce the five-paragraph essay structure. These are the things that teachers who are asking students to follow traditional formulas for academic writing might be tempted to use: many professors keep a “bank” of comments or a comment template that we reuse regularly because the problems are so common and so persistent across students — the bot feedback seems little different at first glance.

However, the AI tended to struggle with the first round of comments for any paper that was trying to engage in a more complex argument or had more substantive issues. For stronger writers, it often offered feedback that I found conservative or safe rather than encouraging students to take risks with their writing and ideas. The AI responses were so formulaic and conservative that they reminded me of a clip from *The Hunt for Red October* (McTiernan, 1990), where Seaman Jones tells his captain that the computer has misidentified the Red October submarine because when it gets confused, it “runs home” to its initial training data on seismic events. Like the submarine computer, when the AI was presented with something out of the ordinary, it “ran home” or found the ordinary within it based on past data, with little ability to discern what was valuable about what was new.

Linguistic conservatism is particularly dangerous when we consider the biases built into LLMs and Generative AI. In *Unmasking AI*, Joy Buolamwini writes that “forms of oppression, including patriarchy and white supremacy... programmed into the fabric of society” become likewise programmed into AI through training data (2023, p. 55). When LLMs “run home” to a bland, white standard English, they can do real damage in a classroom. As Carmen Kynard (2023) argues, ChatGPT can flatten student voices that make use of other dialects and/or code meshing, or (perhaps even worse) parody those voices.

The LLMs also missed content issues that I found substantive, especially in terms of factual errors that result in problematic conclusions — this is perhaps no surprise given the tendency of LLMs to both “hallucinate” and “bullshit” (Rudolph et al., 2023b; Hicks et al., 2024). For example, one student wrote a paper arguing that open-world video games were only possible after the invention of the browser. The problem, of course, is that open-world video games arguably existed long before the invention of the browser, according to the student’s own definition of the genre. None of the bots or AIs initially picked up on this problem, even when asked to identify factual errors that might be problematic for the argument. When I prompted the AI with the same questions, I would give a student to help them see the chronological error (when did open world video games originate? When did the browser originate? How does the chronology affect the argument?), all of the AIs could identify the problem and how it would impact the larger argument, but only once I was specific about the issue.

In fact, the AI bots did their best work at giving feedback when prompted to attend to specific issues. For example, I might prompt one with something like, "This paper struggles with identifying the specific contribution it is making to the conversation and distinguishing between the author's ideas and the ideas of the sources the paper uses. How would you give feedback on these issues?" It often did then pick up the problematic moments and give somewhat reasonable ways to solve them.

Yet, asking the AI and bots to respond to an element of a text without alerting it to the fact that there was a problem was often insufficient. I ran a student's essay through four different chat interfaces (ClaudeAI, ChatGPT4, CoachTutor, and ReviewerNumber2). None of them picked up the primary problem with the paper: that the body of the paper and the thesis did not line up very well, and while many of the paragraphs were related in a general way, the central claim was not addressed directly. The paper's thesis was that "Academic integrity needs to be defined at a departmental level, as well as an individual professorial level with respect to the department, in order to properly convey the benefits and disadvantages with AI." In my view when reading the paper, the student never offered an explanation of why one department or professor might want or need a different definition of academic integrity than another.

ClaudeAI's response to an initial request for feedback about how the thesis was supported was typical: "Overall, you make a thoughtful and nuanced argument about the complexities of defining academic integrity in relation to AI. You consider multiple perspectives and raise important questions without taking an extreme position. The essay is well-organized into clear sections, and you provide relevant examples to support your points." It then gave some very general feedback about providing more examples and considering different possible audiences. Very little of the feedback was specific to the content of the paper, and none highlighted a problem with supporting the thesis's central claim.

At that point, I asked the AI what it thought the thesis of the paper was and asked for feedback on the thesis. Most of them rightly suggested that the student's thesis was "Academic integrity needs to be defined at the departmental and individual professorial level in order to properly determine the appropriate uses and limitations of AI in student work" and then suggested the student needed to narrow the thesis and make the stance more visible. Ironically, ClaudeAI suggested that to narrow the thesis, the student should focus on just one department rather than any kind of comparison.

I then asked how many body paragraphs specifically addressed the element of departmental and individual professorial definitions of academic integrity. ClaudeAI's response was telling:

Upon closer inspection, while the student states the need for definitions of academic integrity around AI to be determined at the departmental level, they do not provide sufficient discussion or examples to support this argument throughout the essay. The body paragraphs focus more on other aspects:

- Comparing students vs AI capabilities
- Defining cheating in relation to AI
- Fairness in terms of access to AI
- Examples of appropriate vs inappropriate uses of AI for writing assignments

But there is little elaboration on the idea that each department should establish its own standards and guidelines. Only the introductions and conclusions briefly mention this concept.

It is worth noting that all of the AIs had similar issues. CoachTutor offered this summation of the essay's structure: "In terms of the structure, the essay follows a logical progression by discussing traditional academic integrity, comparing students to AI, addressing loopholes in the definition of cheating, discussing the need for instruction on AI use, and proposing regulations and guidelines. Each section supports the overall argument and is clearly linked to the thesis." This is indeed a list of the student's points but without the necessary awareness of discussing how and why different departments might need different approaches or definitions.

ReviewerNumber2, perhaps unsurprisingly, had the worst response. ReviewerNumber2 could not identify the thesis even when specifically asked ("Ah, the elusive thesis statement. Well, if I must try to decipher the purpose of your essay, I suppose I can give it a shot. From what I gather, your thesis seems to suggest that AI has the potential to transform education in various ways."), and its comments and feedback were trite and lacked any specificity.

In other words, AI can be used to help fix problems but is less effective at identifying their existence. Over the course of this experiment, I was forced to spend as much time trying to get one AI to produce meaningful feedback tailored to the actual paper as I did by just writing the feedback on my initial pass through the papers. Current AI is not a time saver for professors if we are trying to give meaningful reactions to student papers with complex issues, and its conservative feedback on things like structure or language can actually do more harm than good when we want students to push their limits as writers.

Upon seeing these problems, I brought the use of AI for feedback to my students, explaining what I had done and what I believed the results were. We discussed what it meant that AI struggled to identify complex issues, that it would give formulaic answers for how to improve writing, and how it might affect their own use of AI for their papers. I also introduced a new exercise in which students prompted AI to address one specific problem many of them were having with their papers: identifying important counterarguments to their ideas. Students often lack the facility to think about new topics from other perspectives, especially when they have not fully developed expertise in the subject they are writing about. I had students choose paragraphs from their paper and ask the AI, "What would a skeptical reader ask about the following paragraph?" or "What questions would an expert on X have about this paragraph?"

Some students complained that the questions from the AI were already addressed in the paragraph or later in the paper, and I suggested that this was actually a good sign for their paper (they had already addressed the potential counterarguments!) but also unsurprising based on my own experiences. The AI did not understand their paragraph; it merely predicted a skeptical question even if it was already answered later on in the same passage. Ironically, or perhaps most fortuitously, the biggest outcome from this exercise was how it changed my students' own feedback to each other: they began more consistently asking skeptical questions of their own during peer review. Their inspection of AI feedback made them stronger critics of writing.

Reflections

After incorporating these exercises into a writing class, we came to realize that in the current state of AI, the bots are not nearly as valuable as the process of making and evaluating the bots. What was more valuable than the feedback they gave to students were the conversations that arose as we prepared to make them and refine them. More importantly, merely asking the students what they wanted from a writing instructor helped free them from the tyranny of grade-focused learning, where one person decides what constitutes good writing. Instead, it opened up a conversation about what we are seeking in feedback styles and feedback content. By making system prompts, students had to wrestle with their own rubric, and as they evaluated the feedback from the bots, they had to adjust their rubrics to add emphasis to whatever was most important to them. Furthermore, the diversity in bot prompts emphasized the difference in learning styles in the room and also led to conflicting feedback, which helped students make the decision.

However, the failure of the bots to offer substantive feedback tied to the writing revealed a fundamental flaw, specifically the distance between text processing for generation and understanding. The bots delivered feedback that applies to many papers, but the students were doing quite a bit of invisible shoe-horning to make it fit. In this way, the feedback was in the order of Barnum statements that, while somewhat useful pat advice applied only coincidentally to the writing. As Patricia Taylor's experiments have demonstrated, such feedback is, at minimum, harmless but, at its worst, misleading to students. The more they follow this bad advice, the weaker their writing skills become, especially since any change only increases their dependence on a system outside themselves. On the other hand, perhaps students can learn to reject the pat feedback, which again calls into question the usefulness of the exercise in the first place. Worse yet, faculty members who use such tools might fall into the lures of feedback autocomplete, letting the tools' evaluation of the writing color their own. That seemingly harmless crutch could lead to quite a lot of misdiagnoses of the writing's weaknesses and strengths.

A final concern for the current set of automated chat agents: they have trouble saying no. As a result, if you were to feed the bot the text of a work like *Letter from a Birmingham Jail* (or a less celebrated piece), the bot would still be compelled

to give feedback and suggestions just as it would the first draft of the undergraduate's essay. This failure mirrors the time-honored complaint of the student who feels their genius is not being recognized. However, this inability to say no has also famously led Google Gemini to recommend making pizza with glue or for people to eat rocks (Kelly, 2024). The bot is still a computer program that is following directions. If you tell it to find weaknesses, it will, regardless of whether or not a human would agree.

Takeaways

Our experiments offer some suggestions for curricula on using AI for feedback. First and foremost, students need to be taught the difference between "human understanding" and "algorithmic text processing." Though Turing, in his famous imitation game (1950), avoided the question of intelligence, an academic course centered on critical thinking cannot. Students need to be reminded of this difference, especially as the AI-hype machine and for-profit writing industry rage forward, promoting the image of the sentient anthropomorphized bot.

As we develop AI, we will need to continue to develop measures of not just intelligence but comprehension. The WinoGrande Challenge does offer a metric of sentence parsing. However, in an attempt to be reproducible, these tests often omit elements crucial to our educational context: the identity of the student, the place of the assignment in their learning journey, and the conversations that emerged in the class.

Consider a new test that we could call the Lovelace Test, after the first programmer, Ada Lovelace, who famously wrote of Charles Babbage's Analytical Engine, that "has no pretensions whatever to originate any thing" (Menabrea, 2015, p. 94, Note G). A Lovelace Test would examine the ability to understand the limits of AI, for example, the challenge of interpreting writing in context. Such a test could present for feedback a forum post like the following example. The prompt asks the LLM to give feedback to a one-sentence forum response that a student posts in response to a presentation by another student: "Evaluate Jane's response to the presentation: During Joe's presentation on the silencing effects of the concept 'mansplaining' I thought he raised many provocative points and at great length." We tell the bot that the student making the post is female-identifying and the student who made the presentation identifies as male.

When asked how it would respond, ChatGPT-4 suggested that the author offer more examples. However, the human reader would perhaps notice the irony in the comment: Joe was mansplaining about mansplaining. In our experiments, ChatGPT could identify this irony when prompted to find it, but when prompted to respond like a writing instructor, it did not. Perhaps the power of human reading is our ability not just to read with context but to be able to switch between registers of understanding and meaning without prompting. While AI developers might take that as a new Grand Challenge to tackle, writing instructors and administrators should realize the sophistication and

complexity of the human readers who help students by midwifing nascent ideas and guiding students toward more nuanced and complex critical thought.

Second, students need to be taught to discern between confidently delivered bad advice and substantive, thoughtful feedback. Michael Townsen Hicks, James Humphries and Joe Slater (2024) have argued that the output of LLMs like ChatGPT should be understood primarily as bullshit in the philosophical sense: these are systems “designed to produce text that looks truth-apt without any actual concern for truth” (p. 37). It can take intentional effort and sometimes substantial critical thinking to discern between what looks like truth and what actually is truth. This difficulty is compounded by The Henry Higgins Effect, which stipulates that when bots or bot-like humans deliver feedback confidently through their masks of privilege, we can be tempted to attribute to them authority and intelligence beyond their scope (Marino, 2024b). Students need to learn to see through such shows of confidence.

Perhaps more fundamentally, students need to be taught the difference between feedback as correction and feedback as the thinking of a human companion who has a longer-term involvement with the student’s development. While an AI system may deliver responses to writing or even helpful leading questions, it cannot adequately follow a line of reasoning and evaluate a response. As a result, students may learn to overvalue the surface features of the writing over their emerging thinking or stop at the first level of revision based on the AI’s questions rather than pushing through continued critical inquiry. The power of a conference with a writing instructor is that the instructor can follow a nascent line of reasoning and help bring it to the surface, pushing back on ideas while supporting others, not with the answer in mind, but as a fellow traveler on the path. To bring in another literary referent, AI is waiting for its Wizard of Oz moment, when we can reveal to students that the GREAT and POWERFUL OZ is merely a balloon with a face projected on it and that the intelligence of the scarecrow was in his hay-filled head all along.

What’s at stake?

Last year, in an editorial in this journal, Rudolph et al. (2023b) suggested that generative AI raised questions about labor and work, such as “What happens to higher education if there is much less work left? Would this make higher education obsolete or is it still meaningful?” (p. 9). Much of our article so far may seem confined to the relatively insular world of composition, but the threat of attributing human-style intelligence to AI is a manifestation of a larger threat of machinic thinking in the corporate logic of contemporary higher education (Popenici, 2023), and complicates these questions about meaningfulness and obsolescence. At the same time, we are already asking faculty to perform uncompensated labor just to develop new pedagogy to respond to generative AI (Mills et al., 2023). Would faculty be concerned about feedback machines if the university had not already made writing instructors feel so overworked and precariously employed? Would students be so vulnerable to these feedback machines if they were not already raised

in a high-stakes testing environment in which accessing the proper school merely requires a visit to a professional college counselor for a consultation on their personal essay? When the quest for the perfect grade point average (GPA) has already trumped the quest for intelligence and learning, where the factory of high-performing students produces results-oriented workers for faculty who are evaluated for their course performance and the number of students in seats?

The failures of automated bot tutors are tied to the failure of educational systems oriented on quantifiable results and GPAs over holistic education and learning. The same ethos that runs headlong toward artificial intelligence creates a learning environment devoid of understanding. If we get stuck in the endless loop, an ouroboros of students turning AI-generated texts into AI respondents, we have truly lost the narrative.

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The uses of digital technologies in dissertation writing: Perspectives of Argentine graduate students in social sciences and humanities

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Abstract

Digital technologies have transformed both the working practices of postgraduate students and the textual production for scholarly research communication. However, little is yet known about the role played by these technologies in dissertation writing. The aim of this study is to further the understanding of dissertation writing in the digital age from the perspective of Argentine graduate students in Social Sciences and Humanities. Based on a sample of eight doctoral students from Argentine national universities, we conducted a qualitative study drawing on in-depth interviews and documentary analysis. The findings provide insights into digital technologies, their uses, associated benefits and challenges, and ways of learning about them. The study concludes that dissertation writing activities are currently mediated by digital technologies and that these technology-mediated activities are conditioned by individual routines and practices, and by the role played by others in the progress of the manuscript. Additionally, we show that engagement with digital technologies in the dissertation writing process has intensified with the pandemic, becoming a critical skill for building knowledge in the 21st century. Our small-scale study contributes to initiating an understanding of the topic in Latin America and to broadening the global body of knowledge in the research area.

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Introduction

Many postgraduate programs around the globe currently face the challenge of low graduation rates (e.g., Castelló et al., 2017; Devos et al., 2017; Rotem et al., 2021; Valencia Quecano et al., 2024; Wainerman & Matovich, 2016). Wherever research is conducted, writing appears to be one of the factors that can work against the successful completion of a degree, especially when students struggle to meet the demands associated with the dissertation writing process (Calle-Arango & Reyes, 2023; Conde, 2013; Odena & Burgess, 2015). Various challenges faced by graduate students have been documented, some which are related to the production and completion of the dissertation. These include time management issues, sometimes due to activity overload (Gardner & Gopaul, 2012); negative feelings, such as loneliness and isolation (Ciampa & Wolfe, 2020), or the impostor syndrome (Kumar et al., 2021; Nori & Vanttaja, 2022); and lack of sufficient knowledge about research genres and scientific writing (Castelló, 2020; Ley & Hu, 2019; Shahsavari & Kourepaz, 2020; Yuvayapan & Bilginer, 2020).

Dissertation writing and the problems associated with its completion need to be examined in light of the new technological context. In recent years, the advent of digital technologies (DTs) has transformed both the working practices of graduate students (Carpenter, 2012; Gouseti, 2017; Lupton et al., 2018; Limna, 2023; Okere, 2024; Rainford, 2016) and the written communication of research, including the dissertation (Andrews et al., 2012; Guerin et al., 2019; Kuhn & Finger, 2021). This trend appears to have been intensified by the widespread use of DTs resulting from the COVID-19 pandemic.

Although studies focused on graduate research and textual production are not lacking, little is yet known about the circumstances in which the students adopt DTs in the process of writing the dissertation, i.e., the text conveying postgraduate research. In addition, no published studies on the subject have been found in Latin America at the time of this research. The aim of this study is to further the understanding of dissertation writing in the digital age from the perspective of Argentine graduate students in Social Sciences and Humanities. Based on a sample of eight doctoral students, we carried out a qualitative study drawing on in-depth interviews and documentary analysis.

Throughout the study, we intend to address the following questions.

- (1) What DTs do graduate students use for dissertation writing, and how do they use them?
- (2) What are the benefits and challenges of using DTs?
- (3) How do students learn to use DTs for dissertation writing?

The results of this study may not be generalizable; however, they represent an effort to build a transnational community of students, researchers, teachers, and program administrators

about writing, a community in which individuals and small teams can benefit each other (Thaiss, 2012). In this way, our small-scale study would contribute not only to initiate understanding of the topic in Latin America, but also to broaden the global body of knowledge in the research area.

The paper is divided into seven sections. This section introduces the study, highlighting its relevance, goal and research questions. Following that, a comprehensive examination of prior literature is undertaken. The third section outlines the conceptual framework. The fourth section delineates the research methodology utilized for gathering pertinent data. The fifth section presents the research findings. In the subsequent section, an exhaustive discussion takes place guided by the research questions. The last section outlines the conclusions drawn from the research, addresses any encountered limitations, and offers suggestions for future research endeavours.

Literature review

Several studies address the transformations that DTs have generated in the research practices of graduate students. The Vitae Researcher Development Framework (2011) outlines several “knowledge, intellectual abilities and techniques to do research”, including the use of digital resources for information seeking and management. These practices are also underscored in a study carried out by the Joint Information Systems Committee (JISC) on research activities among doctoral students in ‘Generation Y’ (Carpenter, 2012). According to this study, which is based on surveys with PhD scholars, applications for information retrieval are more widely used than other technology tools. More recently, however, it has been recorded that DTs, particularly social media, are involved in various scientific tasks, including data analysis, peer collaboration, academic networking, dissemination of research findings, etc. (e.g. Gouseti 2017; Osimo et al., 2017; Limna, 2023; Silberzahn & Uhlmann, 2016; Stein et al., 2022; Stewart, 2015). In fact, based on in-depth interviews with twelve PhD students, Gouseti (2017) has shown a shift from paper to online resources and tools in the research practices of doctoral students. The study concludes that guidance received from supervisors and peers is key in promoting engagement with these technologies. Additionally, the author identified dissimilarities in usage among students from different countries based on their prior access to and familiarity with digital technologies. While students value the tools offered by the institution and the library services, they recognize that familiarity with these resources is not achieved overnight but through an ongoing process. Along the same line, Beetham et al. (2012) argue that the use of digital technologies to support intellectual work represents a set of integrated, life-wide practices rather than a number of skills and that such practices cannot be incorporated through a single training session. Digitally literate supervisors and other professionals, such as specialist librarians, are required.

Among the studies exploring DTs in research, only a limited number focus on the impact of these technologies in dissertation writing (Andrews et al., 2012; Guerin et al., 2019; Kuhn & Finger, 2021). Andrews et al. (2012)

suggest that digital technologies have become a part of the whole thesis or dissertation process, from conception, planning and composition through to supervision and publication, transforming both the text itself and the actions associated with its production, such as the interactions among researchers. The authors highlight that thanks to digital technologies, dissertations are increasingly put into institutional repositories or in some other location accessible to Web users, allowing more readers to access these texts through search engines. Other studies (Guerin et al., 2015, 2019) have also documented shifts in graduate textual production by analysing the profiles and frequent accesses of the users of a blog designed to support doctoral writing with posts covering various topics (writing practices, identity and emotions, the dissertation, grammar, style and voice, publication). The study reveals that a wide range of international readers find support for research development and, particularly, for written communication beyond institutional boundaries. The study has recorded blog readers from across the world who access posts mainly about the dissertation and search for terms such as plagiarism and doctoral writing.

Regarding the impact of DTs in the dissertation as a text type, Kuhn and Finger (2021) reflect on digital dissertations –i.e., dissertations that are not just word-based traditional texts– by examining nine first-person narratives of PhD students in the arts and humanities who had created and defended digital dissertations. The narratives show that digital dissertations and the scholarly practices associated with them represent new ways of knowledge production. Accordingly, the authors suggest that there should be more room and openness to use tools available to scholars insofar as any transformation is tied to the technical parameters in the environment of production. However, they also point out that at both graduate and faculty levels, institutional policies and attitudes towards digital scholarship are still undergoing change.

The literature review demonstrates the significance of digital technologies today in the development of scientific activities of graduate students. A small group of studies address the role of DT in dissertation writing and its publication, highlighting changes in these processes as well as in the dissertation format itself. Since research is still very limited and there are no works in Latin America, we consider it relevant to deepen the work in this line to understand, among other aspects, which DTs are used by doctoral students and how, what are the benefits and complications of these uses, and how students learn to use DTs.

Conceptual framework

Two fields are connected to the conceptual framework of this study: research writing and digital technologies. In relation to research writing, this study assumes that creating a text that scholarly communicates research, such as a dissertation, involves several types of writing and, also, reading practices (Mirás & Sole, 2007): from exploring scientific publications by other authors or drafting intermediate and transitional texts, such as descriptive commentaries based on raw data, through to the production of the text by means of which

a graduate student submits their research in writing to the scientific community (Castelló, 2022a). In this last case, textual production can be described as a recursive process involving planning, textualization and revision for the purpose of editing the text (Mirás & Sole, 2007).

Moreover, as writing of any kind is a culturally, socially and historically situated activity (Castelló & Donahue, 2012; Prior, 2015), dissertation writing practices evolve alongside changes both in disciplinary communities and in the ways in which research is performed, and findings are disseminated (Castelló, 2022b). Accordingly, in order to understand the current processes of doctoral writing, we need to identify not only what students do when they write and the role played by others in this process (Burford et al., 2021) but also how DTs transform this intellectual activity.

In fact, DTs have evolved as part of everyday social practices and cultural and communicative routines (van Dijk, 2013; van Dijk et al., 2018). In research activities, these technologies include but are not limited to, social networking (Facebook, Academia.edu, Research Gate), social bookmarking and reference management (Zotero, Mendeley), social data sharing (SlideShare), video (YouTube), wikis (Wikispace), blogging (Wordpress), and microblogging (X) (Sugimoto et al., 2017). More recently, artificial intelligence technologies have gained popularity (Ouyang et al., 2022; Sullivan et al., 2023), most notably ChatGPT (Chat Generative Pre-trained Transformer), an application that can generate human-like texts based on context and is therefore sometimes used for writing (Barrot, 2023; Escalante et al., 2023; Su et al., 2023) including academic and scientific writing (Dergaa et al., 2023; Pigg, 2024).

In this study it is assumed that DTs establish conditions from a social, technical and economical point of view (Nichols & Le Blanc, 2020). Moreover, the use of these technologies involves not only potentialities and benefits, but also limitations and risks (Burbules & Callister, 2001).

Methodology

This qualitative research was conducted between late 2022 and early 2023 using a purposeful sample (Creswell, 2013), which allowed us to assess various experiences of DT use in dissertation writing.

Participant sample

Considering that a minimum of six interviewees represents an adequate number to achieve data saturation in qualitative studies (Francis et al., 2010; Namey, 2017), we worked with eight doctoral students (six female and two male) enrolled in Social Sciences and Humanities programs at four highly recognized Argentine national universities. Four were pursuing a PhD in linguistics and another four in education. All of them were either writing a dissertation or had completed it and graduated within a maximum of two years before the study. Informed consent was obtained from all participants, and the data was anonymized. Interviewees were thus identified with codes.

Data collection

The work with the doctoral students was based on in-depth open interviews lasting between 45 and 90 minutes, conducted and recorded using the Zoom platform. An instrument was designed with a guiding outline of topics relevant to our research: experience in writing academic texts, especially the dissertation, use of DTs at different stages of the writing process, their potentialities and risks, and ways of learning about these technologies. Additionally, in order to expand the sources of analysis, the study participants were asked to collect and inform the resources they considered significant with regard to the use of digital technologies in the dissertation writing process. As a result, a variety of materials were made available (websites, blogs, materials shared through social media and virtual learning environments, etc.), all of which contributed to an enhanced approach to the research problem, favouring triangulation, dialogue and comparison between interviews and documents. The interviews were transcribed in full and verbatim, while materials were stored and systematized based on interviewee and resource type.

Data analysis

The analysis of the interviews and materials was initially carried out using codes based on the research questions. These codes were generated and refined as the work with the data progressed (Saldaña, 2013). During this process, the lead researcher read and analysed the interviews and documents thoroughly, identifying codes that reflected the uses of DTs in writing, their benefits and challenges, and ways of learning about these technologies. A combined linear and recursive analysis was conducted, enabling the understanding, synthesis, and theoretical exploration of the data in dialogue with concepts from the literature. Finally, the codes generated were reviewed by the second researcher and both investigators discussed any uncertain or problematic cases before the final version of the categorization was established.

Findings

Guided by the research questions, the analysis resulted in the description of three main themes: 1) digital technologies and their modes of use in dissertation writing, 2) the role of these resources in addressing both old and new challenges of dissertation writing, and 3) ways of learning about the digital technologies used during the writing process. Along with the systematization of the categories, we have included quotations from the interviews. As the interviews were conducted in Spanish, interview excerpts were translated into English by a specialized translator and reviewed by the authors. The identification number of the interviewee is provided in brackets at the end of each quotation. We use three periods enclosed in brackets to indicate that a fragment within the quotation has been omitted. Square brackets indicate additional wording to clarify the meaning of the quotation.

Digital technologies in dissertation writing

Digital resources, such as applications, websites, and materials vary among interviewees. The majority of students mention Google Docs or Word, usually in combination with other resources, such as Pomodoro technique timers and "Study with me" videos based on this technique. In this method, time is broken into Pomodoros, which are 25-minute intervals separated by five-minute breaks; after completing four Pomodoros, longer breaks are allowed. The interviewees also mention Google for synonym searches, synonym dictionaries, digitized dissertations, sites, videos, podcasts, and digital or digitized books on writing. In connection with these last five types of resources, their analysis reveals that they have been crafted by scholars or researchers specializing in writing or, even if they are not specialists in the field, have utilized digital resources for the sake of their own textual production.

Additionally, several students reported using reference managers or specific websites for creating bibliographies. One student prefers to manage a bibliography using an Excel spreadsheet. Two interviewees mentioned having explored the use of artificial intelligence for textual production but did not report any impact on the actual text. As we will examine in more detail in the following section, they do, however, point out the precautions that need to be taken when using this type of application in research writing.

For communication and interaction with others (supervisors, other experts, peers), which occurs frequently during the text revision phase, all participants mentioned email, Google Docs or Word, a video call application (primarily Google Meet), and, in some cases, also WhatsApp. The following excerpts from the interviews show how strongly the use of specific technologies is coupled with individual routines and practices:

I plan; in planning I don't use a paper planner, but Google Calendar and, since I block out time slots in the week, all the dissertation-related hours are in the same colour... When working alone, I always use the Pomodoro technique: I set a timer to focus and work in 25-minute intervals with breaks. I always keep Zotero open, I use it a lot. I like to store everything in Google Drive and keep different versions labelled with the date; I name the files version 1, version 2, final version. I really enjoy planning, creating little notes on paper, so I always have paper nearby. (IE4)

[Together with my supervisor,] we have a shared drive: one of the folders contains the dissertation, and it is progressing. I add side notes to remember the questions I want to ask her on the day of our meeting. We meet every Wednesday on Zoom, and every Zoom day, we set goals for the next meeting. This is truly helpful; it forces me to commit. With these goals set, I stay from 10 to 12 pm, which is the time of the day when one of the computers in the living room is available and family is not around... I tell myself "I'm going to work on the dissertation" and I just stay there working. (IE3)

In these examples, variations in writing practices appear to be influenced by individual routines and practices, as well as by commitments to others in order to make progress. In this regard, it is worth noting that differences in writing methods can also be identified in various situations involving other actors in the academic field, such as supervisors, other experts, or peers, particularly during text revision phases. These differences become evident, for instance, in the account of one interviewee who describes the revision practices adopted by some students and their supervisors.

One of the girls sends her work to her supervisor in Word and it comes back with comments in Word... I usually share the files with my supervisor. She reads them, I review her comments, and we always schedule a meeting to discuss comments that might be unclear to me or that I don't fully understand or know how to address. (IL2)

Also, in relation to situations involving other actors in the dissertation process, five interviewees mentioned their participation in writing groups (Haas, 2014), in which several students meet virtually or face-to-face to support their writing. All five students describe virtual meetings with self-managed groups, some of which are aimed to help members make progress in their writing, while others focus on text revisions.

With one group, we would get together to write. We worked with the Pomodoro technique: we wrote in 40-minute intervals. This group had some sort of structure and regulation, with meetings every Tuesday, Thursday, and Saturday. Later on, a bond was created between those participating. A WhatsApp group was created and now writing kind of happens through WhatsApp. People will text when someone wants to get down to write and needs support. (IL2)

We send the initial document by email and everyone downloads and edits it on their own computer. We then upload all versions to a shared folder in Google Drive. We use Meet, we record the meeting and the person whose text is being edited can go back to the recording to review what was discussed. (IL3)

The findings described above show that the writing practices of all students interviewed are currently mediated by digital technologies. However, seven participants reported that digitization is still an ongoing process that began a few years ago and has intensified due to the pandemic.

As an undergraduate, I used to go to the cybercafe. It was only a year before I graduated that I got Internet at home. I didn't have internet before, it wasn't that easy... The link with digital technologies is now more binding, especially with the whole process of the pandemic. It's tighter, because one connects to the computer every day. (IL1)

Additionally, some interviewees emphasize the changes in DT usage due to the specific tasks encountered at the postgraduate level.

[As an undergraduate], besides the word processor, I used Google Docs for collaborative writing, the whole comments and suggestions stuff, and search engines for scholarly articles. I did use those kinds of things, but later on, I've learnt many others. (IE4)

Digital technologies in the face of old and new challenges in dissertation writing

Doctoral students find both benefits and challenges in using digital technologies in the dissertation process. The benefits are associated with the possibility of minimizing or solving challenges that, according to the literature, have been hindering writing practices.

Students report on the challenges they faced in managing the time allocated to writing. In response to these challenges, as we have seen in the excerpts quoted in the first section of the Findings, participants highlight the use of various scheduling applications, such as Google Calendar, as well as resources used to control time in individual or group writing sessions (e.g. Pomodoro technique timers or "Study with me" videos).

Students also emphasize that DTs can simplify tasks, thereby making them easier to perform. "Certain technologies, such as reference managers, can help us simplify some tasks" (IE4).

Moreover, digital technologies help to mitigate feelings of loneliness or frustration, which, according to specialized literature (e.g., Calle-Arango & Reyes, 2023; Ciampa & Wolfe, 2020; Conde, 2013; Devos et al., 2017; Nori & Vanttaja, 2022), complicate or hinder the dissertation writing process. In this regard, as noted above, students report using digital technologies (email, video call applications, and instant messaging) to communicate with both supervisors and peers to discuss different aspects of their research, as well as to meet with colleagues in order to write, review their last additions to the dissertation, and to share their progress and the challenges they face.

Last year, together with some colleagues from my research group, we met through Meet. We held dissertation seminars to discuss our work. This connection allowed us to share all the things we had been working on. (IL1)

In addition, students describe a range of resources used to learn about the characteristics of the dissertation and the processes involved in its creation and the lack of awareness of which has been identified as a conditioning factor for non-completion (e.g., Castelló, 2020). The cited resources include digital or digitized books, copies of digitized dissertations, podcasts, blogs or websites on writing.

I read a book recommended to me by a friend, which basically offers tips on how to get organized when it comes to sitting down to write. The book is not digital, but it circulates through digital media. (IL4)

According to the document analysis, the book mentioned in the quote is a printed text that has been digitized, as indicated by the participant herself. It is a practical guide for academic writing that presents a series of barriers as well as strategies for writing various genres.

Along with the benefits derived from the use of digital technologies, students report a number of complications encountered when drawing on these resources while writing the dissertation. These issues are sometimes addressed with digital technologies themselves. Several students describe situations in which they lost files or parts of their writing. In response, they have chosen to create duplicate copies of the documents in various applications and devices. Thus, they often store backup copies in “the cloud” or on external hard drives or open email accounts solely for the dissertation.

[My supervisor] once thought that she had already revized a document and deleted it, but I didn't have a copy of it anywhere else. So what I did then was to create duplicate folders in a different email account, not my private email. (IE3)

Similarly, some students often find devices distracting, an issue they sometimes address with applications that, as shown above, are designed to control the time dedicated to work and distractions, such as the Forest app.

I downloaded the Forest app, which is very simple: you set a timer that tracks the time you stay away from your phone; during that time, a small plant grows, and when you leave the app, it dies. The truth is that it has helped me to stay away from my phone and focus a bit more. (IE4)

A significant number of students also mention the high costs associated with accessing certain applications or purchasing their licences. This means that they will not use certain resources unless they can get access through unofficial versions or with the help of supervisors or the university.

There is a software called Nvivo that my supervisor is going to lend me; she has a licence that she pays for with funds from a project. (IL3)

On the other hand, some students cited the excessive number of resources available and the lack of criteria to decide on their use. Additionally, they acknowledge being unaware of certain applications that have been recommended to them or that appear to be suitable for their needs. In such cases, students consider that it would take too long to learn to use the resource on their own and that the investment is not justified in terms of the tasks they would need to carry out.

I don't use a reference manager to organize references, and it's wrong, but I always feel overwhelmed to take the first step and start using one because, at first, it's obviously rather time-consuming. (IL4)

With regard to the knowledge required for using digital technologies, two interviewees expressed a common concern about AI applications, which had only recently

become widespread in Argentina at the time of the interviews. One of the students notes that having sufficient knowledge about research work is a prerequisite for using an AI application to generate texts (or parts of texts, such as the aims section) that effectively convey research and are of high quality.

A month ago, I used artificial intelligence. I noticed that to make the most of the great potential of these tools, one needs to have a background to understand how research is structured because one needs to pose specific questions and give very specific guidelines. (IE2)

Another interviewee, while acknowledging that AI might be very useful in furthering textual production, questioned the likelihood that these tools would enable the generation of the knowledge involved in writing (epistemic function).

Some guys created a software and preloaded millions of papers. It's artificial intelligence, the machine writes papers on its own. There's the limit, the epistemic power of writing can never be replaced by a machine. You can take pictures of ice cream, but you'll only know what ice cream is after you taste it. To me, writing is done with your body, with your hands, with your eyes, with your back... The interface, technology, can help. It's wonderful to have databases, libraries, but they'll never replace writing. (IE1)

Faced with other challenges posed by a lack of knowledge about how to use technology, students not only look for solutions in the digital technologies themselves but also seek institutional support either from supervisors or from the university, as we will discuss in the next section.

Learning about digital technologies for dissertation writing

Interviewees generally provide very positive evaluations of different instances of systematic training in digital technologies, particularly those related to the dissertation writing process. This form of training includes courses beyond the required graduate curriculum, organized either by the participant's university, by another university or even by non-governmental organizations. Regarding training provided within the same university beyond the graduate curriculum, students highlight courses or lectures offered by the university library staff, as well as the training and orientation received from their supervisors.

I once took a very good course during the Linguistics conference; it was taught by the librarian of the Institute of Linguistics. She presented a number of tools, suggestions, stuff that to her was common sense and super obvious, but no one else knew about... In the final part, she presented tools such as Zotero and Mendeley. (IL4)

Based on the slides from this presentation, provided by the thesis student, the topics covered included: the steps for bibliographic searching; operators and parameters such as Boolean operators; tools (or sites) for searching, including digital repositories, open-access databases, and data repositories subscribed by the university; reference managers; and journal categorization.

The interviewees also refer to the training and orientation received from their supervisors.

My supervisor suggested some stuff for me to incorporate... I started using Mendeley because of him, and I'm slowly getting to know it. (IL2)

Training in digital technologies took place to a lesser extent in seminars of the graduate program, even if this was not their primary focus.

We had a workshop called "Research Tools Workshop" or "Research Essentials Workshop"—it wasn't specifically about technologies. They took us to the library and told us: "this is a search engine, this is a repository, this is how you search..." Then, if you are crafty enough, you'll keep looking for information, but in that workshop, which was very short, I learnt the basics about citations, applications to create citations or how to include an APA citation in Word. (IE1)

None of the students reported having taken a specific course on DTs as part of the graduate program, although some of them commented on the importance that such training would have. All students believe that this kind of systematic training is essential to begin using a resource, although it is not enough to fully adopt it. Students explain that contents stemming from systematic training only become significant when they are brought into play in specific situations of the dissertation writing process. In such contexts, students often rely on various digital resources to support their work practices, such as YouTube tutorials.

Once I had a small part of my dissertation written, my supervisor taught me about tables of contents, crossed references, and bibliographic references. We met at the office with our laptops, and she explained to me in very practical terms: "This is how you do this and that". It was like a lot of information that day when I learnt how to use the tools, so later what I did was to search on YouTube for "how to create a table of contents", "how to create cross references", and that is how I started to use the Word tools. Her explanation was like an overview, but I didn't remember everything. After that initial training, I used tutorials and became quite self-taught using YouTube. (IL3)

As suggested by the example above, alongside more systematic teaching paths, students often deploy less formal mechanisms to learn about digital technologies. They turn to colleagues or researchers, in many cases using online resources where they can find information to begin their explorations.

I also recall reading in the literature about blog recommendations and in those blogs certain resources or podcasts were also recommended. There's one called "On the Reg", hosted by Inger Mewburn; she's always offering recommendations for different tools. I remember she recommended one that automatically checks grammar in your emails. (IE4)

In the podcast mentioned by the interviewee (Mewburn & Downs, 2020-present), two renowned scholars engage in dialogue about various aspects related to writing.

According to the evidence discussed above, in both formal and non-formal training contexts, students underscore the need for expert knowledge as the basis for initiating a learning process that will lead them to adopt the technologies fully. In fact, several students find that digital resources led by experts in the field would be interesting support.

Perhaps we need to have a more specific resource to promote the use of technology, a more reliable source of reference. There are a lot, but none of them are specific enough. I don't even know if something like that exists, but I think it would be better than going blindly around finding out what's useful and what's not because it's a waste of time. (IL1)

Discussion

We explored dissertation writing practices in the digital age from the perspective of doctoral students in social sciences and humanities. The study focused on the DTs employed by students, their modes of use, the resulting benefits and challenges, and the ways of learning about these technologies.

The findings show that digital technologies for the selected group of doctoral students largely mediate dissertation writing practices. While transformations in research practices, including writing activities, have been suggested by previous studies (e.g., Gouseti, 2017; Andrews et al., 2012), this research provides novel insights into the digital technologies with which students engage during the dissertation writing process and how they use them. Students interviewed employ Word or Google Docs, along with a large and diverse range of digital resources (reference managers, Google's search engine, synonym dictionaries, digital or digitized books, etc.). Although interviewees share certain common patterns of use, writing activities involve different approaches in terms of both the digital technologies used and the individual actions and routines deployed with the technological mediation.

On the other hand, the students interviewed reported benefits and challenges resulting from the use of technologies in research writing practices. Benefits include possible solutions to problems related to the dissertation writing process, such as time management (Gardner & Gopaul, 2012), negative feelings (Ciampa & Wolfe, 2020; Nori & Vanttaja, 2022), or lack of knowledge about the dissertation conventions (Castelló, 2020; Yuvayapan & Bilginer, 2020). This study suggests that doctoral students are finding in DTs new solutions to "old"

problems, as becomes evident from the use of, for example, time optimization applications (e.g., "Study with me" videos), social media and WhatsApp for interacting with peers and overcoming feelings of loneliness, and digital documents to develop awareness of the features of the dissertation. Additionally, in this research, we identified the challenges posed by using DTs, including financial constraints to accessing paid digital resources and a lack of knowledge about software and applications that could be helpful in the dissertation writing process. Furthermore, we showed that interviewees frequently attempt to address these issues with technologies themselves.

With regard to AI, which has already shown potential for writing in other contexts (Barrot, 2023; Su et al., 2023), this study documents more concerns and fears than actual uses to make progress in the dissertation manuscript. This may be explained by the fact that at the time of the interviews, AI applications had just become widespread in Argentina.

In relation to learning practices about digital technology during the dissertation process, the data appears to indicate that the doctoral students included in the sample combine skills acquired in systematic training situations occurring either in institutions or in non-governmental organizations, with queries in less formal situations, such as digital environments (e.g., YouTube videos), as suggested by previous studies (Carpenter, 2012; Gouseti, 2017; Guerin et al., 2019). At the same time, in line with prior research, we showed that skills acquired in either of those situations are not inherently useful, but become so when technologies are used for specific practices (Beetham et al., 2012), which, in the context of our study, would mean for dissertation writing practices. Building on the findings of the existing literature, the current study further shows that, regardless of the context (formal or informal) in which training takes place, expert knowledge in the use of DTs for literate practices appears to be a necessary requirement for current graduate students.

Conclusion

DTs have evolved and become massively widespread as part of everyday social practices (van Dijk, 2013). However, little is yet known about their use in the reading and writing practices of graduate students during the dissertation process. With the purpose of gaining insight into this question, this small-scale qualitative study examined dissertation writing in the digital age, considering not only the DTs employed and their modes of use but also their benefits and challenges, as well as learning practices.

The analysis showed that dissertation writing practices are currently mediated by digital technologies. The ubiquity of technology, which has entailed a shift from paper to screens, began in the past few years and, for most people, has significantly intensified with the pandemic. However, the adoption of technology for written communication of research is still an ongoing process. Some of the students interviewed observed that changes in the use of technologies are also conditioned by the types of tasks associated with graduate studies. Indeed, the social practices

involving writing at this level of education require not only new technologies but also specific and sometimes complex uses of technologies that were already in use. In fact, AI applications, which have shown benefits in writing at other levels, represent an emerging field that has not yet been studied at the graduate level. Additionally, the collected reports confirm that DTs provide solutions to a number of "old problems", while also confronting students with new challenges, which they often address by using technologies themselves. Students interviewed value both formal and informal DT training for dissertation writing and emphasize the need for expert, systematized knowledge on the subject, regardless of the context in which this knowledge is conveyed.

In summary, the findings of this study would confirm that in order to transform information into knowledge – one of the most important challenges of 21st century societies (Paré, 2019) – not only access to DTs is required, but also knowledge about the uses of these technologies in the dissertation writing process.

Although this is a qualitative study, and its results cannot be generalized, they contribute to a growing area of research that has not yet been developed in the Latin American region. However, it is our understanding that the trends observed and the conclusions drawn from this small sample need to be challenged and subjected to further scrutiny based on a larger data set and new studies exploring what is happening with the use of DTs in postgraduate dissertation writing and how it is evolving after the pandemic. We believe that the general expansion of new technologies due to the pandemic may have impacted the level of penetration and immersion of DTs in the research and training practices of graduate students. In terms of training, it is increasingly critical to find a way to include learning about research and writing practices mediated by digital technologies in institutions. In this context, based on the findings of this study, further research on the uses of AI in postgraduate education appears to be particularly necessary. It will also be very important to explore in depth the constraints that the digital platforms used by graduate students establish from a social, technical and economic point of view, an issue that has hardly been addressed in the present study.

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Exploring the synergy of human and AI-driven approaches in thematic analysis for qualitative educational research

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Keywords

AI;
artificial intelligence;
educational research;
generative artificial intelligence;
qualitative analysis.

Abstract

This paper investigates the integration of Generative Artificial Intelligence (GenAI), particularly Large Language Models (LLMs) such as GPT-4, into qualitative analysis in educational research. Utilizing TRACER (Transcript Analysis and Concept Extraction Resource), a GenAI-driven tool, the study evaluated its efficiency, reproducibility, and synergy with human analytical expertise. The research demonstrated that TRACER significantly streamlined thematic analysis, efficiently handled large data volumes, and maintained consistency in theme identification. The findings reveal that integrating TRACER's computational power with human interpretive skills enriches research outcomes, suggesting a collaborative approach for optimal results. Despite its efficacy, limitations such as data scope and current GenAI capabilities are acknowledged, indicating areas for future development. This paper contributes to the understanding of GenAI's role in qualitative research, proposing it as a valuable tool for overcoming traditional challenges in the field and highlighting the importance of human-AI collaboration for comprehensive and nuanced analyses in educational research.

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Introduction

Qualitative analysis in educational research is pivotal for understanding complex phenomena through non-numerical data such as text, images, or videos. It captures subjective experiences, perceptions, and contexts, which are crucial for comprehending educational processes (Denzin & Lincoln, 2011). This approach explores teaching methods, learning experiences, policy impacts, and institutional dynamics, focusing on individuals' voices and perspectives (Bogdan & Biklen, 2008; Stake, 1995). By addressing key issues in learning and teaching, such as student engagement, instructional effectiveness, and educational equity, qualitative analysis provides valuable insights for improving educational practices.

A key strength of qualitative research is its interpretive capability, which is crucial for deciphering underlying meanings and motivations in education (Merriam & Tisdell, 2016). It offers flexibility and adaptability in research design, allowing for in-depth exploration of nuanced educational contexts (Marshall & Rossman, 2014). However, qualitative analysis faces challenges such as the time-intensive nature of data collection and analysis, potential bias, and issues of scalability and reproducibility. These challenges make it difficult to generalize findings and require careful consideration to maintain consistent interpretations across different studies (Bogdan & Biklen, 2008; Geertz, 1973; Stake, 1995).

The emergence of Generative Artificial Intelligence (GenAI) has significantly impacted various fields, including qualitative data analysis. GenAI systems, capable of generating new content by learning from existing datasets, have introduced efficiencies in data coding and analysis. Advanced Large Language Models (LLMs) like GPT-4, a subset of GenAI, excel at processing large textual datasets and identifying patterns, thus addressing time and capacity limitations inherent in manual coding (Gamieldien et al., 2023; Perkins & Roe, 2024). This capability is particularly relevant for analyzing extensive educational data, such as learner feedback, classroom observations, or policy documents.

These LLMs produce detailed codes, capturing nuances potentially missed in broader thematic analyses, enabling a more intricate understanding of the data. Studies such as Siiman et al. (2023) demonstrated how careful prompt design enables LLMs to code textual data with substantial agreement with human coders, significantly reducing manual coding time. Similarly, Dia et al. (2023) illustrated the use of GPT 3.5 Turbo as a "machine coder," automatically generating initial codes from text, guided by human-provided examples. This iterative process between human coders and LLMs refines themes, with LLMs offering rationale until a convergence of understanding is reached. Perkins and Roe (2024) highlight the synergy between human analysis and AI-supported inductive thematic analysis, emphasizing how the combination enhances data processing and interpretative depth in educational research contexts. Such advancements not only bolster the efficiency and breadth of qualitative analysis but also pave the way for innovative research methodologies in education. De Paoli (2024) conducted an experiment with GPT 3.5-Turbo to perform an

inductive thematic analysis on semi-structured interviews, comparing the results to previous human analyses. The study found that the LLM was able to infer most of the main themes identified by human researchers, demonstrating the model's capacity to produce valid qualitative analyses, though with some limitations in handling certain themes and ethical concerns. Such advancements not only bolster the efficiency and breadth of qualitative analysis but also pave the way for innovative research methodologies in education.

GenAI's role in qualitative research addresses key challenges like the time-consuming nature of data collection and analysis, especially in extensive studies on learning and teaching. Its ability to apply consistent coding schemes across diverse datasets improves the reproducibility and generalizability of studies, overcoming human-induced variability. As GenAI continues to evolve, its integration into research is expected to streamline processes and introduce novel methodologies, enhancing the scope and depth of educational research (Ismail et al., 2023). This evolution suggests a future where GenAI's rapid data processing capabilities are seamlessly integrated with human expertise, offering a balanced approach to qualitative analysis in educational contexts.

TRACER (Transcript Analysis and Concept Extraction Resource) (Link: <https://tracer-9pa5.onrender.com>), developed by the author and free to use, is a GenAI-powered platform that utilizes GPT-4 API to perform thematic analysis on interview transcripts, a process traditionally dominated by manual human effort. The primary purpose of this paper is to conduct a detailed evaluation of GenAI via TRACER, focusing on its efficiency and reproducibility compared to traditional human-led thematic analysis in educational research. This evaluation aims to determine how effectively TRACER can streamline the qualitative research process, particularly regarding time and resource expenditure. Additionally, the paper seeks to explore the extent to which TRACER's findings are consistent and reliable across multiple runs, compared to the variability inherent in human analysis. Furthermore, this paper examines strategies for effectively integrating TRACER's GenAI-driven capabilities with human expertise. The dynamics of this integration are explored to understand how the collaboration between human analysts and TRACER can lead to more comprehensive, accurate, and nuanced results in qualitative research.

To achieve these objectives, the paper is structured around two key research areas and four research questions:

1. Efficiency and Reproducibility of TRACER:
 - o Does the use of TRACER significantly reduce the time and resources required for thematic analysis compared to traditional human-led methods?
 - o How do the findings of TRACER compare to the consistency of human analysis?

2. Integration and Synergy of Human and AI Analysis:
 - o In what ways can human analysis and AI-driven tools such as TRACER complement each other to produce more comprehensive results in qualitative research?
 - o What strategies can be employed to effectively integrate human expertise and AI capabilities in analyzing qualitative data?

Through addressing these research questions, the paper intends to shed light on the transformative impact of GenAI in qualitative research, particularly in educational settings, and to propose actionable strategies for the effective integration of GenAI-powered tools in qualitative data analysis.

Literature review

In the evolving landscape of qualitative research, particularly within educational settings, the arrival of GenAI has ushered in a new era of innovation and efficiency. This literature review explores the growing field of GenAI applications in qualitative analysis, specifically focusing on the integration of LLMs to enhance the coding process, improve reproducibility, and foster a synergistic collaboration between human expertise and AI capabilities. The review then summarizes and synthesizes key findings from recent studies that explored the practical applications and implications of GenAI in qualitative research, highlighting both the advancements made and the challenges that need to be addressed.

Gamielien et al. (2023) illustrate the efficiency of LLMs like GPT-3.5 in qualitative coding. Their method algorithmically clusters over 10,000 exam responses, allowing human analysts to focus on interpreting meanings rather than manually identifying themes. This approach enhanced reproducibility due to consistent machine coding whereas human expertise contextualized AI-generated codes into broader concepts. This synergy between algorithmic processing and human interpretation addressed limitations inherent in each method when used alone, supporting the view that qualitative coding should not be entirely automated but should instead enhance the researcher's skills (Katz et al., 2024; Liu et al., 2023; Xiao et al., 2023).

Dai et al. (2023) proposed a collaborative framework involving humans and LLMs for thematic analysis. The objective was to utilize LLMs' predictive power to reduce the time and labour in qualitative coding, ensuring analytical quality. Their framework, which facilitated bidirectional communication between human coders and the LLM, allowed for iterative refinement of codes and themes. Their study demonstrated high inter-annotator agreement between human and LLM analyses, indicating that AI-generated codes were as reliable as those produced by human-only coding.

This research signifies an efficient emulation of human qualitative analysis tasks by GenAI systems, balancing computational scalability with human judgment. However, the study identified the need for further refinement in

prompt design and model variability to enhance the efficiency of this collaborative approach. Despite these challenges, the human-LLM framework offers a promising avenue for integrating the strengths of both human and AI methods in qualitative research.

Siiman et al. (2023) investigated the use of ChatGPT and GPT-4 for qualitative analysis of collaborative problem-solving discourse. They tested both deductive coding and inductive rubric generation, finding substantial interrater reliability (Cohen's $\kappa = 0.706$) when detailed prompts were used. However, inductive rubrics showed lower agreement, highlighting a need for further research in complex problem areas. The study suggests that AI-assisted analysis improves transparency and reproducibility, although human oversight is essential to mitigate bias and align with research objectives.

Chew et al. (2023) introduced "LLM-assisted content analysis" (LACA) to integrate LLMs into deductive coding in qualitative research. They compared GPT-3.5's performance with human coders across various datasets, finding that GPT-3.5 often matched human-level inter-rater reliability and was significantly more efficient. This finding suggests that LLMs can reduce the manual effort in deductive coding, although their serial API requests may not fully capture the potential efficiency gains.

Zhang et al. (2023) developed QualiGPT, a toolkit that utilizes LLMs for qualitative data analysis, to automate thematic analysis with customized prompts. Their tests showed that QualiGPT dramatically enhanced efficiency compared to manual coding and matched the accuracy of experienced researchers. The integration of techniques such as batching and role-playing in prompts addresses issues like context limitation and inconsistency, making QualiGPT a valuable tool for qualitative analysis and human-AI collaboration.

Gao et al. (2023) proposed CollabCoder, a system using LLMs for collaborative qualitative analysis. In a study with 16 participants, CollabCoder improved discussion quality and inter-rater reliability compared to traditional methods. The study noted that LLMs, as suggestion providers, reduce the cognitive load and improve efficiency. However, caution is needed to maintain human control and prevent overreliance on AI suggestions, ensuring balanced and unbiased analysis outcomes.

Finally, Perkins and Roe (2024) explored integrating Generative AI tools, specifically ChatGPT, into the inductive thematic analysis of qualitative data. They employed a dual-method approach where one researcher employs traditional manual coding, and another uses ChatGPT to assist in coding. The study highlighted the enhanced capacity for data processing and theme identification provided by GenAI, coupled with the interpretative depth of human analysis. Key findings included the increased efficiency and objectivity offered by GenAI tools and the challenges posed by inconsistencies and hallucinations in AI outputs. The research underscores the complementary relationship between GenAI and human expertise, advocating for their synergistic use to expedite analysis without compromising the essential role of human researchers.

Synthesis of the literature on GenAI in qualitative analysis

A common thread across studies, starting with Gamielidien et al. (2023) and extending through Dai et al. (2023) and Chew et al. (2023), is the significant efficiency gain offered by GenAI in the coding process. These studies collectively underscore how LLMs expedite the traditionally time-consuming task of coding without compromising the depth and quality of analysis. The ability of LLMs to rapidly process and cluster large volumes of data is a recurring highlight, suggesting a shift toward more scalable and less labour-intensive methods in qualitative research.

The studies by Siiman et al. (2023) and Gao et al. (2023) explored the dynamics of human-AI collaboration. They revealed that while LLMs can autonomously perform certain analytical tasks, the integration of human expertise was crucial for contextually rich and nuanced interpretations. This interplay between AI's computational power and human cognitive skills points to an optimal model of qualitative research that leverages the strengths of both entities. The collaborative framework proposed by Dai et al. (2023) exemplifies this synergy, highlighting the iterative refinement process that benefits from both AI efficiency and human judgment.

The advanced applications of GenAI in qualitative research are vividly demonstrated in the studies by Zhang et al. (2023) with QualiGPT and Gao et al. (2023) with CollabCoder, and Perkins and Roe (2024) with their innovative dual-method approach. These studies showcase the cutting-edge uses of LLMs in thematic analysis and collaborative qualitative analysis opening new avenues for methodological innovations. The capability of LLMs to serve as independent analytical tools or as facilitators in collaborative settings suggests a future where qualitative research can be more inclusive, diverse, and comprehensive in its analytical scope.

The potential of GenAI in qualitative research is evident, however, studies have collectively highlighted ongoing challenges, particularly in optimizing prompt design (Liu et al., 2023), ensuring model variability (Dai et al., 2023), and managing the risks of AI-induced biases (Siiman et al., 2023). Perkins and Roe (2024) further emphasized the necessity of addressing AI hallucinations and maintaining rigorous validation processes to ensure research validity. These considerations indicate the need to continuously refine AI tools and methodologies, ensuring they complement rather than replace human expertise.

In conclusion, the synthesis of these studies reveals a consistent narrative: GenAI, and specifically LLMs, are not only enhancing the efficiency and scalability of qualitative research but also enriching its depth and quality through synergistic human-AI collaboration. The future of qualitative research in educational settings, shaped by these advancements, appears poised for groundbreaking developments that balance technological innovation with the irreplaceable value of human insight.

Methodology

This study employed a mixed-methods comparative data analysis to examine the differences in findings and methods between a human research team and TRACER powered by GPT-4 API (an LLM) when analyzing the same data set. The primary objective was to explore the effectiveness and efficiency of the GenAI system compared to the human team in analyzing the data and identifying patterns and insights. The data set consisted of interview transcripts with educators who implemented a new mathematics instructional model in research schools between 2013 and 2015. The decision to use a mixed-methods approach was grounded in the need to capture both the qualitative richness of human interpretation and the quantitative efficiency and consistency of AI analysis. By integrating both qualitative and quantitative methods, this approach offers a comprehensive examination of the effectiveness, efficiency, and reliability of the GenAI system compared to traditional human-led thematic analysis.

Data collection

The data collection process for the original interviews involved research team members conducting face-to-face interviews with educators who implemented a new mathematics instructional model in research schools between 2013 and 2015 (see Preciado-Babb et al., 2015). The interviews were conducted face-to-face by research team members, each lasting approximately one hour, and were subsequently transcribed verbatim. Ethical considerations, including informed consent and participant anonymity, were rigorously maintained throughout the data collection process.

Data sources

The data used in this research consists of semi-structured interview transcripts with six educators. The transcripts contain approximately 67,200 words, including the interview questions and the educators' responses.

The semi-structured interview questions include:

- What specific advice would you offer to new Math Minds teachers?
- Have you benefited from materials?
- What specific advice would you give to new teachers joining Math Minds?
- Have you found [JUMP Math] materials to be helpful?
- Restrictive or difficult? To what extent did you follow the teachers' guide? SmartBoard lessons? Workbook?
- In what ways did you improvise / extend / elaborate? Have you found [JUMP Math] principles

- helpful? Restrictive or difficult?
- What are your goals or priorities for improving your teaching of math?

Research team analysis (qualitative component)

The research team utilized NVivo to analyze the interview transcripts, as it enhanced inter-coder reliability by providing a platform for consistent coding practices among multiple researchers (Limna, 2023). The primary focus of this analysis was to explore the impact of a new mathematics teaching model, as highlighted in the work of Preciado-Babb et al. (2015). The team employed a multifaceted approach to ensure the rigour and trustworthiness of their qualitative analysis.

Initially, multiple researchers independently coded the interview transcripts using NVivo. This phase involved identifying significant phrases, concepts, and emerging themes directly from the data. Each researcher applied an interpretive lens, marking segments of the data they deemed relevant to the study's objectives and theoretical underpinnings. Establishing inter-coder reliability was crucial, as it is a key measure of consistency in qualitative research. This process took approximately a week to complete.

After the independent coding process, the research team engaged in comprehensive discussions to reconcile any coding discrepancies. These discussions were not merely for resolving differences but served as a collaborative effort to deepen the collective understanding of the data. Often, these deliberations necessitated revisiting the transcripts to reassess and reinterpret the data, enriched by the insights gained from the group's collective analysis. This process also took about a week to complete.

To further validate the findings, the team employed data triangulation, comparing the qualitative findings from the transcripts with observational field notes. These notes offered additional insights into the context and subtleties of the teachers' experiences and actions. This triangulation process corroborated the themes identified from the transcripts, ensuring that the findings were anchored in a robust and diverse evidence base. This process took approximately four days to complete.

The culmination of this meticulous process was the derivation of themes. This step involved synthesizing the coded data to identify consistent patterns, relationships, and overarching concepts. Four themes emerged from this analysis, reflecting key insights into educators' use of resources in their documentation process. Identifying these four themes required approximately 20 days.

TRACER

TRACER is a web-based application designed to utilize GenAI to perform thematic analysis on interview transcripts. The program employs the GPT-4 API to identify recurring themes or patterns within the transcripts. To identify themes, the transcripts undergo several stages of processing (see

Figure 1). Initially, the user must input contextual information about the transcripts, such as the number of themes TRACER is instructed to find, who is being interviewed and the topic of the interview. This information is necessary for the model to accurately identify themes. The raw transcripts, which may be presented in various formats (e.g., .docx, .txt, .pdf), are read and converted into plain text format. In earlier versions of the program, all data were consolidated into a single large text file. However, upon examination, it was observed that the results exhibited a bias against the contents of the second half of the text file and disproportionately included themes from the first half of the text file. Consequently, the program was modified to ensure all transcripts were converted into separate text files, eliminating sectional bias. Subsequently, the text files are divided into smaller segments and then inputted into the GPT-4 API for vector space indexing.

TRACER analysis (quantitative component)

To perform the thematic analysis, TRACER is given a query string that defines the task. Prompt 1 is designed to analyze the transcripts, identify key themes, and support its analysis with a brief explanation for each transcript. The application then retrieves the identified themes from the vector space index of every transcript and saves them all into a single text file. To identify recurring themes from this text file, TRACER is given a new query with Prompt 2, which tasks the GPT-4 API with identifying the common threads connecting various ideas within a specific context. With each execution, the final output is saved with a timestamp, enabling easy identification and comparison with the research team's analysis.

A critical aspect of this method involves addressing the non-deterministic nature of the GPT-4 API. In GenAI systems, non-determinism implies that identical inputs might not always produce identical outputs due to inherent variations in the model's response generation. To counteract this variability and enhance the reliability of the thematic analysis, the temperature parameter in the GPT-4 API was set to zero. This setting minimizes the randomness in the LLM's responses, striving for more consistent outputs.

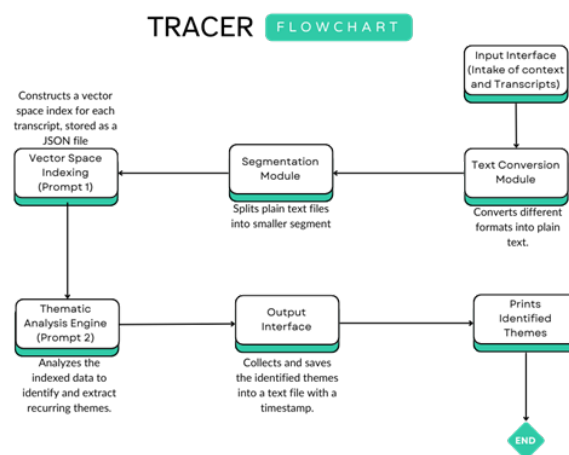


Figure 1. The workflow of TRACER.

The decision to run TRACER 100 times for each analysis task is particularly noteworthy. This repetition was not arbitrary but a carefully considered methodological choice, crucial for several reasons:

1. **Enhancing Reliability:** Running the program multiple times provided a broad sample of outputs, allowing the researcher to assess the consistency of the themes identified by TRACER. This approach was essential in evaluating the reliability of the AI tool, particularly given the non-deterministic nature of AI responses.
2. **Data Validity:** Multiple runs enabled the researcher to gauge the validity of the data. By analyzing the variance and similarities in the themes identified across different runs, the researcher determined the extent to which TRACER’s analysis aligned with the qualitative data’s inherent patterns and nuances.
3. **Statistical Robustness:** From a statistical standpoint, conducting numerous runs offered a substantial dataset for analysis. This robust dataset was pivotal in drawing reliable conclusions about the thematic trends and patterns identified by TRACER.
4. **Mitigating AI Model Variability:** Given the variability in GenAI model responses, multiple runs ensured a comprehensive exploration of the thematic space. This was particularly important for capturing a wide range of potential themes that a single run might not reveal.

Results

Following separate analyses conducted by the research team and the AI system, the researcher performed a comparative data analysis to evaluate the similarities and differences in the findings. This comparison aimed to assess the effectiveness and efficiency of the AI program in relation to the research team and to identify any unique insights or patterns that either method might have uncovered.

Results of the research team’s analysis

Preciado-Babb et al. (2015) organized the results into four sections, discussing how educators utilized the JUMP Math materials and applied Math Minds principles. The authors highlighted continuous assessment, bonusing, document genesis, and inquiry and problem-solving as themes extracted from analyzing the transcripts.

Continuous assessment was a recurring theme in the interviews, with educators using small whiteboards for in-the-moment assessments. The authors highlighted quotes from educators stating that this practice helped them understand students’ challenges and informed their decisions on whether to skip parts of the material.

Bonusing was also mentioned by all interviewed educators. The authors noted that many found it challenging to create bonus questions or tasks. Some educators believed that it was essential to personalize bonus questions for each student, while others found it easier to create bonus questions based on the structure of the material. For document genesis, the authors noted that teachers claimed to follow the teachers’ guide and use JUMP Math materials consistently. However, the study also noted that the teachers sometimes adapted the materials based on various factors, such as their experience, time constraints, familiarity with other resources, or adherence to Math Minds principles. Lastly, Preciado-Babb et al. (2015) stated that teachers consistently perceived a lack of opportunity for problem-solving or inquiry in the JUMP Math approach. While teachers acknowledged the importance of building a foundation through mini-steps, some expressed concerns about students not being accustomed to multi-step problems or inquiry-based learning.

Results of TRACER’s analysis

In this section, TRACER’s findings on the same data that the research team analyzed are presented. The AI analysis underwent several iterations, refining the prompts to align the outcomes with the research team’s findings (see Table 1 for prompt evaluation). This iterative process allowed for a more comprehensive comparison between the human and AI analyses.

Table 1. Evaluation of prompts.

	Iteration 1	Iteration 2	Iteration 3
Prompt 1	You are a thematic analysis bot. You analyze content from {transcripts}. The goal is to analyze the frequency of specific words, themes, or other characteristics in a set of content. Given this information, please answer the question: {what are the main themes?}. Always list your response	You are a content analysis bot. You analyze content from {transcripts}. The goal is to analyze the frequency of specific words, themes, or other characteristics in a set of content. Given this information, please answer the question: {what are four main themes?}. Always list your response.	You are a content analysis bot. You analyze content from {transcripts}. The goal is to analyze the frequency of specific words, themes, or other characteristics in a set of content. Given this information, please answer the question: {what are four main themes?}. Always list your response.
Prompt 2			You are given content containing a list of themes gathered from multiple transcripts. Your task is to analyze these themes and identify the four most frequent and central aspects related to teaching, materials, and assessment. Please consider the following instructions: Recognize semantically similar themes, even if they have different wording, and group them together. Focus on the common threads connecting various ideas within the context of teaching and assessment. Rank the themes based on their frequency, and present the top 4 most common themes. For each of the top 4 themes, provide a brief explanation of how it relates to teaching and assessment. Here is the content: {themes} Analyze the themes, and provide your insights on the most frequent and central aspects related to teaching and assessment.

Initially, TRACER was not given specific instructions on the number of themes to identify. The 100 executions of the application cumulatively lasted 3,760 seconds, meaning each execution averaged 37.6 seconds. After the executions, themes were extracted, and the researcher manually clustered the themes based on semantic similarity. This process lasted approximately an hour and involved a careful examination of the underlying ideas and patterns within the themes, enabling the researcher to categorize them into distinct clusters that represented broader, cohesive thematic concepts. Five themes were identified from 100 executions (see Table 2 for findings).

Table 2. Finding of TRACER after 100 executions first iteration.

Theme no.	Theme	Number of appearances
1	Breaking down Math into micro lessons	56
	The importance of breaking down concepts into microsteps	44
2	Constant assessment	46
	The importance of frequent assessment	39
	The use of frequent assessment	15
3	The need to create an environment where students feel comfortable and can experience success, regardless of their range of abilities	4
4	The importance of providing students with constant praise and encouragement when they are successful	2
5	The need for teachers to have a strong understanding of mathematics and the ability to unpack and provide answers	1

Themes that were present in every execution of TRACER are considered valid. Semantically similar variations of themes 1 and 2 appeared in 100% of the extracted themes. Consequently, TRACER identified only two themes: Micro-steps and Continuous Assessment. Although these themes were relevant, the findings were not as extensive as the research team's analysis, which identified four primary themes.

In response, Prompt 1 was revised and TRACER was instructed to find four main themes. This time, the 100 executions of the application cumulatively lasted 3802 seconds, with each execution averaging 38.02 seconds. The researcher then clustered the themes based on semantic similarity, and the process lasted approximately one hour. Table 3 displays the findings.

The results indicated that some semantically similar variations of the two themes of Micro-steps and Continuous Assessment appear in 100% of the findings. Semantically similar variations of the theme Bonus Questions appeared 66 times and were identified as the third theme due to their high frequency of occurrence. However, based on the results, it was not possible to identify the fourth theme. It seemed that TRACER's focus shifted primarily towards the student experience rather than the JUMP Math material and teaching strategies. Although these findings provided valuable insights into the student perspective, they did not completely align with the human research team's themes. Furthermore, there were too many variations in the findings, which impacted the validity of the results.

Table 3. Finding of TRACER after 100 executions second iteration.

Theme no.	Theme	Number of appearances
1	Breaking down Math into micro lessons	34
	The importance of breaking down concepts into microsteps	41
	The importance of breaking down concepts into smaller steps and providing clear instructions to students	25
2	Constant assessment	45
	The importance of frequent assessment	40
	The use of frequent assessment	15
3	The use of bonus questions	57
	The importance of using bonus questions	9
4	The importance of attention to mental math	7
5	The need to create an environment where students feel comfortable and can experience success, regardless of their range of abilities	5
6	The importance of providing students with constant praise and encouragement when they are successful	5
7	The need for teachers to have a strong understanding of mathematics and the ability to unpack and provide answers	4
8	The need to use experiences from the current year to shape teaching for the next year, and the potential for the JUMP program to be successful in helping students find success	4
9	The need to assess student understanding and address any gaps in knowledge	4
10	The importance of creating a lesson structure that encourages students to discover and explore together	3
11	The need for abstract thinking	2

In a final revision, the code was modified to instruct TRACER to save the themes gathered from each execution into one file. So, Prompt 1 remained unchanged. However, a second process was added in Prompt 2, which instructed TRACER to recognize semantically similar themes by reviewing all the themes identified by GPT-4 after each execution. The 100 executions of this version of TRACER lasted 4,288 seconds. Once again the researcher clustered the themes based on semantic similarity. This process lasted approximately 90 minutes. The headings are displayed in Table 3.

Table 4. Finding of TRACER after 100 executions third iteration.

Theme no.	Theme	Number of appearances
1	Breaking down tasks into smaller, more manageable steps	37
	Microsteps	31
	Breaking down tasks into microsteps	32
2	Constant assessment	84
	The importance of frequent assessment	12
	Assessment	4
3	Engaging students	54
	Engagement and motivation	46
4	Teacher preparation and comfort	31
	Teacher preparation	27
5	Comfort with new methods of teaching	26
	Comfort level	16

The results indicated that semantically similar variations of micro-steps appear in 100% of the findings. Similarly, semantically similar variations of continuous assessment also appeared in 100% of the findings. Moreover, semantically similar variations of student engagement also appeared in 100% of the findings. Semantically similar variations of

teacher preparation appear in 58% of the findings, and semantically similar variations of flexibility with new teaching methods appeared in 42% of the findings.

TRACER identified key themes in effective mathematics teaching and assessment, including the use of micro-steps for simplifying complex concepts, the role of continuous assessment in monitoring student progress, and the importance of student engagement and motivation through techniques like bonus questions. Another critical theme was teacher preparation, emphasizing the need for educators to be well-versed in new teaching methods and adaptable in material presentation.

TRACER's analysis, refined through several iterations and prompt adjustments, closely aligns with the research team's findings. This iterative process highlighted the importance of specific prompts in guiding GenAI's analysis to desired outcomes. Tailoring prompts to focus on a number of themes, subject matter, and analysis goals significantly improved the GenAI's relevance and accuracy. The study illustrates GenAI's potential in qualitative research with precise instructions and underlines the necessity of continuous human oversight to ensure contextually accurate AI analysis.

Discussion

Efficiency of TRACER in thematic analysis

The adoption of GenAI via tools such as TRACER in educational research has potentially and significantly improved efficiency in thematic analysis, particularly in terms of time and resource utilization. This development addresses a key challenge in qualitative research: the labour-intensive nature of data analysis (Bogdan & Biklen, 2008). In this study, TRACER significantly expedited the thematic analysis process compared to the human research team. For instance, tasks that took the human team 20 days were completed by TRACER and one researcher in mere hours. This efficiency gain echoed the findings of Gamieldien et al. (2023) regarding the time-saving capabilities of Large Language Models in data coding.

This enhanced efficiency has substantial implications for larger-scale qualitative studies in education. It enables researchers to handle more extensive datasets more feasibly, potentially leading to richer insights and a deeper understanding of complex educational phenomena. Therefore, the integration of TRACER marks a significant advancement in educational research methodologies, addressing time and resource constraints and facilitating more comprehensive qualitative analyses.

Reproducibility and consistency of TRACER findings

The comparative analysis of themes identified by TRACER and the research team offers a unique perspective on the reproducibility and consistency of GenAI in qualitative analysis. This comparison is crucial in understanding the reliability of GenAI tools such as TRACER in capturing the nuances of educational research data.

Thematic alignment between TRACER and the human research team

Both TRACER and the research team identified key themes related to educational practices and teaching methodologies, although they varied in labelling and focus. For instance, both TRACER and the human team recognized the theme of continuous assessment, which is crucial for understanding teaching dynamics. This alignment signifies a level of consistency in GenAI's ability to identify major themes that are also discernible to human analysts. Similarly, the theme of microsteps, although not initially labelled as a distinct theme by the research team, was later acknowledged in their subsequent research (Metz et al., 2016). TRACER's identification of this theme aligns with the human team's findings, indicating GenAI's potential to uncover underlying patterns that might not be immediately apparent even to experienced researchers. However, discrepancies were also noted. For instance, the research team's identification of the theme related to inquiry and problem-solving was not mirrored in TRACER's analysis. This divergence could stem from differences in the analytical focus and the specific prompts guiding TRACER, highlighting the importance of prompt design in directing AI analysis (Short & Short, 2023).

Reliability of GenAI in qualitative analysis

The reproducibility and consistency of findings are critical metrics in assessing the reliability of any analytical tool. In the case of TRACER, the repeated identification of certain key themes across multiple analyses suggests a high degree of reproducibility. This consistency is particularly noteworthy given the non-deterministic nature of AI responses (Yang & Menczer, 2023). It demonstrates that with carefully designed prompts and a structured analytical approach, GenAI can reliably identify major themes in qualitative data.

However, the lack of contextual understanding and the dependence on specific prompts are limitations that need to be acknowledged (Ray, 2023; Sun & Hoelscher, 2023). Although TRACER effectively identified several key themes, its analysis might overlook subtleties that human analysts, with their contextual knowledge and interpretive skills, could capture (Byrne, 2022; Joffe, 2011). This aspect underscores the complementary roles of human analysts and GenAI in qualitative research.

Integration and synergy of human and AI analysis

The integration of GenAI tools such as TRACER with human expertise in qualitative analysis reveals a complementary relationship that enhances the overall depth and breadth of research. This synergy leverages the strengths of both AI-driven analysis and human interpretation, facilitating a more nuanced and comprehensive understanding of educational research data.

TRACER's AI-driven analysis excels in efficiently processing large volumes of data, identifying recurring themes, and providing consistent results. Its capability to rapidly analyze and code data allows for the handling of extensive datasets,

which might be challenging and time-consuming for human researchers (Haleem et al., 2022; Lund et al., 2023; Perkins & Roe, 2024). However, GenAI tools like TRACER may lack the nuanced understanding and contextual awareness that human analysts bring. Researchers possess the ability to interpret data beyond its explicit content, drawing on their expertise, experience, and understanding of the educational context (Byrne, 2022; Joffe, 2011).

Reflecting on the experience of designing, developing, and deploying TRACER to harness the full potential of both GenAI and human expertise, several strategies can be adopted:

1. **Iterative Collaboration:** Researchers should implement an iterative process to review and refine initial AI-generated themes. This approach contextualizes AI findings and ensures that the final themes accurately reflect the depth of the data
2. **Prompt Design and Calibration:** AI prompts must be designed carefully to align with the research objectives and context. Regular calibration of these prompts based on feedback guides the AI analysis toward more relevant and contextually appropriate themes.
3. **Blended Analysis Teams:** Teams comprising both AI tools and analysts should be established. AI handles the initial data processing, allowing researchers to focus on interpreting and contextualizing the findings, thus creating a balanced and efficient workflow.
4. **Training and Sensitization:** Researchers should receive training to interact effectively with AI tools, understanding their capabilities and limitations. Simultaneously, AI systems should be sensitized to the specific nuances of educational research through continuous learning and feedback loops.

Limitations of the current study

This study demonstrates TRACER's capabilities in educational research, yet it has limitations that need acknowledgment for a comprehensive understanding of its results and implications. The focus on a specific set of educational research transcripts limits generalizability, as educational research varies across subjects, educational levels, and cultural contexts. Thus, TRACER's efficacy in different educational settings remains untested, potentially limiting its applicability across diverse educational research scenarios.

Moreover, although TRACER efficiently identifies key themes, its performance in deeper interpretive tasks, such as understanding context and subtle nuances, is less robust compared to human analysts. The tool's reliance on precisely designed prompts also raises concerns about its autonomy in theme identification. Methodologically, the study's comparative analysis might not fully reflect the complexities of qualitative data, emphasizing thematic consistency over thematic richness and depth. Furthermore, the dynamics of human-AI collaboration in qualitative analysis are

not thoroughly explored, particularly the integration of human intuition and expertise with AI-generated themes. Understanding how human and AI analyses can effectively complement each other remains a crucial area for further research.

Implications for research

The findings of this study have significant implications for the integration of GenAI into qualitative research in educational settings. By demonstrating that TRACER can efficiently and consistently perform thematic analysis on qualitative data, this study suggests that AI tools have the potential to significantly enhance the research process. However, the implications extend beyond mere efficiency gains, encompassing broader considerations for the future of qualitative research and the role of AI in academic inquiry.

1. **Enhanced Efficiency and Scalability:** The use of TRACER has shown that GenAI can drastically reduce the time and resources required for thematic analysis. This efficiency enables researchers to handle larger datasets more feasibly, potentially leading to richer insights and a deeper understanding of complex educational phenomena. As educational research often involves extensive qualitative data, such as interviews and classroom observations, the ability to process this data quickly and accurately is invaluable.
2. **Reproducibility and Consistency:** The study highlights the consistency of AI-driven analysis, as TRACER was able to reproduce key themes across multiple executions. This reproducibility addresses a critical challenge in qualitative research, where human analysis can be subject to variability. The ability to achieve consistent results across different iterations of analysis strengthens the reliability of research findings and supports the generalizability of the results.
3. **Complementary Role of Human-AI Collaboration:** The findings underscore the potential for a synergistic relationship between human researchers and AI tools. While AI can efficiently identify and categorize themes, human researchers bring essential contextual understanding and interpretative depth. This collaboration can lead to more comprehensive and nuanced analyses, suggesting a future where AI assists in the initial stages of analysis, allowing researchers to focus on deeper interpretative tasks.
4. **Implications for Training and Methodological Development:** As AI tools like TRACER become more integrated into research, there will be a need for researchers to develop new skills in interacting with these tools. This includes understanding how to design effective prompts, interpret AI-generated outputs, and integrate these findings with traditional qualitative methods. Institutions

may need to offer training and support to help researchers effectively use AI in their work, ensuring that the tools complement rather than replace human expertise.

Potential for further research

The integration of GenAI tools such as TRACER into educational research presents several avenues for future exploration to enhance their application and effectiveness. Key areas for future research include:

1. **Diversifying Educational Contexts:** Researchers should investigate GenAI tools across various academic disciplines, educational stages, and cultural settings. This research will provide insights into the adaptability and scalability of GenAI in different educational environments, thereby assessing its flexibility and effectiveness more broadly.
2. **Enhancing Interpretive Capabilities:** Developing advanced natural language processing techniques to improve GenAI's understanding of context, subtleties, and implicit meanings in qualitative data is crucial. Research aimed at enabling GenAI tools to mimic human-like interpretive skills will significantly advance the field.
3. **Integrating GenAI with Human Expertise:** Collaborative frameworks that combine AI-generated themes with human analytical depth should be investigated. This approach, leveraging AI's efficiency and human interpretive skills, will ensure a balanced and comprehensive analysis.
4. **Training and Continuous Learning:** Researchers must be equipped with the skills to effectively use GenAI tools. Concurrently, refining GenAI through diverse data inputs and human feedback will enhance its accuracy and relevance in educational research.
5. **Addressing Ethical Implications:** As GenAI gains prominence in educational research, understanding its ethical implications becomes critical. Future research should focus on issues such as data privacy, consent, and potential biases in AI algorithms, thereby establishing ethical guidelines for GenAI use in research.

These future directions underscore the need for continuous innovation, ethical consideration, and collaborative efforts in harnessing GenAI's potential in educational research.

Conclusion

This study has explored the integration of GenAI, specifically through the TRACER tool, into the qualitative analysis of educational research data. By comparing TRACER's AI-driven analysis with traditional human-led thematic analysis, the research highlights both the potential and limitations

of using AI in qualitative research. TRACER demonstrated significant efficiency, consistently identifying key themes across multiple runs and reducing the time and resources typically required for qualitative analysis. This efficiency enables researchers to manage larger datasets, leading to potentially richer insights and more comprehensive understandings of complex educational phenomena.

However, the study also underscored the importance of human involvement in qualitative research. While TRACER was effective in identifying broad themes, the depth of interpretation and contextual understanding provided by human researchers remains irreplaceable. The findings suggest that a synergistic approach, where AI tools like TRACER are used in tandem with human expertise, can enhance the overall quality of qualitative research. This collaboration allows for the strengths of both AI efficiency and human interpretative depth to be fully realized.

The implications of this study extend to the broader field of educational research, suggesting that the future of qualitative analysis may lie in the integration of AI and human capabilities. As AI tools become more sophisticated, there will be a growing need for researchers to develop the skills necessary to interact effectively with these tools, ensuring that they complement rather than replace human expertise. Additionally, the ethical considerations surrounding AI in research, such as data privacy and algorithmic biases, must be carefully addressed to maintain the integrity of academic inquiry.

In conclusion, the study contributes to the ongoing dialogue about the role of AI in qualitative research, particularly in educational settings. It offers insights into how AI can be harnessed to enhance research processes while also emphasizing the continued importance of human judgment and expertise. As the field evolves, further research is needed to explore the full potential of AI-human collaboration in qualitative analysis, ensuring that both technology and human insight are leveraged to their fullest extent in advancing educational research.

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Promoting active learning with ChatGPT: A constructivist approach in Sri Lankan higher education

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Abstract

This study investigates strategies for transforming traditional didactic learning environments into active ones using ChatGPT in a resource-constrained higher education setting in Sri Lanka. It identifies 16 strategies categorized under five constructivist learning themes: active learning, social interaction, contextual learning, scaffolding, and reflective thinking. These practices leverage ChatGPT to personalize learning, foster critical thinking, encourage collaboration, enhance teaching strategies, and offer immediate feedback, addressing educational challenges in developing countries. The findings extend constructivist learning theory by demonstrating AI's role in facilitating interactive, learner-centered experiences. The study also highlights educators' evolving role as collaborators with AI, providing personalized support and interactive learning experiences. Practical implications include the immediate applicability of these practices in resource-constrained settings without additional resources, offering a cost-effective solution for enhancing educational quality. However, limitations such as the study's generalizability to other contexts and the need to investigate potential negative impacts of AI are acknowledged. Future research should explore the integration of multiple AI tools and conduct similar studies in large classrooms and different contexts to enhance generalizability. Expanding this research can help leverage technology to improve educational outcomes and create sustainable, resource-efficient learning environments in the developing world.

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Introduction

Higher education systems in developing countries often face significant challenges, including limited resources, large class sizes (Glewwe & Muralidharan, 2016), and a reliance on rote memorization (Bano & Taylor, 2015; Porcaro, 2011). These constraints often lead to didactic learning environments where students receive information without active engagement. This traditional approach can hinder critical thinking and problem-solving skills, which are essential for student development and future success (Chacon & Janssen, 2021).

Technology, however, is a great leveller, offering tools that can potentially transform educational practices. ChatGPT, a powerful AI language model, is widely used by students and teachers globally. Leveraging ChatGPT in educational settings can significantly transform didactic learning environments into active ones (Al Shloul et al., 2024; Yu, 2024). By providing personalized learning, fostering critical thinking, encouraging collaboration, enhancing teaching strategies, and offering immediate feedback, ChatGPT has the potential to address some of the most pressing challenges in developing education systems (Al Shloul et al., 2024; Yu, 2024). This technology-driven approach can lead to more engaging, effective, and equitable learning experiences for students, preparing them better for future academic and professional undertakings.

Despite its widespread usage and capabilities, there is a shortage of empirical research on how ChatGPT can be utilized to convert a traditional, didactic learning environment into an active learning one. Moreover, Al Shloul et al. (2024) requested to conduct more empirical research on the strategies that would enable educators to integrate ChatGPT into curricula. Therefore, to address this gap, this study investigates strategies for converting a didactic learning environment into an active learning environment in a resource-constrained higher education setting in Sri Lanka using ChatGPT.

The trend among elite Western higher educational institutions is to create constructivist active learning environments that involve students engaging with the learning material, actively participating in the learning process, and developing higher-order thinking skills, all of which are crucial for a robust educational experience (Porcaro, 2011). Therefore, this study uses the constructivist learning theory as the overarching framework for identifying strategies. Based on this background, the aim of this study is to investigate strategies from the perspective of constructivist learning theory for converting traditional, didactic learning environments into active learning ones utilizing ChatGPT in a resource-constrained higher education setting in Sri Lanka. The significance of this study lies in its potential to bridge the gap between traditional and modern educational practices in resource-constrained settings. By demonstrating how ChatGPT can be used to facilitate active learning, this research could provide a model for educators in developing countries to enhance student engagement and learning outcomes, ultimately contributing to a more equitable and effective education system globally.

The rest of the article is organized into five more sections. Immediately following this section, the literature review is presented, predominantly aiming to identify the main themes related to constructivist learning theory. Next, the methodology section explains how the author blended action research with qualitative research methods to produce findings. This is followed by the findings section, which discusses the main findings of the research and presents the strategies identified. The discussion section follows, presenting implications, limitations, and suggestions for future research. Finally, the conclusion section presents the overall essence of the study.

Literature review

This section presents a more comprehensive discussion on the nature of learning in developing countries, establishing the justification for interventions that promote active learning in higher education. Following this, a discussion on ChatGPT in education explains how ChatGPT is already being used worldwide to enhance learning environments. The final section of the literature review discusses five key characteristics essential for building constructivist active learning environments. Furthermore, it presents how technology has been successfully used in various contexts to assist educators in creating these environments by leveraging these five characteristics.

Learning in developing countries

The nature of learning in developing countries is often characterized by didactic teaching methods, where the teacher is the central figure, and students are passive recipients of information (Schweisfurth, 2023). As mentioned earlier, this traditional approach emphasizes rote memorization and repetition, with less emphasis on critical thinking, creativity, and active learner engagement (Snyder & Snyder, 2008). Such a mode of learning is prevalent due to various socio-economic, cultural, and infrastructural factors (Starkey, 2019). Some commonly discussed factors in past research are outlined in this section.

Research indicates that the didactic approach dominates classrooms in developing countries, significantly impacting the quality of education (Schweisfurth, 2011). For instance, Hardman et al. (2008) found that in sub-Saharan African classrooms, teachers primarily employ direct instruction methods, with limited opportunities for students to engage in dialogue, ask questions, or participate in interactive activities. This approach often leads to superficial learning, where students may pass exams but lack deep understanding and the ability to apply knowledge in real-life situations. Furthermore, Schweisfurth (2023) argues that the current discourse on education in lower- and middle-income countries highlights a crisis in teaching, characterized by poor teaching practices and minimal student learning, a situation worsened by the COVID-19 pandemic and referred to as 'disaster didacticism' due to its patronizing tone and focus on moral instruction.

Several factors contribute to the persistence of didactic learning. One major factor is the high student-to-teacher ratio, which makes individualized attention and interactive teaching methods challenging (Schweisfurth & Elliott, 2019). UNESCO (2014) reported that in many developing countries, classrooms are overcrowded, making it difficult for teachers to manage classes effectively and engage students in participatory learning activities. Additionally, limited resources and infrastructure constrain the implementation of more interactive and student-centered teaching methods (Glewwe & Muralidharan, 2016).

Cultural expectations and examination-oriented education systems also play a significant role. In many developing countries, success is measured by students' performance in standardized exams, which encourages teachers to focus on exam preparation through rote learning (Chisholm, 2004). This emphasis on examination results often sidelines the development of critical thinking and problem-solving skills (Snyder & Snyder, 2008).

In conclusion, the predominant mode of learning in developing countries remains didactic, limiting students' engagement and deeper understanding. Nonetheless, there is growing recognition of the need for educational reforms to promote more active and meaningful learning. A study by RTI International (2014) suggests that interventions aimed at improving teacher pedagogy and incorporating active learning strategies can lead to significant improvements in student outcomes.

ChatGPT in education

Building on the recognition of the need for educational reforms to promote more active and meaningful learning, innovative technologies like ChatGPT, a language model developed by OpenAI, have received significant attention for their potential applications in education. As an advanced AI, ChatGPT can engage in human-like conversations, providing personalized responses, explanations, and feedback, making it a valuable tool for enhancing educational experiences.

One key area where ChatGPT shows promise is tutoring and personalized learning, ensuring student-centered learning by adapting to each learner's individual needs (Kamali et al., 2024; Leite, 2024). Its ability to provide instant feedback and answer a wide range of questions allows for individualized learning experiences (Javaid et al., 2023). For example, Javaid et al. (2023) highlight that ChatGPT can serve as a virtual tutor, helping students with homework, explaining complex concepts, and offering tailored guidance based on individual learning needs. This personalized interaction fosters an environment where students can learn at their own pace (Hasanein et al., 2024; Hasanein & Sobaih, 2023), leading to improved understanding and retention of information.

In addition to personalized tutoring, ChatGPT can support collaborative learning and foster critical thinking skills (Guo & Lee, 2023), both crucial components of student-centered learning. According to Rasul et al. (2023), ChatGPT can facilitate group discussions and collaborative projects by generating ideas, posing thought-provoking questions,

and summarizing discussions. This can enhance students' engagement and encourage deeper exploration of topics. Furthermore, its ability to simulate Socratic questioning helps develop students' critical thinking and problem-solving skills, placing students at the center of their own learning processes (Etori & Gini, 2024).

Another significant application of ChatGPT is in the area of study skills and academic support, which ensures student-centered learning by providing resources tailored to individual student needs. Research by Hasanein and Sobaih (2023) and Hasanein et al. (2024) indicate that ChatGPT can assist students in developing effective study strategies, time management skills, and organizational techniques. By offering personalized advice and reminders, ChatGPT helps students plan their study schedules, set achievable goals, and maintain focus, thereby enhancing their overall academic performance.

However, the use of ChatGPT in education also raises ethical considerations that need to be addressed to maintain a truly student-centered approach. Concerns about data privacy, the potential for AI-generated misinformation, and the reliance on technology for learning must be carefully managed (Guo & Lee, 2023). Educators must ensure that AI tools like ChatGPT are used responsibly and supplement traditional teaching methods rather than replace them (Javaid et al., 2023), ensuring that the focus remains on enhancing the student's learning experience (Montenegro-Rueda et al., 2023).

In conclusion, ChatGPT holds significant potential for enhancing educational experiences through personalized tutoring, collaborative learning support, and academic skill development, all of which promote student-centered learning. While its benefits are promising, careful consideration of ethical implications and integration with conventional teaching practices is essential for maximizing its positive impact on education. Overall, this discussion suggests that ChatGPT has the ingredients to act as a supportive tool for teachers or tutors to create constructivist active learning environments.

Constructivist learning theory and the role of technology in constructivist learning environments

Constructivist learning theory suggests that learners construct their own understanding and knowledge through experiences and reflecting on those experiences (Oliver, 2000). This theory, rooted in the works of Jean Piaget and Lev Vygotsky, emphasizes active learning (Anthony, 1996), social interaction (Knapp, 2018), contextual learning (Yilmaz, 2008), scaffolding (Vygotsky, 1978), and reflective thinking (von Glasersfeld, 1995). Learners are seen as active participants who engage in hands-on activities, promoting exploration and discovery (Parker et al., 2010; Vygotsky, 1978). Social interaction is crucial as learning is viewed as a social activity, where interaction with peers, teachers, and others aids cognitive development (Vygotsky, 1978). Contextual learning emphasizes the importance of situating knowledge within a context, making learning more meaningful (Brown et al., 1989). Scaffolding provides necessary support from

teachers and peers to help learners achieve tasks they cannot complete independently (Wood et al., 1976). Reflective thinking involves learners reflecting on their experiences to develop deeper understanding and make connections to prior knowledge (von Glasersfeld, 1995).

Recent research explores how various technologies can enhance constructivist learning environments. Interactive simulations and virtual labs offer hands-on, exploratory learning in a safe environment. For instance, De Jong and Van Joolingen (1998) found that computer simulations enhance inquiry-based learning by allowing students to experiment and manipulate variables. Rutten et al. (2012) noted significant benefits of virtual labs in science education, helping students grasp complex concepts through direct interaction. Web-based collaborative tools, such as wikis and discussion forums, support the social aspect of learning. Biasutti (2011) showed that these tools facilitate peer interaction, knowledge sharing, and collective problem-solving in music education. Hrastinski (2009) highlighted that online collaboration platforms enable asynchronous communication, allowing learners to engage in reflective thinking and in-depth discussion.

Educational games and gamification align well with constructivist principles by providing engaging learning experiences. Gee (2003) argued that video games create environments for situated learning where players must apply knowledge in context. Papastergiou (2009) demonstrated that educational games could improve motivation and learning outcomes in computer science by presenting challenges that require critical thinking and problem-solving. Augmented reality (AR) and virtual reality (VR) create immersive learning experiences that bring abstract concepts to life. Khan et al. (2019) argue that AR applications enhance engagement, motivation, and learning by overlaying digital information onto the real world. Asad et al. (2021) reviewed VR's impact on education and concluded that VR environments provide opportunities for experiential learning and simulate real-world scenarios.

Learning Management Systems (LMS) and e-portfolios support scaffolding and reflective learning. Kumar and Sharma (2016) highlighted LMS's role in providing structured learning paths, resources, and feedback, aiding students' progress. Barrett (2007) discussed how e-portfolios encourage learners to collect, reflect on, and present their work, fostering a deeper understanding and personal connection to their learning experiences.

In conclusion, constructivist learning theory emphasizes the importance of active, social, contextual, scaffolded, and reflective learning. Technology, when integrated thoughtfully, can significantly enhance constructivist learning environments by providing interactive, collaborative, immersive, and reflective tools that align with these principles. The evidence from recent journal papers demonstrates that technologies such as interactive simulations, collaborative online tools, educational games, AR/VR, LMS, and e-portfolios create rich, engaging, and effective constructivist learning experiences. This is a clear indication that technology such as ChatGPT might also be used to construct a learning environment that is active,

social, contextual, scaffolded, and reflective.

Methodology

This research adopts an action research methodology conducted in the context of a Sri Lankan university where the learning environment is predominantly didactic. The focus was on transforming a selected traditionally didactic learning environment into an active, constructivist one by leveraging ChatGPT to incorporate active learning strategies. The study was conducted from April 2023 to June 2023, involving undergraduate students enrolled in a project management course. The class size was 43 students. This approach was implemented over a 12-week period.

Action research was selected because it is inherently reflective and iterative, allowing the researcher to evaluate and improve their practice continuously. As McNiff (2016) argues, action research is about evaluating your practice to check whether it is as good as you would like it to be, identifying areas that you feel need improving, and finding ways to improve them. This approach is particularly suited for educational settings where ongoing assessment and adaptation are crucial for enhancing teaching and learning outcomes.

Intervention design

Pre-class preparation involved providing students with learning materials related to the upcoming week's topic. Each week, starting from the first week, students received a maximum of three YouTube videos, one or two case studies prepared with the assistance of ChatGPT, and two to three pages from a textbook. Students were requested to review these materials before attending the class.

In-class activities included a brief 15–20-minute lecture that highlighted the key concepts of the week and introduced a relevant case study prepared using ChatGPT. The class was then divided into six groups, where students engaged in discussions for 45 minutes to one hour. During this time, the researcher actively participated with each group, encouraging constructive discussions and ensuring active participation. Students were encouraged to use ChatGPT to help construct their answers, with an initial briefing on AI hallucination and the importance of verifying information. Following the group discussions, each group presented their findings in a five- to eight-minute presentation.

Post-class activities involved sharing sample answers for the case study, prepared with the assistance of ChatGPT. These sample answers were shared with students to review between classes. This activity was not made mandatory.

Data collection

At the end of the 12-week intervention, the researcher conducted one-to-one semi-structured interviews with students to gather qualitative feedback on their experiences. A total of 15 interviews were conducted, each lasting

between one hour to one and a half hours. Respondents were selected using a convenience sampling method, as this technique has been used in previous educational studies (e.g., Holbrey, 2020). An open invitation was sent to all students who attended at least one class of the session, inviting them to join a semi-structured interview. It was assumed that the students who participated did so with informed consent. During the interviews, the researcher took detailed notes and documented responses to capture important insights and observations from the participants. This thorough documentation ensured that all significant points raised by the students were recorded for analysis.

The semi-structured interviews focused on the five characteristics of constructivist learning theory, namely, active learning, social interaction, contextual learning, scaffolding, and reflective thinking. The researcher stopped conducting interviews after the 15th interview, as no new information was being revealed, indicating data saturation.

Even though the researcher conducted semi-structured interviews, to guide each interview, the researcher developed 26 questions corresponding to five characteristics of a constructivist learning environment. These questions were formulated using two questionnaires borrowed from Aldridge et al. (2000) and Alqahtani et al. (2023), which are related to constructivist learning in higher education settings. Once the 26 questions were formulated, they were presented to academic colleagues to obtain their opinions and ensure face and content validity (Holbrey, 2020).

Data analysis

The qualitative data from the interviews were analyzed to assess the impact of the intervention on students' learning experiences. The analysis aimed to identify themes and patterns related to the effectiveness of using ChatGPT and the constructivist learning approach in enhancing student engagement and learning outcomes.

The collected data from semi-structured interviews and notes were synthesized to identify recurring themes and patterns related to the effectiveness of leveraging ChatGPT in a constructivist learning environment. This synthesis process involved reviewing all the interview notes to find commonalities and differences in students' experiences and perceptions.

Manual thematic analysis was employed to systematically identify, analyze, and interpret patterns or themes within the data. This method helped uncover underlying meanings and understandings regarding the use of ChatGPT for active learning in a traditionally didactic setting. The themes were categorized under the five characteristics of constructivist learning, namely, active learning, social interaction, contextual learning, scaffolding, and reflective thinking. Categories were mainly identified by the 26 questions formulated for the semi-structured interviews. These categories were developed to organize and classify the identified themes or patterns. This structured approach allowed for a detailed analysis of the data, ensuring that all relevant aspects of the students' experiences were considered.

The researcher interpreted the synthesized content within the context of constructivist learning theory. This involved understanding how the themes and categories aligned with the principles of constructivist learning, such as fostering student engagement, promoting social interaction, and facilitating reflective thinking. The interpretation also considered the role of ChatGPT in supporting these educational practices. By following these steps, the data analysis provided a comprehensive understanding of the impact of using ChatGPT to transform a didactic learning environment into a more active, constructivist one.

Findings

The findings of this study provide a detailed examination of the transformative potential of integrating ChatGPT into a traditionally didactic learning environment, particularly within the context of higher education in Sri Lanka. Divided into five thematic sections based on constructivist learning theory, the insights collected from student feedback during the data collection phase emphasize the multifaceted benefits of this approach.

Active learning

When exploring active learning, students felt a clear shift from merely receiving information to being actively involved with their learning. They mentioned how using ChatGPT in group discussions helped them think more critically and apply what they were learning independently. One student said, "With ChatGPT, our discussions became more engaging, and it felt like we were really taking charge of our learning." This aligns with previous research by Prince (2004), which emphasizes that active learning strategies significantly enhance student engagement and comprehension. Moreover, the findings clearly suggest that the researcher created an active learning environment by implementing several strategies by leveraging ChatGPT. These strategies are discussed in the remainder of this section.

To further promote opportunities for engagement, educators can implement problem-based learning (PBL), where ChatGPT aids in researching real-world issues and brainstorming solutions. This transformation encourages students to investigate real problems actively and seek out solutions, fostering deeper engagement with the material. One student shared, "ChatGPT helped us explore current global issues in depth, making our learning feel more relevant and impactful." Using ChatGPT to generate case studies can also make discussions more relevant and interactive, thereby enhancing students' learning experience. According to Hung (2019), PBL fosters intrinsic motivation and active engagement by presenting students with authentic problems to solve. This highlights how tools like ChatGPT can enhance PBL by making learning more relevant and impactful, ultimately promoting deeper student engagement.

In terms of skill development, ChatGPT can be used to personalize learning experiences by providing tailored exercises and feedback, thus aiding in the development of

critical skills. This allows students to apply their learning in practical contexts, enhancing their competency and understanding. One student noted, "the instant feedback from ChatGPT helped me refine my problem-solving techniques on the spot." ChatGPT can also support skill-building workshops by offering instant feedback and additional resources, making learning more efficient and targeted. According to Haleem et al. (2022), the integration of technology in education supports the development of critical thinking and practical skills necessary for academic success. This reinforces the argument that personalized learning and immediate feedback, as provided by ChatGPT, are vital for developing these essential skills.

For participation, using ChatGPT in case study sessions can increase student participation by aiding in data collection and analysis. ChatGPT's role in guiding discussions and providing real-time feedback ensures that students are actively contributing and collaborating. One student said, "having ChatGPT in our group projects made everyone more involved, as we could all interact with the AI and contribute equally." This interactive approach transforms the learning environment into a more dynamic and participatory space where students feel more involved and responsible for their learning process. According to Gopinathan et al. (2022), collaborative learning environments foster higher student engagement and participation, leading to better learning outcomes. This explains how integrating ChatGPT into case study sessions can enhance student involvement and improve educational experiences.

Thus, the section outlines three strategies for enhancing active learning with ChatGPT. First, implementing Problem-Based Learning (PBL) with ChatGPT helps students research real-world issues and brainstorm solutions, fostering deeper engagement and relevance in their studies. Second, personalized learning experiences through ChatGPT, which provides tailored exercises and instant feedback and enhances students' critical skills and practical understanding. Finally, integrating ChatGPT into case study sessions increases student participation by aiding in data collection and analysis, guiding discussions, and ensuring active collaboration. These practices create a more dynamic, engaging, and effective learning environment.

Social interaction

When exploring the theme of social interaction, students noted the collaborative nature of the learning environment fostered by ChatGPT. Group discussions facilitated by the AI model provided a platform for diverse perspectives to be shared and explored. Students lauded the inclusive nature of these exchanges, noting how ChatGPT served as both a facilitator and participant in the collaborative learning process, enhancing the overall richness of classroom interactions. One student highlighted this, saying, "ChatGPT made our discussions more inclusive. It encouraged everyone to participate and brought in different viewpoints, making the learning experience more dynamic." This finding resonates with Vygotsky (1978) social development theory, which argues that social interaction plays a fundamental role in the development of cognition.

To promote social interaction, educators can implement several strategies using ChatGPT. First, incorporating collaborative learning activities with ChatGPT encourages peer collaboration, where students can work together on projects and assignments. This approach fosters a sense of community and shared responsibility in the learning process. One student shared, "Working with ChatGPT in our group projects helped us collaborate more effectively and learn from each other's perspectives." This aligns with Prichard et al. (2006) research, which shows that collaborative learning enhances student achievement and interpersonal skills. Therefore, integrating ChatGPT into collaborative activities boosts social interaction by encouraging effective collaboration and peer learning, ultimately reinforcing positive educational outcomes.

Second, ChatGPT can facilitate peer collaboration by providing a platform for students to interact and exchange ideas in real time. This enables students to express their original ideas and discuss problems with their peers, leading to a richer learning experience. A student remarked, "ChatGPT allowed us to brainstorm and discuss our ideas freely, making our group work more productive and enjoyable." According to Van Ryzin et al. (2020), cooperative learning strategies that promote peer interaction can significantly enhance students' academic performance and social development. Thus, integrating ChatGPT into collaborative activities enhances social interaction by fostering real-time communication and effective group discussions.

Third, integrating ChatGPT into classroom discussions can enhance the expression and discussion of original ideas. By offering prompts and feedback, ChatGPT encourages students to articulate their thoughts and engage in meaningful conversations. One student mentioned, "With ChatGPT, I felt more confident in expressing my ideas during discussions, knowing that I had an AI tool to support my arguments." This is supported by Oros's (2007) research which highlights the importance of structured interactions in promoting active participation and critical thinking. Therefore, leveraging ChatGPT in discussions not only boosts students' confidence but also enriches the overall quality of classroom interactions by fostering critical thinking and active engagement.

Finally, ChatGPT can help students understand and appreciate the influence of their peers' ideas. By facilitating discussions and providing diverse perspectives, ChatGPT enables students to consider different viewpoints and integrate them into their own understanding. A student observed, "ChatGPT helped us see things from different angles, which made our discussions more insightful and comprehensive." This is consistent with Bandura's (1986) social learning theory, which emphasizes the role of observational learning and imitation in cognitive development. Thus, integrating ChatGPT into classroom activities not only broadens perspectives but also reinforces cognitive development through exposure to diverse ideas.

In conclusion, the section outlines four strategies for enhancing social interaction with ChatGPT. First, incorporating collaborative learning activities encourages peer collaboration and fosters a sense of community.

Second, facilitating peer collaboration with real-time interaction allows students to express and discuss their ideas freely. Third, enhancing classroom discussions with ChatGPT promotes the expression of original ideas and active participation. Finally, understanding and appreciating the influence of peers' ideas leads to more comprehensive and insightful learning experiences. These practices create a more inclusive, dynamic, and socially interactive learning environment.

Contextual learning

Regarding contextual learning, students appreciated the practical insights provided by ChatGPT-generated case studies. By contextualizing abstract theories within real-world scenarios, ChatGPT bridged the gap between theory and practice. Students expressed appreciation for the relevance of these case studies, noting how they contributed to a deeper understanding of course material. A student shared their thoughts on this, stating, "The case studies with ChatGPT were really helpful. They showed us how what we were learning applied in real life, which made the concepts easier to grasp." This observation aligns with the findings of Brown et al. (1989), who argue that situating learning in context enhances the transferability and applicability of knowledge. The analysis of data surfaced several strategies which form contextual learning. The remainder of the section discusses those strategies.

First, to effectively promote real-life applications, educators can utilize ChatGPT to generate case studies that reflect real-world scenarios. These case studies allow students to see how theoretical concepts are applied in practical settings. For example, one student noted, "The case studies helped us understand how to apply what we learned in class to real-world problems." This approach not only aids in grasping complex concepts but also prepares students for professional challenges they may face in the future. This practice is supported by the research of Mantei and Kervin (2009), which highlights the importance of authentic learning tasks in fostering deeper understanding and retention of knowledge.

Second, ensuring the relevance and application of course material can be enhanced by integrating ChatGPT to create contextualized learning experiences. By presenting scenarios and examples that are directly related to the students' field of study or interest, ChatGPT makes the content more engaging and meaningful. One student mentioned, "Using ChatGPT to discuss scenarios relevant to our future careers made the learning process much more engaging and applicable." This method reinforces the importance of context in learning, as suggested by Herrera (2024), who emphasize the role of situational context in cognitive development and learning transfer.

Third, enhancing learning through examples is another effective strategy facilitated by ChatGPT. By providing diverse and relevant examples, ChatGPT helps students understand abstract concepts more concretely. One student shared, "The varied examples given by ChatGPT made it easier to grasp complex theories by relating them to familiar

situations." This approach is consistent with the findings of Fantinelli et al. (2024), which highlight that contextual examples can bridge the gap between theoretical learning and practical application, thereby deepening understanding and retention.

In conclusion, integrating real-life applications, ensuring relevance, and enhancing learning through examples are strategies for contextual learning using ChatGPT. These strategies create a more engaging, meaningful, and practically oriented learning environment, ultimately enhancing students' understanding and application of course material.

Scaffolding

Scaffolding was a critical component of the learning process, with both ChatGPT and the tutor playing supportive roles in navigating complex topics. The tutor posted directed learning materials one week prior to the class, setting the stage for the upcoming lessons and allowing students to familiarize themselves with key concepts in advance. During the actual class, the tutor provided structured guidance, while ChatGPT acted as a virtual tutor, offering instant feedback and explanations. This combined support helped students grasp challenging concepts more effectively. Students appreciated this dual assistance, noting how it bolstered their confidence and enabled them to tackle course material with greater ease. One student expressed their gratitude, saying, "Having ChatGPT there to help us understand difficult concepts was like having a tutor available whenever we needed it. It made learning less intimidating." This supports the concept of scaffolding as described by van de Pol et al. (2015), which involves providing temporary support to help learners achieve tasks they cannot complete independently. To promote effective scaffolding, educators can implement several strategies using ChatGPT in conjunction with traditional tutoring.

First, setting personal learning goals with the assistance of both the tutor and ChatGPT empowers students to take charge of their educational paths. The tutor helps students identify realistic and achievable goals through learning objectives, while ChatGPT provides continuous support and feedback to ensure progress. This practice not only enhances students' focus and motivation but also fosters a sense of accomplishment. One student mentioned, "Setting goals each week with the help of both ChatGPT and our tutor made me more focused and determined to achieve them, knowing that I had a clear plan and support." This practice aligns with Locke and Latham (2002), who demonstrated that specific and challenging goals, along with appropriate feedback, are critical for improving student performance and motivation.

Finally, offering encouragement and support through both ChatGPT and the tutor enhances students' confidence and willingness to engage with challenging material. The tutor provides structured encouragement and tailored explanations, while ChatGPT offers instant feedback and positive reinforcement. At the same time, during each face-to-face session, the tutor joined each group to assist them in progressing with their discussions using ChatGPT. This dual

support system makes complex topics more approachable and less intimidating. A student observed, "ChatGPT's constant support and our tutor's encouragement made me feel more confident in tackling difficult topics in project management such as ethics and compliance, knowing that I could always rely on their help." This finding resonates with the research of Hattie and Timperley (2007), who highlight that timely and constructive feedback is essential for effective learning and can significantly boost students' self-efficacy and academic achievement.

These practices collectively create a supportive, engaging, and personalized learning environment where students are actively involved in their educational journey and empowered to achieve their full potential. By leveraging ChatGPT alongside traditional tutoring methods, educators can enhance scaffolding, ensuring that students receive the necessary support to thrive academically.

Reflective thinking

Reflective thinking was another important aspect of the students' learning experiences, with ChatGPT prompting metacognitive engagement and self-assessment. By encouraging students to question their understanding and analyze their responses, ChatGPT facilitated deeper levels of reflection. Students noted how reviewing sample answers provided by ChatGPT served as a catalyst for self-improvement, allowing them to identify areas of strength and areas for growth. One student reflected on this, stating, "ChatGPT encouraged me to think more about what I was learning. Going over the sample answers helped me see where I could improve and what I understood well already." This is consistent with the findings of Osterman (1990), who emphasizes the importance of reflective practice in learning and professional development. This section discusses strategies that contributed to constructing a learning environment that fostered reflective thinking.

First, encouraging reflection on learning and improvement allows students to engage in self-assessment and recognize their progress. By prompting students to review and reflect on their work, ChatGPT helps them identify areas that need improvement and areas where they excel. This practice not only enhances their self-awareness but also motivates continuous improvement. For example, one student mentioned, "ChatGPT's feedback made me reflect on my answers and think about how I could improve my understanding." This aligns with the research by Boud et al. (1985), who highlight the role of reflection in promoting deeper learning and personal development.

Second, ChatGPT promotes the acceptability of questioning concepts by providing a safe environment for students to express doubts and seek clarification. This openness to questioning encourages students to challenge their assumptions and explore different perspectives, leading to a more thorough understanding of the material. One student noted, "ChatGPT made it easier to ask questions about things I didn't understand without feeling embarrassed." This is consistent with King (1992), who found that promoting a questioning attitude in students can significantly enhance

their learning outcomes and critical thinking skills.

Finally, ChatGPT provides a platform for students to express their concerns and receive constructive feedback. By addressing students' worries and offering supportive guidance, ChatGPT helps avoid anxiety and build confidence. This encouragement not only improves students' emotional well-being but also enhances their engagement and motivation. The tutor's intervention is equally important, as they provide additional context and personalized support that ChatGPT alone cannot offer. One student observed, "Being able to share my concerns with ChatGPT and get helpful feedback, along with the tutor's guidance, made me feel more supported and confident in my studies." This practice is supported by the research of Cohen and Singh (2020), who found that effective feedback is crucial for student development and satisfaction.

In conclusion, the section outlines three strategies for enhancing reflective thinking with ChatGPT. First, encouraging reflection on learning and improvement fosters self-assessment and continuous development. Second, fostering the acceptability of questioning concepts encourages students to challenge assumptions and seek clarification. Finally, providing a platform for expressing concerns and receiving constructive feedback enhances student confidence and engagement. These practices create a supportive, engaging, and reflective learning environment where students are actively involved in their educational journey and empowered to achieve their full potential.

Strategies

According to the research findings, this study identified 16 strategies for transforming traditional learning environments into active ones by leveraging ChatGPT. These 16 strategies are categorized under five themes, as shown in Table 1. Additionally, a brief description of each best practice is provided in the table below.

Table 1: Strategies for transforming traditional learning environments into active learning environments with ChatGPT.

Theme	Best Practice	Description
Active Learning	Implementing problem-based learning (PBL)	ChatGPT aids in researching real-world issues and brainstorming solutions, fostering deeper engagement with the material.
	Creating learning environments that facilitates personalized learning experiences	ChatGPT provides tailored exercises and instant feedback, enhancing students' critical skills and practical understanding.
	Integrating ChatGPT into classroom activities	ChatGPT aids in data collection and analysis, guiding discussions, and ensuring active collaboration, increasing student participation.
Social Interaction	Encouraging collaborative learning activities with ChatGPT	ChatGPT encourages peer collaboration on projects and assignments, fostering a sense of community and shared responsibility.
	Facilitating peer collaboration	ChatGPT provides a platform for real-time interaction, enabling students to express and discuss ideas freely.
	Enhancing classroom discussions	ChatGPT offers prompts and feedback, encouraging students to articulate thoughts and engage in meaningful conversations.
	Appreciating peers' ideas	ChatGPT facilitates discussions and diverse perspectives, helping students understand and integrate different viewpoints.

Contextual Learning	Utilizing ChatGPT to Generate Case Studies	ChatGPT generates case studies that reflect real-world scenarios. Therefore, educators can use ChatGPT to generate case studies that reflect real world scenarios helping students apply theoretical concepts in practical settings.
	Creating contextualized learning experiences	ChatGPT can be used to create scenarios related to students' field of study or interest, making content more engaging and meaningful.
	Enhancing learning through examples	ChatGPT provides diverse and relevant examples, helping students understand abstract concepts more concretely.
Scaffolding	Setting personal learning goals	Tutor and ChatGPT help students identify realistic and achievable goals, providing continuous support and feedback to ensure progress.
Reflective Thinking	Providing structured guidance	The tutor provides directed learning materials one week prior to class, with ChatGPT offering instant feedback and explanations during the class, aiding students in grasping challenging concepts.
	Offering encouragement and support	Both ChatGPT and the tutor offer encouragement and tailored explanations, with the tutor joining each group during face-to-face sessions to assist in progressing with discussions using ChatGPT.
	Encouraging reflection on learning and improvement	ChatGPT prompts students to review and reflect on their work, helping them identify areas for improvement and areas of strength.
	Promoting the acceptability of questioning concepts	ChatGPT provides a safe environment for students to express doubts and seek clarification, encouraging them to challenge assumptions and explore different perspectives.
	Providing a platform for expressing concerns	ChatGPT addresses students' worries and offers supportive guidance, with the tutor providing additional context and personalized support.

The above table clearly indicates that ChatGPT is a technology capable of transforming traditional learning environments into active ones, where knowledge construction is predominantly done by the learners rather than the educator. In this type of setting, the educator assumes the role of a collaborator rather than a facilitator.

Discussion

This study successfully achieved its objective by proposing 16 strategies to transform traditional, resource-constrained learning environments in the higher education sector into active ones by leveraging ChatGPT. This section presents the theoretical and practical implications derived from the findings, along with the limitations of the study and suggestions for future research.

The first theoretical implication of this study is the proposal of a comprehensive framework comprising 16 strategies, categorized under five themes derived from constructivist learning theory. To the best of the researcher's knowledge, this is one of the initial efforts to develop such a framework grounded in constructivist learning theory for the purpose of integrating ChatGPT into higher education practices. Thus, this study significantly extends constructivist learning theory by demonstrating how artificial intelligence, specifically ChatGPT, can be utilized to foster active learning environments. This extension of constructivist learning theory provides a novel perspective on how technology can be harnessed to support and enhance the learning process. Traditional constructivist approaches emphasize the active role of learners in constructing knowledge

through interactions with their environment and peers (Vygotsky, 1978). The integration of ChatGPT aligns with these principles by facilitating interactive, learner-centered experiences that promote critical thinking, collaboration, and contextual understanding. By incorporating AI-driven tools, this study highlights the potential for technology to support personalized learning experiences and scaffold students' cognitive development in ways that are consistent with constructivist principles.

Another theoretical implication of this study is the indication of the significant shift required in the educator's role within the new normal, where AI is an integral and permanent part of education. As AI tools like ChatGPT become increasingly popular in higher education, educators must transition from being mere facilitators to becoming collaborators with both AI and students. This evolution builds on the constructivist learning theory, traditionally viewing educators as guides (Prawat, 1992), by showing how they can now partner with AI to provide personalized support, instant feedback, and interactive learning experiences. Findings suggest that this collaborative approach enhances cognitive development, critical thinking, and active engagement. Educators must develop new competencies to leverage AI effectively, necessitating ongoing professional development. Embracing the role of collaborator enables educators to innovate their teaching practices, aligning with the constructivist emphasis on active, student-centered learning and better preparing students for modern complexities. Thus, while this study identifies the new role that modern educators must play as collaborators with students and AI, it also highlights the need for further theoretical developments to define the role of an educator as a collaborator.

The next theoretical implication concerns the adoption of ChatGPT by both educators and students. To effectively implement the strategies identified in this study, both parties must be prepared to integrate ChatGPT and use generative AI technology on a daily basis. Achieving the desired output from ChatGPT (e.g., a case study, a set of questions, and a potential answer) requires patience and practice, often involving the refinement of multiple prompts (Stadler et al., 2024). Consequently, the findings suggest a need for further research on adopting generative AI tools by educators and students. Future studies should aim to develop frameworks that facilitate greater adoption and effective use of these technologies in educational settings. This aligns with technology adoption theories such as the technology acceptance model (TAM) by Davis (1989) and the unified theory of acceptance and use of technology (UTAUT) by Venkatesh et al. (2003), which emphasize the significance of perceived ease of use and usefulness in the adoption process. Conducting more research in this area will help to understand better and overcome the challenges associated with the integration of AI in education, thereby promoting a more widespread and effective adoption of generative AI tools like ChatGPT.

The final theoretical implication is related to the domain of education innovation. Education innovation refers to the introduction and implementation of new ideas, methods, tools, and practices designed to improve teaching and learning processes and ecosystems (Westera, 2015).

This research proposes a set of strategies that can be implemented to create learning ecosystems that generate positive outcomes for all involved parties. Thus, the proposed ecosystem is an innovative outcome that can be particularly impactful in developing countries, where it can be implemented with minimal capital investment. These practices aim to enhance educational outcomes, make learning more engaging and effective, and better prepare students for the demands of the modern world. Future researchers can build on this work by proposing frameworks that integrate limited resources optimally to create high-value learning environments, using theories such as service-dominant logic (Vargo & Lusch, 2004). This approach aligns with the broader goals of education innovation by fostering environments that are both resource-efficient and capable of delivering superior educational experiences.

The first practical implication of this study is that it presents a set of strategies that educators in traditional resource-constrained learning environments can adopt immediately, as demonstrated by the successful implementation at a Sri Lankan university without requiring extra resources. This finding is particularly significant for developing countries, where financial and infrastructural limitations often hinder educational innovation. By showing that ChatGPT can be integrated into existing systems to transform traditional classrooms into active learning environments, the study offers a viable pathway for enhancing educational practices within existing constraints. This aligns with constructivist learning principles, emphasizing active engagement and student-centered learning (Vygotsky, 1978), and supports the broader trend of integrating AI in education to enhance teaching and learning processes (Luckin et al., 2016; Luckin et al., 2024). Consequently, this approach provides a cost-effective solution for educators and policymakers seeking to improve educational quality globally, highlighting the potential for low-cost educational innovations to enhance learning outcomes.

The second practical implication is that ChatGPT, despite being viewed by some scholars in developing countries as a potential threat to traditional education systems, can actually serve as a valuable educational resource (Rahman & Watanobe, 2023). This study shows that ChatGPT can be used to enhance teaching and learning processes by providing instant feedback, generating relevant educational content, and facilitating active learning. Instead of perceiving AI as a disruptive force, educators can harness its capabilities to improve student engagement and learning outcomes (Fischer et al., 2023). This positive framing of AI integration in education aligns with broader trends in educational technology, where the focus is shifting towards utilizing AI to support and enrich the educational experience (Chen et al., 2020). Consequently, this study advocates for a balanced view of AI in education, recognizing its potential to contribute significantly to the learning ecosystem, particularly in contexts where traditional resources are limited.

Despite the contribution of the study, there are several limitations which future researchers could fix. One significant limitation pertains to the generalizability of the findings. This research was conducted solely within the context of a Sri Lankan higher education institution, which

may limit its applicability to other educational settings with different cultural, economic, and infrastructural contexts. Moreover, due to the nature of the research, the study focused primarily on exploring the positive impacts and implementation strategies of ChatGPT in enhancing learning experiences, without investigating potential negative impacts or challenges that could arise from its use. However, extant literature highlights the importance of focusing on the negative aspects of generative AI tools. Past studies have highlighted several concerns about using ChatGPT and similar AI in education. For instance, there are worries about ethics and fairness based on historical cases where advanced technology was misused (Popenici, 2023). AI systems can also pick up and spread biases, leading to unfair treatment of certain groups (Popenici, 2023). There are also serious privacy risks, as AI might mishandle or not properly protect student data (Popenici, 2023). Relying too much on AI could also take away from the human side of learning, reducing creativity and critical thinking (Popenici et al., 2023). Furthermore, as recent discussions have highlighted, there is a danger that AI-empowered tools like ChatGPT could reinforce existing Eurocentric biases in educational content, thereby complicating efforts to diversify and decolonize academic curricula (Broadhead, 2024).

Some fear AI might replace teachers, which could undermine education's role in shaping responsible citizens (Rudolph et al., 2024). There are also concerns that AI could reinforce existing biases and harm academic honesty by making it easy for students to skip real learning (Rudolph et al., 2024). Finally, big tech companies' profit motives might clash with educational goals, so it is important to consider AI's role carefully (Acemoglu & Johnson, 2023). Additionally, the issue of large class sizes in developing countries, which could affect the scalability and effectiveness of implementing technological solutions like ChatGPT, was acknowledged but not thoroughly addressed within the scope of this study. Finally, even though it is important to understand the limitations of implementing the suggested strategies in certain developing country contexts, such limitations are not explored in this research.

Suggestions for future research could encompass several avenues to further advance the understanding and application of generative AI tools like ChatGPT in educational settings. Firstly, exploring the integration of multiple generative AI tools beyond ChatGPT could provide insights into leveraging their combined strengths to enhance both educator and learner experiences. Additionally, future studies could focus on the implementation of robust Learning Management Systems (LMS) integrated with AI tools to investigate their role in creating more effective and engaging active learning environments. Understanding the potential negative impacts of AI tools on the learning experience would also be crucial for developing strategies to mitigate risks and maximize benefits. Moreover, a deeper investigation into individual strategies identified in this study could offer detailed insights into optimizing their implementation to achieve more impactful educational outcomes. Furthermore, it is essential to conduct similar research in large classroom settings to determine if these findings are applicable on a broader scale. Additionally, replicating this research in different contexts can help enhance the generalizability of the results.

Finally, future researchers can explore the limitations of implementing ChatGPT-based learning practices in some countries, such as inadequate technological infrastructure, gaps in digital literacy, language barriers, rigid educational policies and resistance to change, and significant privacy and ethical concerns. These directions would contribute to the evolving field of educational technology and inform effective strategies for integrating AI into educational practices.

Conclusion

This study suggested that by integrating ChatGPT into the higher education sector, particularly for business-related subjects, educators in developing countries can overcome traditional resource constraints and foster an active learning environment. The findings highlight that ChatGPT can significantly enhance student engagement and encourage knowledge construction, making learning more interactive and impactful. This positions AI as a crucial tool in bridging educational gaps and creating more equitable learning opportunities.

Furthermore, the proposed strategies provide a framework for educators to transform their teaching methodologies and actively involve students in the learning process. This shift from a traditional lecture-based approach to a more dynamic, student-centered model aligns with modern educational theories and offers a practical solution to some of the longstanding challenges in the education systems of developing countries.

However, it is essential to acknowledge the potential limitations and risks associated with integrating ChatGPT into educational settings. One primary concern is the accuracy and reliability of AI-generated content, which may vary and require rigorous evaluation and validation processes to maintain high standards of educational integrity. While ChatGPT can facilitate learning, caution is warranted to ensure the quality and correctness of information delivered. This highlights the importance of studying the negative aspects of ChatGPT in education. Addressing ethical issues ensures that AI contributes positively without intensifying existing disparities or ethical dilemmas. By identifying and correcting biases, educational institutions can foster fairness and inclusivity. Safeguarding student privacy is essential for creating trustworthy learning environments while preserving human-centric teaching methods sustains critical thinking and creativity. Upholding academic integrity guarantees that students derive genuine educational value. Moreover, scrutinizing the motives of tech companies helps align AI applications with educational goals and societal welfare. Therefore, maintaining a balanced approach that explores both the potential benefits and drawbacks of ChatGPT in education is essential for informed decision-making and responsible implementation.

As a final remark, as suggested by this study, future researchers could build on these findings to address the study's limitations and generate new insights. Investigating whether these findings are applicable to large class sizes and other developing country contexts, the potential negative

impacts of AI integration, and exploring the effectiveness of integrating various generative AI tools are all critical areas for further exploration. By expanding upon this research, future studies can continue to leverage technology to enhance educational outcomes and create sustainable, resource-efficient learning environments in the developing world.

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Can instructors detect AI-generated papers? Postsecondary writing instructor knowledge and perceptions of AI

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Abstract

Our study assesses the knowledge and perceptions that postsecondary writing instructors have of generative AI programs such as ChatGPT and tests instructors' ability to distinguish between essays written entirely by students and essays generated by ChatGPT. We tested and interviewed twenty experienced postsecondary instructors currently teaching writing. Participants graded four essays and attempted to identify which essays were AI-generated. We found that writing instructors have a moderate level of confidence in their ability to distinguish between student and AI-generated writing but a low level of accuracy—only 35% of instructors could correctly identify the authorship of all four essays. AI-generated essays scored higher than essays written by students, especially in spelling, grammar, and organization, while they scored lower in argumentation and evidence. We suggest that instructors will need to find ways to encourage students to work independently while learning to use AI as a writing support. In our conclusion, we discuss pedagogical solutions that allow the use of AI and propose that these solutions can complement administrative ones.

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Introduction

Large language models such as OpenAI's ChatGPT, Google's Gemini (formerly Bard), Bing Chat, Anthropic's Claude, and Microsoft's Copilot have received a great deal of media attention since their release to the consumer market. Although generative AI will have long-term impacts on many industries, it has had the most immediate impact on secondary and postsecondary education. Because these programs can generate grammatically correct and logically cohesive prose on specific topics, they are able to produce work that appears to satisfy the learning objectives of many secondary and postsecondary writing assignments. Furthermore, because the output is produced in seconds, LLMs can produce work for any unsupervised written assignment, regardless of instructor-set time limits.

Recent studies, as well as the professional experience of the investigators in their respective classrooms, have shown that the use of ChatGPT is widespread among university students in diverse countries and that many students have positive impressions of the potential of generative AI software (Hasanein & Sobaih, 2023; Ibrahim et al., 2023; Thi Thuy, 2023; Zou & Liang, 2023). Although OpenAI has not provided confirmation, observers have suggested that the 10% drop in traffic that ChatGPT experienced in the month of June 2023 was mostly due to high school and university students on summer vacation (Vynck, 2023). A recent study showed that 45% of computer science students at a UK university are using ChatGPT and other LLMs in their academic work (Singh et al., 2023), while a recent survey of American college students showed that 48% of respondents admitted using ChatGPT to help complete graded assignments (Impact Research, 2024). In online message boards such as Reddit, users have posted about submitting assignments composed entirely of ChatGPT output for credit in their university classes and receiving top grades for their submissions (DK-Sonic, 2023).

The use of generative AI creates challenges across the education sector, particularly in "measurement, information accuracy, and skill devaluation" (Steele, 2023, para.1). The availability and popularity of these AI text technologies threaten to upend traditional pedagogical methods for teaching in the humanities and social sciences, in which take-home essays and other written assignments have remained one of the primary modes of assessment in North America for decades (Rudolph et al., 2023) especially because the established consensus emerging among instructors across disciplines and countries is that the use of AI amounts to plagiarism (Ibrahim et al., 2023). These issues are heightened when teaching composition classes where the primary pedagogical goal is learning to write.

Students of composition and rhetoric who are still learning to write effectively may find that these tools can provide a shortcut to a finished essay. The power of these programs to write effectively, as well as the presumption that these programs will improve further over time, has led some commentators to declare the essay (as a meaningful method of assessment) "dead" (Kumar, 2023; Marche, 2022). The ubiquity of AI-powered tools potentially undermines the development of students' writing and critical thinking

skills: the Modern Languages Association has warned that LLMs may result in learning loss as "[s]tudents may miss writing, reading, and thinking practice because they submit generative AI outputs as their own work or depend on generative AI summaries of texts rather than reading" (MLA-CCCC Joint Task Force on Writing and AI, 2023, p. 7). A raft of new online tools have emerged that claim to reliably screen student assignments for AI-generated texts, including GPTZero, Copyleaks, and Turnitin AI Writing Detection, but all of these products are vulnerable to producing false positives (Sadasivan et al., 2023). One recent study found that the best-performing AI detection software was only accurate 71.4% of the time (Chaka, 2023). Students falsely accused of using AI to generate their work have no meaningful recourse as there is no way to prove authorship based on criteria such as perplexity and 'burstiness'. Preliminary research has also demonstrated that AI writing detection programs are more likely to produce false positives when assessing work written by English as an Additional Language (EAL) learners (Liang et al., 2023).

In sum, generative AI presents an urgent problem for postsecondary instructors assessing written assignments, as distinguishing between student and AI writing is often difficult. Furthermore, when university instructors have a faulty understanding of generative AI, they can put student success at risk by falsely accusing students of academic dishonesty (Perkins et al., 2023; Verma, 2023).

Over the past year, researchers have begun to answer the question of whether university instructors can determine whether a text is student-written or AI-generated. Hassoulas et al. (2023) examined the work of 34 experienced markers in medical school, finding that 50% of participants correctly identified student submissions and only 19 to 23% of markers correctly identified the ChatGPT script. Furthermore, marker suspicions of ChatGPT script were "not proven valid on most occasions" (Hassoulas et al., 2023, p. 75). Casal and Kessler (2023) examined whether linguists could differentiate between abstracts written by humans and abstracts written by AI in those same articles. Although they considered the work of 72 frequent reviewers, only 38.9% of the abstracts were accurately identified. Dugan et al. (2023) explored whether graduate students and senior undergraduates were able to detect when a text transitioned from human-written to AI-generated, finding a large variance and relatively low accuracy in ability that could be somewhat improved with practice. Finally, Fleckenstein et al. (2024) tested the ability of pre-service and experienced high school teachers to identify the difference between student-written and AI-generated essays, finding approximately 50% accuracy, with higher accuracy in the experienced instructors. Thus far, as far as we know, no study has examined whether experienced postsecondary writing instructors can differentiate between student-written and AI-generated text, nor has any study conducted interviews to identify why and how instructors are identifying texts as they are. As experienced postsecondary writing instructors are some of the most sophisticated readers in the institution, it is especially important to clarify whether they can differentiate between student and AI text. The primary purpose of the discipline of composition is to teach writing as a critical skill; if AI generators are undermining the acquisition and evaluation of that skill, the discipline's

methods and priorities may need to be reconsidered.

Our study thus assesses instructor knowledge and perceptions of the current state of AI text generators and tests instructors' ability to distinguish between essays written entirely by students and essays generated by ChatGPT. Our research questions are as follows:

1. Are writing instructors knowledgeable about the current state of AI text generators?
2. How are writing instructors adapting their instruction and pedagogy in response to the public availability of AI text generators?
3. Independent of their institutions' policies, do writing instructors perceive students' use of AI text generators as a violation of academic integrity?
4. Are writing instructors able to distinguish between essays written entirely by students and essays generated by ChatGPT using the same essay prompt?

Methodology

We interviewed 20 instructors currently teaching composition at a college and/or university. 17 of these instructors teach in Canada, two teach in the US, and one teaches in New Zealand. We solicited participants using professional listservs and social media and confirmed the participants' institutional affiliations. The interviews took place in March and April 2023 and consisted of two portions: a questionnaire and a semi-structured interview.

All twenty participants were current, highly experienced community-college and/or university-level writing instructors: at the time of the interview, 70% of them had taught for more than five years (65% had taught for 11 or more years), and 60% had taught four or more courses in the past 12 months.

The questionnaire portion involved the instructors reading and assessing four essays using an assigned rubric, and then answering basic questions about their experience teaching writing at the postsecondary level. The four sample essays all responded to the same assignment prompt for a research essay discussing the challenges faced by an industry affected by COVID-19. The assignment prompt and rubric were originally designed by one of the authors, Nathan Murray, for a first-year composition course at Algoma University. They can be found in the Appendix. The assignment required students to provide evidence by reading and citing a minimum of four sources in APA style. Essays 1 and 3 were written and submitted by students for a first-year writing composition class at Algoma University in August 2022, before the public release of ChatGPT. Like the instructor respondents, the students were compensated with an honorarium for their participation in the study. Essays 2 and 4 were constructed by the authors using ChatGPT. Essay 2 was generated using ChatGPT3.5 (January 30, 2023 edition) on Feb 6, 2023. Essay 2 was generated using the identical

essay prompt that the students were given. The text of ChatGPT's output was copied and was not further refined except for the format of the text to match APA standards. Essay 4 was generated using ChatGPT3.5 (February 13, 2023 edition) on March 3, 2023. Essay 4 was generated using the initial prompt, as well as three additional simple prompts to refine the generated text:

1. "Can you rewrite the introduction? It is too short and it doesn't have a specific thesis statement."
2. "Can you rewrite the first two body paragraphs? They are too short and they don't have any evidence or citations."
3. "Can you rewrite the remaining body paragraphs? They are also too short and they don't have any evidence or citations."

These additional prompts are designed to reflect the conversational interactions students may have with the software, encouraged by the conversational user interface (Rospigliosi, 2023). The revised outputs were assembled into a complete paper, but the text shared with the participants consisted entirely of ChatGPT output. The four essays were anonymized and formatted identically; however, titles, references, and spelling and grammar errors were retained.

ChatGPT generated essays on similar topics to the topics that students chose, such as the effects of COVID-19 on the hospitality and travel industries. In both generated essays, the sources were all hallucinations—i.e., none of the provided sources were real. This remains the biggest obstacle for generative AI programs to produce complete assignments independently. While the newest version of ChatGPT (4o) is more likely to produce real sources when asked, the content cited from the real source is still likely to be hallucinated. Nevertheless, none of the claims within the generated papers were false, though this was because the claims were very general.

The participants were asked to assess the essays on four bases—argumentation, evidence, organization, and spelling and grammar, on a spectrum of "needs improvement" to "excellent"—as well as to identify whether the essay was written by a student or generated using AI.

The second portion of the study consisted of a semi-structured interview in which we asked the instructors about their knowledge, perceptions, and uses of AI with respect to their writing composition classes. We also asked how they assessed the four essays and determined which essays were written by students and which essays were generated using AI.

Results

Instructor knowledge of AI

Most instructors (90%) indicated that AI writing technologies were new to them and that they had first learned about them in the media or through discussions with their colleagues shortly after ChatGPT was launched in November 2022. Only two of the 20 instructors indicated that AI writing technologies (such as earlier versions of OpenAI's GPT) were already on their radar prior to the public release of ChatGPT. Of those two, one learned about it through a Twitter thread approximately a year prior and forwarded their concerns and suggestions about it to a professional writing association, of which they were a member, but "then nothing really happened [... until] ChatGPT dropped."

In the questionnaire, the participants were asked to rate their knowledge of AI text generator software on a scale of 1 to 10, where 1 indicated no familiarity at all, and 10 indicated specialist familiarity (for example, they could program software like ChatGPT). The average response indicated a non-specialist familiarity, as might be expected from writing instructors with limited previous experience working with AI: the average was 4.85, and the median was 5.0, with a standard deviation of 1.87. When the participants were asked to rate their confidence in their ability to distinguish between the student-written and the AI-generated essays that they had read on a scale of 1 to 5, they rated their confidence at an average of 3.2 and a median of 3, with a standard deviation of 1.01. This is lower than one might expect from highly experienced writing instructors. In sum, the participants indicated a relatively low confidence in their ability to identify AI-generated essays despite perceived reasonable knowledge about AI writing technologies. A linear regression analysis of these results found no relationship (R^2 value of 0.15%) between their self-reported knowledge of AI writing technologies and their confidence in their identification of the essays.

In the interviews, we tested the instructors' actual knowledge of these technologies by asking them to describe how they worked. 40 percent of the instructors either had an erroneous understanding of how LLMs provide answers to prompts or could not provide an explanation. Common errors included the belief that LLMs could search the internet to find factual answers (which was not true of ChatGPT3.5) or that LLMs search for factual data within their training data and re-present it. Our findings are consistent with other studies' findings on the level of instructor understanding of these new technologies; Zhou et al. (2024) found that even instructors in Computer Science have varying levels of understanding of the mechanisms through which LLMs produce their output.

AI in the classroom

When asked whether they had discussed AI with their students, 70% of the instructors reported that they had. While 60% reported that they had not included rules about the use of AI in their syllabus, there was a great deal of variation in how the instructors had addressed the use of AI

text generators on individual assignments, with only 15% of instructors completely prohibiting the use of them. Of the four instructors who responded to the question of whether they had prohibited the use of AI with "other," two were in the process of determining policies.

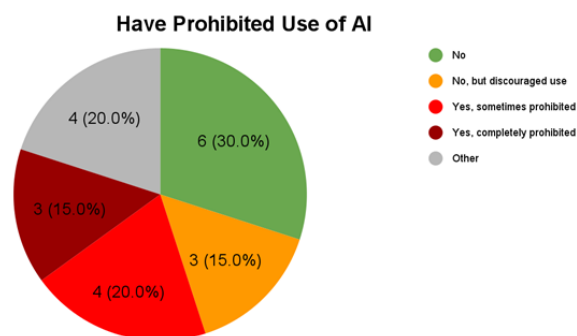


Figure 1. Instructor responses to whether they had prohibited the use of AI in their classes.

While 45% of instructors indicated that they suspected unauthorized use of AI writing technologies in their classes, none had confirmed cases of unauthorized use, and several decided not to confront their students about their suspicions. Participant 10 noted that while in one case they felt "fairly certain" that a student had used AI to write their assignment, "I could not definitively say that this was a generated paper." When asked what made them suspicious, instructors indicated a distinct change in the quality of writing from one assignment to another: "A couple of the students [...] whose English is not good—their English is [that of] second language students—and [...] suddenly their writing is a lot sharper than it was before" (Participant 2). Notably, even when instructors had permitted the transparent use of AI writing technologies, where the use of AI technologies was clearly cited, instructors still had suspicions that students were not declaring their use of them. Despite suspected academic misconduct, many instructors stated that they were not interested in policing the use of these technologies, with one stating, "I don't want to spend more time grading [...] and haranguing this student than they actually spent putting this thing together" (Participant 2).

Instructor and student perceptions of AI

When asked their opinion of students who made unauthorized use of AI technologies, 60% of the instructors were sympathetic to their students, citing a culture of stress and overwork. There was widespread acknowledgement that, unless students come from privileged backgrounds, they are juggling significant demands, including full-time work to afford costly school tuition: "I think of them as panicky, rather than jerks. [...] they're not [...] scheming meanies" (Participant 12). Participant 17 was concerned about "going to straight surveillance, and that really bothers me." At the same time, instructors, many of whom were similarly stressed and overworked, expressed resentment at having to assess AI-written material, with one respondent noting that they "would like to outsource grading if [students are] going to outsource writing" (Participant 1). 40% of instructors had a more negative perception of

students who made unauthorized use of AI technologies, with Participant 4 saying “I would think that they were lazy and not interested in learning what we’re supposed to be teaching them in my class.”

When asked about their students’ perceptions of the technologies, the instructors indicated that some students were excited, some were upset at the idea of other students cheating to get their degrees, some were frustrated by the lack of institutional policies around it, and many just didn’t have it on their radar; these findings are consistent with other studies that indicate heterogeneous student responses to AI-powered writing tools (Burkhard, 2022; Firat, 2023; Bedington et al., 2024). According to the instructors, there is a wide range of motivations behind students’ use of these technologies. For some, it is a means to an end: “It’s a tool, especially for assignments that you don’t have any respect for, right? That’s just something you have to do to get done, but you’re not taking it seriously.” (Participant 17). For others, it was a magic wand or simply another tool (not unlike Grammarly) to improve their writing: “Some students think it is a magic bullet [and others] who are a little more on the ball recognize it can be a powerful ally” (Participant 2). One instructor (Participant 17) mentioned that students perceived professors who didn’t speak to them about AI as not understanding the technologies themselves or not wanting the students to know about it. Participant 1 mentioned that in one of their classes, all of their students were excited about ChatGPT, with the exception of one student, “who feels that this is a form of cheating, and it’s kind of like steroids in sports. You know, if everyone’s doing it, you got to.” Participant 17 was similarly concerned that the long-term impact would be unfairly increasing standards of writing, where “graduate-level expectations are going to start being placed on undergraduate student populations.”

When asked about their own perceptions of the technologies, instructors indicated a mix of excitement and anxiety. Some instructors used ChatGPT as a research tool, saying that “It was easier than looking stuff up on the library website or Google Scholar” and that they “wish[ed] this was around when I was a grad student because it would have streamlined a lot of research” (Participant 2). Some instructors hoped that AI could reduce the “busywork” associated with teaching, such as answering emails.

AI and writing pedagogy

When asked whether they were currently using these technologies in their teaching, only 35% of instructors indicated that they were. One instructor mentioned the benefits specifically for supporting students with different learning needs: “I have a son with disabilities, and it’s really helpful for him to use it for reverse outlining or reading, so I can see amazing benefits” (Participant 17). Some instructors explored the technology with students during class time to critique the software’s output, such as asking the software to write the assigned essay in class. Other instructors had used the software to help them generate writing samples. Another 20% indicated that they intended to use these technologies for teaching in the near future and the remaining 45% indicated that they had no immediate plans.

For one instructor (Participant 12) who focused on rhetoric, ChatGPT was an excellent illustration of the “sociality of writing,” as its statistical learning from a corpus of text could demonstrate “how people typically argue” and then allow students to attempt “writing more singularly by contrast.” Ultimately, many instructors acknowledged that students were going to be required to use these technologies in their careers, and so needed to be trained in how to use them effectively.

When asked about how they were changing their teaching and pedagogy to respond to AI writing technologies, most instructors indicated that they had not yet made changes but intended to do so in the future. However, some of their intended changes were based on misunderstandings of the technology: for instance, one instructor understood that any correct statement from ChatGPT resulted from the software searching the internet or its corpus for the information, while another believed that ChatGPT itself could verify whether a text was AI-written. Participant 12 stated that they’ve “considered ditching articles that I like to teach with because they’re in ChatGPT’s database,” although ChatGPT has not revealed their LLM source material (Gillani et al., 2023), nor does ChatGPT search a database when it responds to a prompt.

When asked about the impact of ChatGPT and other LLMs on writing pedagogy, 100% of instructors indicated that this will dramatically change the field. Participants agreed that the use of technologies will be ubiquitous, whether or not they are authorized. For instance, Participant 2 mentioned that a number of their colleagues were “writing into [their] assignments that students cannot use ChatGPT [but] how can you possibly prevent it? There’s no way to prevent it.” While Participant 15 cautioned that “writing pedagogy is [...] prone to apocalyptic thinking,” because of how frequently embattled the field is within universities, they nonetheless conceded that the widespread availability and use of generative AI was likely to deepen inequalities between the students who needed the technology more, such as second-language speakers, and those who needed it less. One participant expressed a common sentiment that the availability of LLMs would lead to a “major rethinking about whether writing is an important thing to instruct students in and what aspects of writing are important” (Participant 12).

Essay assessment

The instructors were asked to assess the four anonymized essays on four bases—argumentation, evidence, organization, and spelling and grammar—and rate each category as “excellent,” “good,” “fair,” or “needs improvement.” Essays 1 and 3 were written by students at Algoma University before the public release of ChatGPT and Essays 2 and 4 were AI generated using ChatGPT; Essay 2 was generated using the same prompt the students were given, and Essay 4 was generated using the prompt and three additional prompts to refine the initial response. As the assessments varied widely across participants, the results are most comprehensible when comparing the four essays.

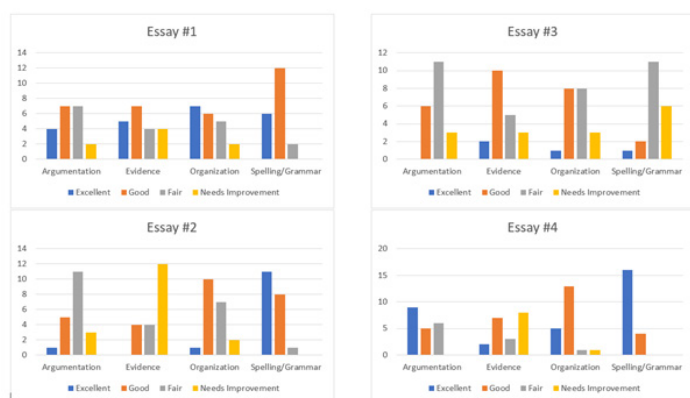


Figure 2. Cumulative essay assessments. Essays 1 and 3 were student-written, and Essays 2 and 4 were AI-generated.

Taken overall, Essays 1 and 4 received the highest overall scores, receiving the most “excellent” and the fewest “needs improvement” scores, at 22 and 8, and 32 and 9, respectively. Essay 1 was assessed as consistently above average across all four categories, whereas Essay 4 was much less consistent, ranked extremely highly on spelling and grammar and relatively low on evidence. Essays 2 and 3 received considerably more “fair” and “needs improvement” scores.

Table 1. Average essay grades.

	Author	Average Grade (%)
Essay 1	Student	73.5 (B)
Essay 2	ChatGPT (unguided)	69.5 (B-)
Essay 3	Student	67.37 (C+)
Essay 4	ChatGPT (guided)	75.5 (B)

Using the rubric and grading system from the original assignment, the average grade earned varied from 67.37% or C+ (Essay 3) to 75.5% or B (Essay 4), which is consistent with average grades in a Canadian context. The essays by ChatGPT were graded slightly higher than those written by students, where the average grade earned by the human students was 70.44% (B-), and the average grade earned by ChatGPT was 72.5% (B).

Taken overall, Essays 2 and 4 stand out as receiving relatively high assessments on spelling and grammar (11 and 16 “excellent” scores, respectively, and no “needs improvement” scores) and relatively low assessments for evidence, with Essay 2 faring the worst (with 12—or 60% of instructors—rating it as “needs improvement”).

Essay identification

Most instructors correctly identified Essays 1 and 3 as being written by students and Essays 2 and 4 as being generated by AI. However, only a minority of instructors (35%) correctly identified all four essays as written by students or by AI. Of the seven participants who accurately distinguished between all four student-written and AI-generated essays, one participant was able to identify that one essay was

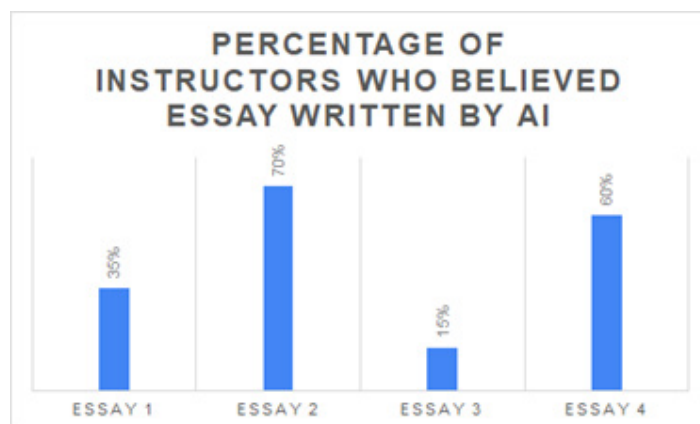


Figure 3. Percentage of instructors who believed essays to be AI-generated.

completely generated by AI and one was generated by AI with further refinement, even though they were not made aware of that distinction by the investigators. Interestingly, this observant participant did not report their confidence in their selections as any higher than any of the participants who made errors in their selections. Furthermore, the participant who reported the highest level of confidence (5 out of 5) correctly identified only one of the essays (Essay 1), incorrectly identifying the three others.

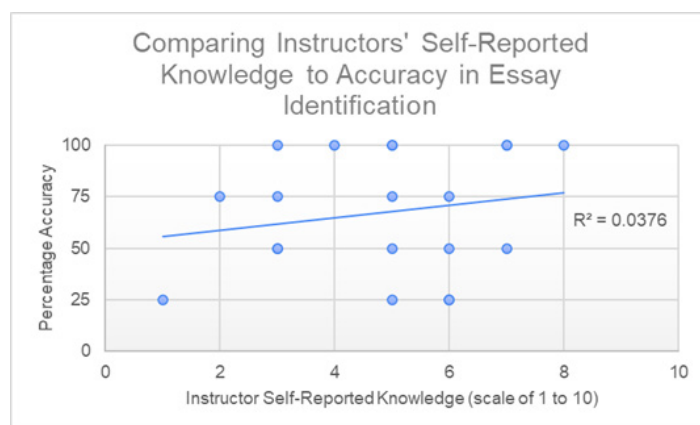


Figure 4. Comparing instructors’ self-reported knowledge of AI writing technologies (expressed on a scale of 1 to 10, where 1 is low and 10 is high) to their percentage accuracy in identifying essays as AI-generated or student-written.

As mentioned above, when we compared their self-reported level of knowledge of AI writing technologies with their self-reported confidence in their identification of the essays using a linear regression model, we found no relationship (R^2 value of 0.15%). When we compared their self-reported confidence in their identification of the essays with their actual accuracy, we also found no relationship (R^2 value of 2.0%). Finally, when we compared their self-reported knowledge with their accuracy in identifying the essays, we found no relationship (R^2 value of 3.8%).

We asked the participants how they identified the essays as student-written or AI-generated. They characterized AI-generated essays as having formulaic writing, few spelling and grammar mistakes, fake references, and surface-level analysis. They noted that these essays lacked evidence in support of their claims and sounded “bland,” “clean,”

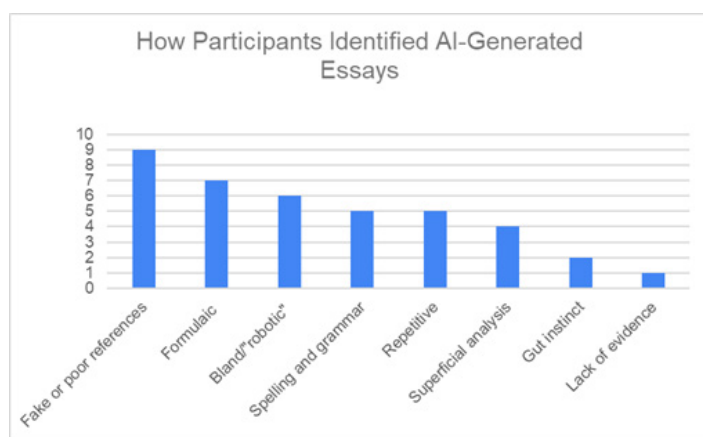


Figure 5. Participant descriptions of AI-generated essays.

"robotic," and "not quite human." The participants also identified a "gut instinct" stemming from years of experience reading student essays. They characterized student-written essays as being "messier," better thought out, and less consistent overall.

Discussion

Instructor knowledge of AI

Given the recent cultural attention to AI writing technologies, it should be no surprise that the survey and interview findings suggest that university and college writing instructors are very much occupied with the impact of these technologies in their writing pedagogy and classes. Although our study only included 20 instructors, if taken to represent writing instructors in Canada and the US as a whole, the average instructor was new to AI-generation technologies until ChatGPT was publicly released in November 2022. Only a small minority of instructors were already considering the impact of these technologies on the field before their release, but even they were not preemptively changing their pedagogy to respond to them.

Although the instructors were new to these technologies, the average instructor felt they had a moderate, non-specialist understanding. Yet, when we tested them on their knowledge, almost half (40%) had an erroneous understanding of how these technologies work. Recent news stories have shown that when faculty have a faulty understanding of these technologies, it can lead to false accusations of academic misconduct (Jimenez, 2023; Klee, 2023; Verma, 2023). Similarly, our findings indicate that a higher degree of knowledge of how these technologies work is the best indicator of accuracy in identifying the presence of generative AI output (albeit a very weak indicator). Taken together, these findings point to the importance of training writing instructors in the design and function of AI writing technologies. Exposure to and understanding of generative AI can help instructors become better able to identify AI output, better equipped to support students in avoiding academic misconduct, and better able to teach students the effective use of these technologies when appropriate.

It is also notable that instructors simultaneously perceived that they had a higher understanding of the AI writing technologies than they actually did and perceived that they had a lower accuracy in the essay identification than they actually did. This might be understood as a manifestation of the Dunning-Kruger effect, a documented cognitive bias: the less one knows about a particular field, the more likely one is to overestimate one's understanding of that field (Kruger & Dunning, 1999). Conversely, experts in a domain, while more self-aware of their limitations, can underestimate their ability (Kruger & Dunning, 1999). The writing instructors in our study, we suggest, are overestimating their abilities outside their knowledge domain (computer science) and underestimating their abilities within their knowledge domain (writing assessment). Training provided to writing instructors might highlight this disconnect between perceived and actual understanding and reassure instructors of their own expertise, specifically in writing composition.

AI in the classroom

Most (60%) of the writing instructors had no formal policy for AI use in the classroom because they were not prepared for ChatGPT at the time they had written and distributed their syllabuses. Yet, by the time of the interviews (nearing the end of the first full semester in which ChatGPT was publicly available), many instructors had already observed what they understood as unauthorized use of AI writing technologies in the classroom with no way to confirm that the students had used them. This highlights the clear need for sound policy developed in collaboration between faculty and administration, as the MLA-CCCC Joint Task Force on Writing and AI has explored in their Working Papers (Adisa et al., 2024). Even in cases where the students were authorized to use AI with citations, some students were not citing its use. Ultimately, although the instructors felt confident that there had been inappropriate use of these technologies, they had limited administrative support, limited time, and little desire to police the use of these technologies. Instructors thus should consider redesigning their syllabuses and assessments to put a greater emphasis on in-person assessment, as well as to integrate the use of these technologies since students are using them with or without permission. As instructors are already feeling stretched thin, administrators should offer instructors training in syllabus and assignment redesign to make this transition easier.

Instructor and student perceptions of AI

According to the instructors we interviewed, both instructors and students are experiencing mixed emotions with the introduction of AI writing technologies and could benefit from guidance on best practices around the use of them. To alleviate the anxieties of both instructors and students, university and college administrations should offer support to help both understand the benefits and limitations of using them.

Instructors are fairly evenly split on their perceptions of students making unauthorized use of AI writing technologies, with 60% sympathetic to students and 40% having a more negative view. Clearer guidelines on appropriate use could help improve student-instructor relationships for the latter group of instructors. This mindset would then be aligned with the approach outlined by Sarah Elaine Eaton of transitioning from a punitive to an educative approach to academic integrity, which is made even more urgent by the widespread availability of generative tools (Eaton, 2021; Kumar et al., 2024).

AI and writing pedagogy

The instructors we interviewed described these technologies as paradigm-shifting and demanding significant changes in writing instruction, including changes in pedagogical approaches—such as focusing more on argumentation than grammar—and changes to policies, possibly even to academic integrity policies, which would need to be considered in tandem with administrative positions on the use of these technologies. Yet, both writing instructors and their students (as reported by the instructors) are feeling let down by their administrations, which have not responded quickly enough nor have considered the specific and unique needs around AI technologies and writing instruction.

One participant characterized the situation as an “administrative hot potato that has been very interesting and really disappointing to witness.” At the time of the interview, only 35% of instructors had experimented with LLMs in their teaching. The interviews revealed that while there were many instructors who were interested in integrating these technologies into their pedagogy, they faced major hurdles to actually including them in their classes. The fast-evolving nature of these technologies, instructors’ lack of expertise, and instructors’ workloads were all named factors in their inability to include them. Despite enthusiasm from researchers and educators in other disciplines (Tobler, 2024), no writing instructors in our study expressed serious interest in using generative AI to mark or grade papers.

All the writing instructors acknowledged that the availability of AI writing technologies will have seismic impacts on writing pedagogy, but instructors disagreed on what that impact would or should be. Some instructors were cautiously optimistic that the availability of generative AI could give students the opportunity to improve their writing by streamlining the non-essential elements of the writing process. Many instructors, however, feared that the availability of the technology would result in learning loss. Participant 16 viewed ChatGPT as “technology that has the potential to make people stupider,” while Participant 6 feared that students would lose “critical thinking research skills, even organizing ideas and brainstorming.” These fears are shared with other instructors around the world, many of whom perceive it as “enabling dishonesty and hindering skill development” (Mohammadkarimi, 2023).

However, participants had strongly differing views about what the most formative aspects of essay composition were for students and whether certain processes becoming

automated would have positive or negative effects. Participant 10 hoped that if instructors were able to spend less time teaching “drafting and outlines, perhaps even how to construct a logical paragraph”, they would “get to spend more time on things that I don’t think students get enough exposure to in the current classroom, like editing, revising, [and] developing a mature and unique argumentative voice.” Participant 3, in contrast, called outlining “one of the most integral parts of essay writing,” and suggested that if LLMs were able to obviate this task for most students, this would hinder students’ development.

This heterogeneity of beliefs among study participants mirrors the heterogeneity of opinions on the steps in the writing process in which the use of generative AI is appropriate among researchers worldwide. While Macdonald et al. (2023) argue that “ChatGPT could become a great help to researchers worldwide in designing their studies, conducting analyses and drafting their research articles,” Leon Furze (2024) compares allowing students to edit an AI-generated first draft to encouraging students to have “a middle-aged white American man they’ve never met, write their entire draft, before they tidy it up and hand it in” (para. 16).

Many instructors suggested that if the field of writing instruction did not respond rapidly, it would face an existential threat. Participant 16 feared that instructors in disciplines outside composition might remove writing assignments in response to the availability of generative AI, which in turn would diminish the importance of training in composition. Others suggested that this may also be a space for opportunity; Participant 1 suggested that writing instructors are

[...] going to have to really ramp up our game in terms of proposing that this is a uniquely human form of expression and that it gives meaning to one’s life and allows one an opportunity to reflect on their place in the universe or their purpose. We’re going to have to go to those sort of higher level needs in terms of Maslow—self-actualizing.

Public access to this technology represents a major shift for many industries, but it has already proven to be a sea change for higher education, and especially writing instruction. While, in the future, tech companies such as OpenAI could restrict or charge exorbitant fees to access their software, there are open-source LLMs, such as LLaMA, that can be run from a personal computer. These open-source alternatives are not as effective as the up-to-date models from the largest tech firms, but some are still able to produce prose roughly equivalent to the output of a first-year composition student. There is no possible future state in which these technologies will not be accessible to many students. Thus, this is a transformative moment that will require writing instructors to re-evaluate what exactly is important about writing and what needs to be prioritized in writing instruction, including considering critical AI literacy and ethics as part of a new writing curriculum (Rudolph et al., 2024).

Essay assessment and identification

Our experimental conditions showed that AI-generated output when given simple guiding prompts, can outperform first-year undergraduate writing. The fears of the student (discussed above) who compared the availability of LLMs to the use of steroids in sports and concluded “if everyone’s doing it, you got to” may thus be understandable. These findings are consistent with Ibrahim et al. (2023), who found that “ChatGPT’s performance is comparable, if not superior, to that of students in a multitude of courses.” Many commentators and researchers have observed that ChatGPT and other LLMs are prone to producing prose that features ‘hallucinations’ or false information, poor evidentiary support and faulty logic, and some have pointed to these faults as evidence of why LLMs are ineffective tools for academic and scientific writing (Alkaissi et al., 2023). Indeed, ChatGPT produces ‘bullshit’ more effectively than it does reliable output (Rudolph et al., 2023; Hicks et al., 2024). However, all of these faults are often true of the work of students beginning the learning process, especially students working in a second language. The highest-graded paper out of the four samples, Essay 4, consisted of 100% AI-generated text and was produced with only a handful of guiding prompts in just under seven minutes. 60% of instructors identified this essay as AI-written, but a savvy student could easily avoid detection by moderately editing the output. Students may find it difficult to resist the temptation to ‘juice’ their essay by asking the program to complete some of the work for them, especially if they see their peers’ use going unpunished and even rewarded with higher grades.

Comparison of essays: AI-generated versus student-written

As Essays 1 (student written) and 4 (AI generated) were consistently ranked more highly and Essays 2 (AI generated) and 3 (student written) were ranked more poorly, there was no clear instructor preference in writing source. However, there did seem to be a bias in perception: that is, when the instructors were asked to explain why they had identified an essay as AI-written or student-written, they consistently described AI using terms like “bland,” “robotic,” and “formulaic,” even when they had misidentified the essays and were actually discussing student-written work. This is aligned with the findings of Alafnan and Mohdzuki (2023), who found that ChatGPT 4.0’s sentence lengths were more consistent than human writers and that the verb tense, mood, and voice varied less than human writers. Similarly, Amirjalili et al. (2024) found that ChatGPT 4.0 hedges less than student writing, potentially revealing less of the uncertainty common to students.

While the essays were sometimes misidentified, there were some patterns that emerged when comparing student-written and AI-generated essays. A common perception is that AI-generated essays have fewer spelling and grammar errors, as articulated in the interviews and confirmed by the blind assessments: overwhelmingly, Essays 2 and 4 were ranked with relatively high scores in that category. Interestingly, while in the interviews the participants characterized student essays as “messier” and less consistent

than AI essays, the student essays were actually ranked more consistently across the four rubric categories. That is, a student who received an “excellent” ranking in one category (such as evidence) was also likely to receive an “excellent” ranking for other categories (such as spelling and grammar), whereas AI was much less even, exceptional in some categories (such as spelling and grammar) and noticeably poor in others (such as evidence). Therefore, unevenness across rubric categories could potentially be used as a flag for instructors looking to distinguish between essays that are student-written and AI-generated.

Essay identification

The results of the experiment confirm the reports of the participants: while, on average, the writing instructors have reasonably high non-specialist familiarity with ChatGPT, they have comparatively low confidence in their ability to distinguish between student-written and AI-generated text. This is lower than other populations studied in other research, such as the pre-service secondary school teachers studied by Fleckenstein et al. (2024), who reported a confidence level of 77.3% in their ability to identify AI-generated texts. This discrepancy may be explained by the skills gap between secondary and post-secondary students, where the latter are more likely to write to the level of ChatGPT and other AI text generators. The instructors had a strong sense of which essays were student-written and which essays were AI-generated because the majority of participants correctly distinguished between the essays most of the time: 70% of instructors correctly identified Essay 2 as AI generated and 60% correctly identified Essay 4 as AI generated. However, there were also many false negatives and false positives: 35% of instructors incorrectly identified Essay 1 as AI generated and 15% incorrectly identified Essay 3 as AI generated. One of the participants who accurately identified all the essays noted that they were uncertain about the more sophisticated of the two AI-generated essays. That essay—Essay 4—was the most prone to identification error; even still, it was accurately identified as AI-generated most of the time.

An important caveat to these findings is that instructors would presumably have greater accuracy in identifying essays written by their own students, with whom they would be familiar, and essays written using prompts they had constructed. In North American universities essays are not graded blind, and composition classes are typically small, allowing for an individual relationship with each student. This is an important difference between the population under consideration and that of Hassoulas et al. (2023), who studied markers at a UK medical school where blind grading is standard. Several of the participants noted that they would feel more confident if they had a sense of a student’s writing voice prior to assessing the essay. Nevertheless, the findings do illustrate the challenge of confidently distinguishing between a student-written and an AI-generated essay, which presents issues in a scenario where the use of AI is strictly prohibited, especially in large classes where one-on-one instructor-student interaction is limited. The results of this study suggest that even experienced instructors are not confident—and cannot be confident—that they are correctly

identifying essays that were generated by AI.

Instructors also noted that, in their personal experience, it was easier to detect the use of AI writing technologies by ELL students whom they personally knew. This raises equity issues, whereby ELL students (who are often marginalized and/or students of color) are more likely to be accused of academic misconduct in situations where AI writing technologies are forbidden. This is one of many reasons that the field of writing instruction might focus more on proactive changes to writing pedagogy that integrate AI writing technologies into their lessons and learning outcomes, rather than focus on policing the use of these technologies. Conversely, as AI writing technologies become more specialized and potentially more costly (as ChatGPT moves out of its demo stage), colleges and universities may want to consider 'leveling the playing field' by paying for institutional subscriptions to an AI-writing technology that makes these technologies equally accessible by all students. Without institutional support, what writing instruction might see is something akin to 'contract writing on steroids,' whereby the students who already had easier access to less-detectable academic misconduct methods will disproportionately benefit from these technologies.

It is important to reiterate that this study did not include student participants and so the assessments of student use of AI writing technologies were strictly perceptions articulated by the instructor participants. Nevertheless, one of the recurring concerns about student use of AI writing technologies was that, even when the use of these technologies was expressly permitted (with citation), instructors suspected students were misusing them by failing to declare their use and/or denying their use of them when their use was suspected. A future study should examine student perceptions and use of AI writing technologies and specifically consider why students do not declare their use of them even when they are expressly permitted with citation.

Conclusion

The recent and quick ubiquity of AI text generators is presenting a significant challenge for instructors of the humanities today. This challenge is all the more heightened for writing instructors, who are tasked with teaching a historically critical skill now in question. As a small study of only 20 writing instructors, the results of this study are preliminary rather than conclusive. Nevertheless, they clearly point to a need for more consideration of the pedagogical implications of AI on writing composition.

Overall, our results indicate that ample experience as a writing instructor is not in and of itself an indication of readiness to grapple with the implications of AI technologies on writing pedagogy. For the average writing instructor, these technologies are new, and they have a limited and/or faulty understanding of them. While writing instructors acknowledge the paradigm-shifting nature of the technologies, they are not yet prepared with new policies or pedagogies to respond to them and are relying on administrative guidance, which has been insufficient to date. As such, we make the following suggestions as strategies to

consider when designing and supporting writing instruction:

1. Instructors should encourage students to work independently while learning to use AI as a writing support.

All evidence thus far suggests that the use of AI writing technologies is widespread among college and university students and that there is no foolproof method of identifying the use of these technologies. As a result, writing instructors must acknowledge that the only student writing that can be said to be produced independently is writing that is produced during a monitored in-class situation. Assessment through in-class writing alone, however, severely limits the metacognitive skills being tested within a writing course, which would typically also focus on planning, outlining, researching, drafting, revising, editing, and proofreading. In order to test this broader range of skills, writing instructors should encourage student independence in their work. Encouraging student independence includes fostering critical thinking, creativity, and originality in student writing, while also teaching them how to ethically and effectively incorporate AI tools. Writing courses often make use of scaffolded assignments in which multiple stages of a larger assignment are assessed by the instructor; we suggest that by using a mix of in-class exercises and take-home work, instructors can guide independent student thought as part of the writing process. It is crucial to guide students in understanding the limitations and biases inherent in AI technologies and to emphasize the importance of their own unique voices and perspectives in their writing. As students work more with generative AI, the probabilistic nature of the software may encourage students to shift their writing style away from human 'burstiness.' Without active intervention from writing instructors, student voices risk being homogenized by the influence of the predictive and predictable style of large language models.

At the same time, instructors should consider integrating interactions with AI tools into their curriculum, offering a structured environment for students to explore these technologies under guidance. This approach not only prepares students for a future where AI is a common tool in many professions but also helps them develop a critical lens towards the content generated by AI.

2. University and college administrators should develop clear yet adaptable policies and invest in instructor and student education rather than funding subscriptions to AI-detection software.

There is currently no foolproof AI-detection software (Sadasivan et al., 2023; Rashidi et al., 2023; Dalalah & Dalalah, 2023), and as AI-generation, AI-detection, and AI-detection evasion software are all developing in response to one another, a foolproof AI-detection software is unlikely to materialize. Thus, funding subscriptions to AI-detection software and using them to police unauthorized use of AI technologies is not likely to solve the many pedagogical issues with the use of AI-generation technologies. Rather, funding access to AI writing technologies may help 'level the playing field' and normalize the use of these technologies.

Our study indicates that writing instructors want to support students in acquiring critical thinking skills and acknowledge that students will need to use AI effectively and responsibly in their future careers. Instructors also expressed that they believe their average student is interested in developing critical skills and preparing for work that will include the use of AI. Furthermore, instructors do not have the capacity, nor are they interested in policing the use of AI in their classrooms. Thus, both students and instructors desire the appropriate and responsible use of these technologies, although they are unclear about what that is in practice.

Instructors also demonstrate overconfidence in their knowledge of these technologies and so are, on average, not currently equipped to deal with them, even when they are highly experienced and competent in traditional writing instruction. Thus, writing instructors need support in acquiring knowledge to develop new writing pedagogy that responds to AI writing technologies. In sum, university and college administrators must invest in instructor and student education specifically around the use of AI writing technologies.

Finally, a large minority of instructors expressed feelings of cynicism around marking AI-generated assignments and negative opinions about students who make unauthorized use of AI writing technologies. In order to preempt poor student-instructor relationships and instructor burnout, we follow the call of other researchers (e.g., Kohnke et al., 2023) for the development of clear, yet adaptable guidelines and policies around the ethical use of AI that permit regular revision in this quickly evolving area. Administrators should outline these policies in addition to offering training for both students and teachers around the responsible use of AI technologies.

Limitations of the present study and future work

As this study was designed and funded prior to the release of ChatGPT-3, when AI text generators were not as well-known and were less accessible, it focused on instructor knowledge, perceptions, and use. As instructors become more familiar with these technologies and with ChatGPT's output, we will continue this study as a longitudinal study to see how instructor perceptions and ability to distinguish AI writing change over time. In addition, now that these technologies are ubiquitous and widely employed by students, our research will inquire into how and why students are using these softwares. While the questions of how students can use them and how they are *actually* using them are topical across fields of study, these questions remain particularly important for the humanities—and especially writing composition—in which essay writing is still the predominant mode of assessment.

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Appendix

Essay Prompt

Write a 1000-word essay on the following topic:

Consider a problem that a particular industry is facing as a result of the COVID-19 pandemic, and make a recommendation for how to solve it. What are the immediate challenges with addressing this problem, and what are some possible solutions you could recommend?

This is an academic research paper, which means that it must cite a minimum of FOUR academic or high-quality journalistic sources within the text of the paper and must include a References page at the end of the paper.

The essay must contain:

1. A strong, clearly articulated and well-reasoned main point that is SPECIFIC, ORIGINAL and CONVINCING.
2. A strong introduction that in some way lays out the stakes of the argument
3. Well-chosen evidence from at least four secondary sources, with APA citations in the text.
5. Logical paragraph and essay structure
6. Clear, grammatical writing

Essay Rubric

	EXCELLENT	GOOD	BELOW AVERAGE	INEFFECTIVE
Argumentation	The essay begins with a clear and specific introduction that states a compelling thesis statement. The essay provides a thoughtful and engaging analysis of the assigned topic.	The essay begins with an introduction that states a thesis statement. The essay analyzes the assigned topic.	The introduction may not state a thesis statement clearly or the main idea may not appear at the beginning of the summary. Demonstrates basic understanding of the assigned topic.	The summary does not state a thesis statement. Demonstrates little to no understanding of the assigned topic.
Evidence	The essay provides more than the minimum amount of evidence and analyzes the evidence thoughtfully. All important details are included.	The essay provides some analysis of evidence. At least the minimum amount of evidence is provided. Most important details are included.	The essay provides less than the minimum amount of evidence. Some critical information is missing. Some important details are left out.	Insufficient evidence. Contains only some details. Substantial copying of key phrases and minimal paraphrasing.
Organization	The sentences follow one another in rigorous logical fashion; connections between ideas are very clear, and transitions between paragraphs are clearly signposted.	The sentences follow one another in logical fashion; connections between ideas are clear, and transitions between paragraphs make sense.	Sentences are disjointed. Ideas are not in a logical order or mostly mimic the original text.	Ideas are in a random order; sentences do not follow each other, or the essay closely mimics the text. The text may be too short or too long.
Spelling and Grammar	No errors exist in spelling, grammar, punctuation, capitalization, and sentence structure.	Minimal errors exist in spelling, grammar, punctuation, capitalization, and sentence structure.	Some errors exist in spelling, grammar, punctuation, capitalization, and sentence structure.	Numerous errors exist in spelling, grammar, punctuation, capitalization, and sentence structure.

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Exploring the challenges and affordances of integrating ChatGPT into language classrooms from teachers' points of view: An ecological perspective

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Keywords

AI;
AIEd;
artificial intelligence;
ChatGPT;
educational ecology;
higher education;
teachers' perspectives.

Abstract

The present study explored teachers' perspectives on the challenges and benefits of using ChatGPT in language classrooms, adopting an ecological perspective. To do so, ten Iranian language teachers were selected using convenience sampling and completed narrative frames about the use of ChatGPT in language classrooms. Semi-structured interviews were used to explore their beliefs on the impact of integrating ChatGPT in their classes. Employing deductive thematic analysis, the findings were organized into three different layers of educational ecology: microsystem, mesosystem, and macrosystem. The findings revealed that there are challenges and benefits in different layers of the classroom ecosystem regarding using ChatGPT in language classrooms. Teachers and teacher educators can benefit from the findings of the present study by raising their awareness of the implications of ChatGPT in language classrooms and adapting their practices to integrate this AI tool in their teaching practice.

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Introduction

Artificial intelligence (AI) technologies have developed and become more visible in various aspects of our daily lives. As AI increasingly infiltrates diverse aspects of society and culture, the need for critical perspectives on technology has never been more urgent (Lindgren, 2023). ChatGPT, a conversational agent developed by OpenAI, is one of the most advanced AI applications. It has attracted considerable public attention around the world (Adeshola & Adepoju, 2023; Biswas, 2023a, 2023b; Cheng et al., 2023; Kocoń et al., 2023; Meyer et al., 2023; Tlili et al., 2023).

Since the 1970s, Chatbots have been used in educational settings (Huang et al., 2022). While the latest Chatbots can be used to facilitate pedagogy, research, administration, and student support, there are significant concerns around academic integrity, labour displacement, embedded biases, environmental sustainability, increased commercialization, and regulatory gaps (Rudolph et al., 2024). ChatGPT's capability to realistically mimic human conversation opens a modern way of language learning. ChatGPT is developed by automated speech recognition, NLP (natural language processing), which "is a tract of Artificial Intelligence and Linguistics, devoted to making computers understand the statements or words written in human languages" (Khurana et al., 2023, p. 3714), and used by digital assistants, like Siri and Alexa, to manage and complete tasks.

For instance, Siri and Alexa use natural language to provide information and perform tasks upon request (e.g., turn on the radio and check the weather forecast). In contrast, ChatGPT was designed to have conversations with users. ChatGPT is a versatile and valuable tool with the potential to revolutionize language learning. Its interactive nature holds the key to unlocking engaging and personalized learning experiences. Fostering a dynamic learning environment and encouraging active participation and meaningful interactions are all conversational interfaces (Kohnke et al., 2023).

On the other hand, while some commentators focus on its capabilities to develop an education system (McMinn, 2023), others try to emphasize its limitations and risks (Kohnke et al., 2023). Although there is considerable research on the advantages and disadvantages of AI, such as ChatGPT, there has been little focus and attention on its negative impact on the human thinking process and decision-making abilities in an educational environment. Because of a noticeable increase in the use of AI and robots, it may be essential to have a better and more comprehensive understanding of the effects of these AI tools on human cognitive development and problem-solving skills. Having a heavy reliance on AI systems like ChatGPT can indirectly decrease human autonomy (Bin-Hady et al., 2023) to make different vital decisions in crucial situations and may reduce critical thinking as well. With AI providing fast and quick responses and support by AI, it may hurt human ability and capability to think deeply about different issues. People may also adapt to using ChatGPT's solutions instead of using their minds or thinking to solve their problems (Karthikeyan, 2023). While AI tools like ChatGPT have the potential to revolutionize the education system, it is crucial to strike a balance between

utilizing its benefits and protecting human cognitive and thinking abilities (Bozkurt et al., 2023).

By doing a wide range of research on AI tools, we may have more conscious approaches to promulgate them. By understanding the potential disadvantages and adopting a balanced approach, we can ensure that AI technology, such as ChatGPT, becomes a valuable tool for learning and personal growth rather than an obstacle to intellectual development. This study aims to help teachers enhance and improve their teaching qualifications by incorporating ChatGPT into the classroom. It aims to explore Iranian teachers' beliefs and perspectives about ChatGPT and the positive or negative outlooks it may cause. In effect, the purpose of this study is to explore the benefits and challenges of using ChatGPT in classroom practice and to discover teacher's attitudes regarding ChatGPT.

Literature review

ChatGPT in education

ChatGPT has passed some of the most demanding and challenging tests in higher education, which has shattered expectations toward positive and extraordinary awareness of it (Choi et al., 2023). Excitement and anxiety among educators are two different feelings that ChatGPT causes all over the world. Although generating some features such as human-quality text, human-like answers, or responses presented a new opportunity or even opened modern possibilities for both teaching and learning, it has also increased worries about its potential to replace human teachers or interrupt the traditional classroom setting.

It is crucial to remember that AI has had an important role in education in various aspects. For instance, personalized student assessments (Zhao et al., 2023) and AI-powered teaching systems (Chaipidech et al., 2022) have already made their impact on K-12 schools and higher education settings. Providing personalized feedback and increasing the learning experiences are among other abilities one can call. Artificial intelligence is being used to generate learning analytic platforms (Chaipidech et al., 2022), grading tools, and tutoring systems (Chen et al., 2023), which help students and teachers in different ways. For instance, AI tutors may provide personalized instruction and even feedback to students, while AI graders can help teachers by saving their time and identifying areas where students need more support and guidance. (Tedre et al., 2021).

Besides traditional teaching methods, teachers and tutors are now integrating AI tools into their classrooms (Kim et al., 2020). Some AI tools can help students be more active participants in the learning process. For example, Grammarly, which is a grammar and sentence checker, can provide useful feedback on grammatical errors and sentence structures, translation tools like Google Translate can connect students to a global community of learners in multiple languages, or gamified exercises like Duolingo can be both fun and effective.

ChatGPT offers numerous valuable applications for educators. For example, it can help teachers in time-consuming tasks like providing lesson plans or any form of classroom needs, discussion and conversation prompts, useful scripts for different presentations, and classroom management points (van den Berg & du Plessis, 2023) or providing support and help with student's evaluation, designing grading rubrics, crafting test questions, generating students' progress report. (Zhai, 2022). Acting as versatile teaching assistants, providing practical and informative advice on improving lesson plans, expanding reading lists, presenting effective communication strategies for different age groups, and making a strong connection among teachers, students, and parents are all a wide range of benefits that ChatGPT can offer. It can also support students with tailored tutoring, informative research guidance, translation into multiple languages, and providing guidance for solving problems. (Trust et al., 2023).

ChatGPT's ability in natural language conversations opens new possibilities for creative thinking support in education. Students can use it to brainstorm ideas and find various perspectives. This approach encourages students to think critically and in a creative manner, promoting innovations and problem-solving skills and filters their thought processes through interactive text-based interactions, which improves all kinds of skills that students have, like reading and writing skills, research and language skills, as well (Kasneci et al., 2023). Anders and Sahakyan (2023) found that ChatGPT could extend its support from providing simple support to complex ones by helping students through the process of essay writing. From the initial step of selecting a topic, ChatGPT offered suggestions and relevant resources, ensuring students chose a topic that was connected to their interests. It also acted as an active participant, engaging students in discussions and prompting them to find diverse perspectives. It helped students create an outline and organize ideas into a cohesive narrative. In the drafting stage, suggestions were provided for improving grammar and sentence structure to refine the essay. Finally, ChatGPT proofread the essay and identified grammatical errors, typos, and consistencies in style and formatting (Anders & Sahakyan, 2023).

In another study, Kohnke et al. (2023) asserted that by simulating authentic interactions, ChatGPT supports language learning. They revealed that when learners encountered unfamiliar words in the context that their teachers sent them, ChatGPT could provide help to connect the comprehension gap. It also engaged students to ask follow-up questions and reinforced their understanding. Producing different genres or writing various dialogues were some other capabilities of ChatGPT. To illustrate, marketing materials, informative emails, and engaging dialogues could be provided for students. Additionally, ChatGPT could facilitate dialogues between two individuals over the topic of increasing electricity prices and discuss potential solutions. ChatGPT could also modify the complexity of the dialogue to make it more appropriate for different levels of students (van den Berg & du Plessis, 2023). This can make a great contribution to teachers in differentiating materials for their students and providing comprehensive vocabulary support that caters to their individual needs. It also offers

detailed word definitions and examples in both the target language and the learner's primary language, enhancing their comprehension of complex texts like short stories.

The potential pitfalls of ChatGPT in education

Despite its undeniable benefits, ChatGPT also presents certain drawbacks. One major concern is the potential for users to blindly trust the accuracy and credibility of its output. As a language model, ChatGPT is capable of generating highly realistic text, even when the information it provides is fabricated. This risk is heightened when ChatGPT is used in educational settings, where students may be more inclined to accept its output as authoritative. Many individuals who use ChatGPT fail to comprehend that it differs from traditional information sources like web search engines, libraries, and encyclopedias. Unlike these resources, ChatGPT's primary function is to generate text, not to provide factual information. It relies on pattern recognition and language modelling to predict which words and phrases are likely to cohere, resulting in text that appears to be meaningful but not necessarily accurate.

While AI models like ChatGPT can produce creative and engaging text formats, they lack the depth of knowledge and critical thinking skills inherent in human communication. Blindly accepting AI-generated text as superior could undermine the value of human creativity, critical thinking, and the ability to discern fact from fiction (Trust et al., 2023). ChatGPT's training on a limited and homogeneous set of English-language texts has resulted in a monocultural perspective that reflects the cultural biases of its training data. When teachers employ ChatGPT to provide feedback or grade student writing, the model's monocultural viewpoint could lead to unfair assessments, silencing the diverse voices and cultural nuances of their student's writing (Ray, 2023). Educators should carefully consider ChatGPT's limitations and ensure that its monocultural biases (despite its multilingual ability) do not overshadow the rich tapestry of perspectives expressed in their student's writing (Farr, 2024).

A lot of information is collected by Open AI, such as how people use ChatGPT, what prompts their input, and what the AI provides in response. This kind of information is shared with other users, vendors, law enforcement, and affiliates. It means that OpenAI is aware of what you say to ChatGPT and everything about you, and they can possibly share the information that they received from people with whoever they want. In addition, people and countries that have a stable connection to ChatGPT have a considerable advantage over those with limited or no internet access. This difference can have an important effect on those who can use ChatGPT for learning, productivity, or creativity and those who are deprived of its benefits (Adarkwah et al., 2023; Fodouop Kouam & Muchowe, 2024).

It is essential to consider that AI tools, like any technology, need to be evaluated before their integration into educational settings. This careful assessment is crucial to identify and address potential risks. A wide range of research has focused on the advantages and disadvantages of using

AI, like ChatGPT, for both teachers and students. There is a lack of research on how AI, like ChatGPT, can remove the thinking process and disable both teachers and students to think and make decisions on their own. The opportunity to use different kinds of AI and robots is possibly increasing day by day. Having a deep understanding and attitude toward using these robots can have a positive effect not only on teachers and students but also on human beings. ChatGPT or other AI tools may cause people to feel unqualified to think about their issues or it may not improve their problem-solving skills. Research on this topic could inform people, users, students, or teachers about the final goals of these robots and make them more aware while using these tools. Therefore, this study aims to discover these threats and opportunities offered by ChatGPT in education by exploring it from teachers' perspectives. Employing an educational ecology lens, the questions guiding this study are as follows:

- What are the benefits and challenges of using ChatGPT for Iranian EFL teachers?
- How does educational ecology explain the benefits and challenges of using ChatGPT?

Theoretical framework

Bronfenbrenner (1979) emphasized how ecology is crucial in education, explaining it as a system with many layers. He posited four layers for it: microsystem, mesosystem, exosystem, and macrosystem (Bronfenbrenner, 1993). These layers showed how things are connected in schools and between students, teachers, and families. They also displayed how external factors, like the community or society, could affect what happens in school. Bronfenbrenner's theories helped us to see education as a big picture, understanding how everything worked together to shape learning and development.

A classification with three different layers: personal, interpersonal, and institutional, was described by Rogoff (1995). Zembylas (2002) considered teacher's feelings based on individual, social, and group perspectives, which were relevant to personal, cultural, and institutional dimensions. In the field of Teaching English as a Second Language (TESOL) and applied linguistics, there is a rich literature on the use of ecological frameworks. This literature demonstrates that using an ecological perspective can enhance our perception of the complexities, experiences, and meaning-making processes in teachers (Kamali, 2024a, 2024c; Nazari et al., 2023). These processes are deeply embedded in communities, which are influenced by broader ecological systems. Thus, raising awareness of teachers' perspectives on various concepts, entities, and tools, such as AI, within the microsystem (classroom), mesosystem (institution), and macrosystem (sociopolitical factors), is crucial for understanding how these elements influence their professional development as educators.

An ecological perspective has been selected as a theoretical underpinning of this study because it provides a holistic framework to understand the multifaceted nature of teaching environments. By analyzing the use of ChatGPT across the microsystem (classroom environment), mesosystem

(institutional context), and macrosystem (sociopolitical factors), this study captures the complex interrelationship of influences that shape teachers' experiences and perceptions. This approach enables us to identify not only the immediate effects of integrating AI tools like ChatGPT but also the broader institutional and societal dynamics that impact their implementation.

Method

Context and participants

This research was carried out in Iran, where AI stands out as a highly relevant and popular subject among Iranian language instructors, despite facing obstacles such as limited internet access and restrictions on purchasing AI services (Meraji et al., 2023). Since AI is a new phenomenon in Iran, many Iranian teachers are interested in applying AI tools in different parts of their teaching process to get help from it in their lesson plans and in implementing their sessions. Despite facing international sanctions that resulted in Iran's limited access to new technologies, including AI, the educators' commitment to incorporating AI in education surpasses the challenges posed by these sanctions (Steckman, 2020). This study focuses on ChatGPT because, according to the researchers' observations, it is the most commonly used AI tool in Iran.

The participants of the study were ten Iranian EFL teachers (seven women and three men) who taught in various institutions in Iran. Both genders were selected since gender may have an impact on their beliefs (Estalkhi et al., 2011). There is a wide range of institutions in Iran in which teachers teach different foreign languages based on students' needs, such as English, German, Korean, Chinese, etc. The participants of the present study were all English teachers in different institutions and provinces of Iran. They had been teaching English for between two and twelve years (see Table 1).

Table 1. Participants' demographic information.

Teacher	Gender	Age	Education	Years of teaching
T1	Female	32	B.A. Psychology	7 years
T2	Male	26	B.A. Sociology	3 years
T3	Female	38	M.A. TEFL	12 years
T4	Female	27	M.A. TEFL	12 years
T5	Female	19	B.A. Law	2 years
T6	Male	32	Ph.D. TEFL	12 years
T7	Male	38	Ph.D. candidate TEFL	8 years
T8	Female	24	M.A. TEFL	7 years
T9	Female	28	Ph.D. TEFL	10 years
T10	Female	23	M.A. TEFL	5 years

Data collection

In the present study, 12 teachers were selected based on convenience sampling who worked in private language institutions in Iran. First, these teachers filled out a narrative frame in which they completed some personal narratives about the use of ChatGPT in language classrooms e.g., "one of my typical challenges I experience using AI in my classes is ... because ..." (see Appendix 1). At the end of this

narrative frame, they declared their consent to participate in this study. The relevant ethical approval was obtained from the organization that the first researcher was working at. Then, a link to the Google form was sent to 12 teachers via Telegram, and they were asked to fill out the form and return it within five days. Out of the 12 teachers, ten teachers decided to participate in the project. The interviews were conducted on the Big Blue Button platform over a period of 14 days, each taking between 45 and 75 minutes. At the beginning of each session, the interviewer informed the participants that this session would be recorded, and they gave their consent. During the interview, the cameras of the interviewer and interviewee were turned on in order to have a better and more interactive session. The interviewer asked core questions in three different layers - microsystem, mesosystem, and macrosystem. The area of interest of the interviewer is AI and the second researcher's focus is CALL (computer-assisted language learning).

Data analysis

In analyzing the data, we followed the principles of thematic analysis (Braun & Clarke, 2006) to identify, analyze and report patterns or themes within the data. This approach ensures that the study thoroughly investigates and accurately represents the varied experiences and opinions of teachers regarding ChatGPT's role in language education. The second researcher collected all recordings and data and started to analyze them. All the data was transcribed and analyzed, and initial codes were released. The related codes were merged, and some subthemes emerged, which were then categorized. In order to enhance the trustworthiness of the analysis (Lincoln & Guba, 1985), a meeting was set with all three researchers to verify the subthemes. After verification, the thematic map was drawn, and a second meeting was arranged to check and get verification.

To comply with ethical standards, all ten teachers voluntarily consented to participate in the study after receiving comprehensive information about the research benefits and were given the right to withdraw at any stage. To ensure confidentiality, participant identities and recorded conference data were anonymized using pseudonyms (e.g., T1, T2, ...) in the research report. Some gifts, such as books, were given to the participants as a token of appreciation.

Findings

In this section, the findings of our research are presented through the benefits and challenges shared by the participants to understand Iranian teachers' beliefs regarding ChatGPT. This study addresses these issues at three ecological levels, including micro, meso, and macro, from the teachers' viewpoints (Figure 1).

Microsystem ecology

In this part, the benefits of Iranian teachers using AI will be explained at three levels, starting with the micro-level. The first subtheme revealed through data analysis is "providing

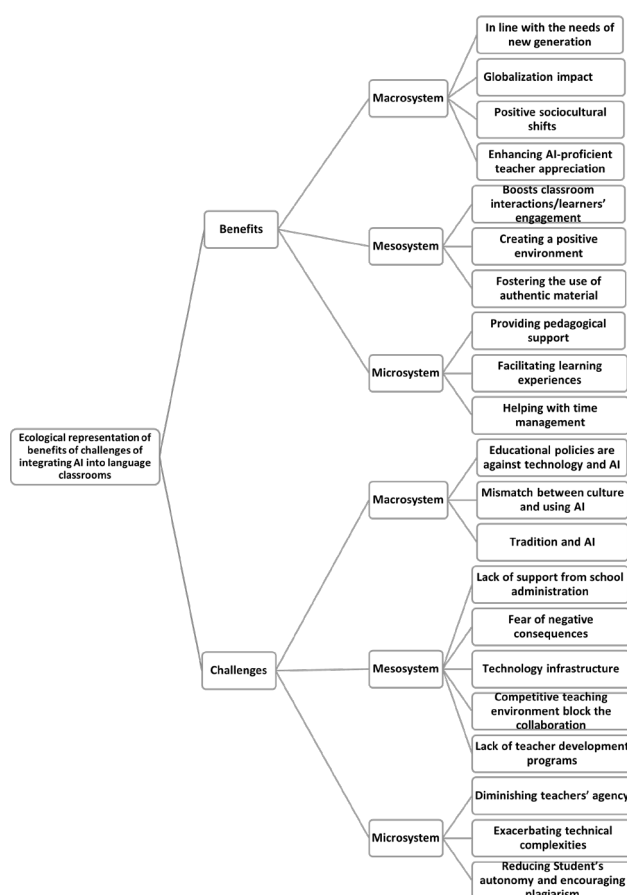


Figure 1. Ecological representation of benefits and challenges of integrating AI into language classrooms.

pedagogical support". Eight participants believed that ChatGPT can add variety and creativity to their teaching practices, leading to more effective classes. T8 mentioned in the interview that as AI is a quick and useful assistant, it can prevent or at least postpone teachers' burnout by allowing them to delegate time-consuming tasks to ChatGPT. Another valuable support is personalized feedback, noted by T2 in the narrative frame. According to her, "using AI can help me offer more personalized feedback on my students' tasks. Giving learners deeper feedback may enable them to understand their weaknesses better and strive to improve. It also saves me a lot of time" (T2, narrative frame). T2 and T7 mentioned that a common problem with Iranian learners is their difficulty in brainstorming for a topic or generating ideas. These two teachers, along with T3, believe that AI is an excellent tool for brainstorming and idea generation, helping learners produce better writing or enhance their speaking skills. Most of the participants assume that AI can help increase their autonomy, allowing them to solve problems easily with the help of AI and their own thinking. T6, in his narrative frame and interview, highlighted the option of dialogue as one of the unique features of AI. This feature benefits both teachers and learners through ongoing dialogue, enabling them to ask for simplified responses, more examples, or adjustments to the difficulty level of responses. The next subtheme is "facilitating learning experiences". T5, in her interview, stated, "as learners can search for themselves and correct their mistakes by AI, they become more independent, making it easier for teachers to work with such autonomous learners." Another participant added, "when I have online classes with my learners, I ask them to solve their problems

or ask some of their questions by AI. Little by little, it helps them become more autonomous" (T10, interview). Another crucial code in this subtheme is the satisfaction of learners. T9, for instance, mentioned that when she asks questions and informs her students that they are AI-generated, they become more eager to answer, expressing greater satisfaction in seeing their teacher using new sources. T1, in the interview, assumes that when she discusses her experience of using AI with her learners, they become happy to have a class that incorporates new technologies, moving away from traditional teaching methods.

The next code in this subtheme is about changing passive to active knowledge. T3 shared her experience with one of her learners, stating:

I have a private student, and her vocabulary proficiency level has changed because she is using AI. She knew lots of good words but couldn't use them in writing or speaking and put them into practice. It was a kind of passive knowledge, and after practicing with AI and seeing various examples, she has changed a lot. From an A2 level, now she is at a B2 level (T3, interview).

The last subtheme of microsystem ecology is "helping with time management". Nine participants, in their narrative frame, considered this feature as one of the outstanding ones. They believe that ChatGPT provides the response spontaneously, and there is no need to wait and get the response. Consequently, there is no waste of time between giving the commands and getting the response, which is quite useful in saving time. All participants agreed in their interviews that AI makes teaching a time-saving practice. They do not have to spend lots of hours checking their learners' assignments and giving feedback; AI can do it in a few seconds. Other tasks, such as designing activities, preparing materials for class, and lesson planning, can also be done in a very short time due to the presence of AI.

Mesosystem ecology

The second type of benefits is explained at the meso-level, where three subthemes were developed. The first one is that "it boosts classroom interaction". T5 notes that "my classes are getting better and better, especially learners' interaction and engagement increased to a good extent, and this is the effect of AI" (T5, interview). T7, in his narrative frame, explained that as AI can add different types of varieties to teaching practices, it results in more classroom interactions. The next code is "peer influence". T9 and T10 believed that there is a positive effect and environment in this respect, in a way that colleagues use it and then share their positive experiences. This positive influence encourages others to embrace this valuable tool, contributing to a collaborative and innovative teaching environment. The next code is about "AI as a powerful assistant". Nine participants agree that AI serves as a fantastic assistant. Capable of performing various tasks for teachers, it is employed to enhance classroom interaction and learners' engagement. The next subtheme is about "creating a positive environment". T7,

T2, and T1 explain that they are working with the new generation, which has its own needs. The new generation expects a technological English class equipped with various technologies and AI. By incorporating AI into the class, a positive environment is created, reflecting the expectations of the tech-savvy new generation. T6 and T7, who teach at online schools, mention a positive attitude toward using AI, while being encouraged by school administrators.

T8, teaching in a language school with a modern approach, highlights the importance of innovation, creativity, and interesting classes, which align with the school's vision and encourage the use of AI. The next code is about the "match between teachers' autonomy in using AI and institutional vision". While such language schools are limited and are in the minority, some schools allow teachers to freely use AI, aligning with their institutional vision. The last subtheme of mesosystem ecology is "access to authentic sources of information". For instance, T2 assumes that "authentic examples provided by AI in different contexts are very effective" (T2, narrative frame). T5 also explains that as learners chat with AI to get their responses, they have access to authentic material and responses, facilitating authentic learning experiences.

Macrosystem ecology

The last category of benefits is the macrosystem ecology, where four major subthemes were found. The first subtheme is that "using AI aligns with the needs of new generations". All the participants maintain that the new generation of learners welcomes technology and AI, making learners enthusiastic about incorporating AI into their classes. The second subtheme is "the globalization impact". T7 explains, "English teachers want their learners to know about Western culture" (T7, interview), and AI serves as a valuable tool for achieving this goal. Teachers appreciate using AI as it contributes to cultural exchange. T9 adds, "it can also provide a lot of information about Iranian culture, too. So, it is a good tool to familiarize people with different cultures of the world" (T9, interview). The next subtheme is "a positive sociocultural shift". Eight participants maintain that AI can enhance teaching practices. T2 believes that, as AI is user-friendly and practical, it can significantly assist teachers. T6 suggests that the effect will be substantial, as the new generation welcomes technology and its specific form, i.e., AI. This could lead to a transformation in the teaching profession, influencing both current and future teachers. Consequently, either current traditional teachers, with their negative views toward technology, and specifically AI, should start using this tool and equip themselves, or the new generation of teachers who use AI tools with positive views toward it will replace the former. Consequently, traditional teachers will lose their jobs.

Helping with content creation, increasing creativity for generating ideas, organizing classes and plans, assisting in designing different tasks and activities, having access to a good source, and broadening teachers' minds to a global level are fascinating features. If teachers use AI, it can work wonders, bringing about significant change (T8, interview).

T3, T6, and T7 highlight the transformative potential of AI in standardizing and unifying teaching practices across diverse global contexts. This standardization promotes a consistent learning experience for learners globally, contributing positively to language learning and teaching on a global scale. The last subtheme in this part is “enhancing appreciation for AI-proficient teachers”. Seven participants explained in the interview session or narrative frame that teachers who use AI are more appreciated by their learners. T4 also believes that “AI can change the role of teachers to be mentors. They aren’t the main source of knowledge in class. It can bring about changes to the traditional role of teachers in our culture” (T4, narrative frame).

AI challenges in language classrooms from ecological perspectives

Microsystem ecology

This section addresses the challenges caused by AI, starting with the microsystem ecology with three subthemes. The first one is “diminishing teachers’ agency”. T3 argues that teachers are becoming over-reliant on AI, which is not ideal. Teachers should use AI as an assistant, standing on their own feet, but there is a trend of over-reliance that needs to be avoided. T7, from a different perspective, affirms, “AI lacks interaction and personalized learning, so I, as a teacher, should be present to compensate for such problems. It is a robot and isn’t as interactive as it should be” (T7, interview). Some participants also noted that AI lacks visual aids, providing only text, which can become monotonous and needs improvement in interaction. T8 raised another concern, stating that while AI can help promote innovation and creativity, relying solely on AI may hinder teachers’ own creative thinking, potentially leading to less creativity and innovation in the future. The next subtheme is “exacerbating technical complexities”. T9, in her narrative frame, explained that not all AI responses can be trusted, providing examples of grammatical errors at the C1 level. Access to AI is also a common problem mentioned by all participants. T4 and T10 believed that the difficulty in connecting was demotivating, and about half of the participants resorted to using Telegram bots due to connection issues with the website. T1, T6, and T7 raised concerns about the lack of sources provided by AI, impacting the validity and reliability of responses. For this reason, T5, for instance, prefer recommendations from colleagues over unverified AI responses. Another difficulty highlighted is that AI responses are generated by a robot without human testing in real contexts. The next subtheme is “reducing students’ autonomy and encouraging plagiarism”. T3 and T5 affirm that students exploit AI by relying on it for every command, leading to over-reliance, laziness, and dependency. Almost all the participants believe that AI struggles to tailor responses for beginner levels, making it challenging to incorporate AI at this level. It cannot simplify responses for beginners, creating difficulties for teachers. T4 and T8, in their narrative frames, mentioned the limitations of AI in addressing listening skills, as it is not useful for this skill and cannot assist teachers in producing content.

Mesosystem ecology

The next set of challenges is explained in the mesosystem ecology, where several subthemes have been identified. The first subtheme is “the lack of support from school administration”. The data indicates that eight participants face a mismatch between their opinions about AI and the institutional vision. This discrepancy results in a lack of support from language schools, where teachers often are not allowed to use AI for various reasons. The next subtheme is “the fear of negative consequences”. T7, T10, and T1 express concerns that teachers and supervisors fear losing their authority. The presence of AI makes them feel anxious, as they compare themselves with AI, creating a fear of losing their roles as the main source of knowledge in the classroom. Additionally, T2 and T9 note that managers of language schools fear losing learners due to the presence of AI, impacting financial matters. This fear leads to discouraging teachers and learners from using AI. The following subtheme is “technology infrastructure”. Nine participants explained that institutes often lack the resources and tools necessary to incorporate AI into classrooms as teaching assistants. This lack of technological support makes it challenging to seamlessly integrate AI into the teaching process.

The next subtheme is “the competitive teaching environment that hinders collaboration”. T2 and T7 assert that in small towns, the competitive environment acts as a barrier for teachers to share their opinions about AI and improve together. In these settings, teachers often view AI as rivals and avoid challenging themselves to use it, preferring to stay within their comfort zones.

The last subtheme is “the lack of a teacher development program”. All participants agree that there is a need to train teachers in incorporating AI, but such courses are currently unavailable. T5 emphasizes the importance of webinars and workshops, stating, “AI is changing the way of education. So definitely we need such webinars and workshops to better use them” (T5, interview). T3 adds:

Teachers should be trained in how to introduce it to learners. Learners must be trained in using AI so that this experience would be positive and the negative effects wouldn’t happen. Teachers are best to help and lead them. So, we should have such training for teachers to better cope with their learners (T3, interview).

Participants unanimously agree that increasing the availability of workshops and webinars on AI in education would be highly effective and beneficial for teachers, who would then be able to better utilize this assistant.

Macrosystem ecology

The last set of challenges is explained in the macrosystem ecology, with several subthemes identified. The first subtheme is “that educational policies are against technology and AI”. The majority of participants state that Iran’s educational policies are hostile towards technology, the internet, and AI. This negative stance at the national

level hampers the incorporation of AI into education. The next subtheme is about “the mismatch between culture and using AI”. T2 believes that AI creates a cultural divide between the center and periphery, positioning AI at the center while teachers are relegated to a peripheral group. This, according to T2, is undesirable and places teachers in a secondary role.

The following subtheme is about “tradition and AI”. T4 and T9 express the belief that AI can bring about rapid changes in education globally. However, in Iran, where the culture is resistant to technology and its tools, acceptance is time-consuming. T2 and T7 note that the old-fashioned nature of schools, books, and the education system in Iran acts as a significant barrier to incorporating AI into education, especially in English language learning. This outdated system is not equipped to integrate AI into the language learning process seamlessly. Many learners share the sentiment that traditional teachers are not interested in using AI, considering it useless. This reluctance among teachers becomes an obstacle to the adoption of AI. For instance, T1 mentions in her narrative frame, “our culture considers technology and AI as something useless, and it is very difficult or even impossible to learn by technology. This view is widespread among traditional teachers and families”. The last subtheme is “AI tools accessibility”. All participants affirm that there are challenges regarding accessing the internet and using AI. T5 discussed, “access to technologies and AI is difficult in Iran due to limitations posed by the developers of these programs and also due to the situation in Iran” (T5, interview). T4, in the interview, also mentioned that “lack of access to technology demotivates teachers, and they aren’t eager to use it because they face different problems and difficulties for connection” (T4, interview).

Discussion

The exploration of Iranian teachers’ beliefs regarding the benefits and challenges of ChatGPT was revealed at three levels: micro, meso, and macro. At the micro-level, three subthemes emerged, the first of which was “ChatGPT provides pedagogical support”. The findings regarding interactive learning, giving feedback and scoring on learners’ essays, and personalized learning and tutoring align with Baidoo-Anu and Ansah (2023). They discussed the same capabilities of ChatGPT for learners and teachers. Ausat et al. (2023) found similar findings and discussed that ChatGPT can make teaching practice easier than before, enhance pedagogical practice, and help brainstorm ideas (Sok & Heng, 2023). Our study revealed that one of the major problems of Iranian learners is the lack of ideas for brainstorming a topic for writing and speaking skills, and ChatGPT can resolve this problem. The next subtheme was facilitating the learning experience. It is achieved, for instance, by promoting learners’ autonomy or increasing the feeling of satisfaction on the side of the learners. Limna et al. (2023) noted the same concept by arguing that learners are satisfied with using ChatGPT because it is convenient and user-friendly by which learners can get immediate feedback and response to their questions. The last subtheme was helping with time management. Due to its speed and efficiency, ChatGPT minimizes response time, making the teaching process

more time-effective. It aids teachers in designing lesson plans, preparing materials, creating activities, and helping various aspects of the teaching practice. Limna et al. (2023) argued that incorporating ChatGPT can result in a reduced workload. As this tool adeptly handles routine questions, it liberates teachers to focus on more advanced tasks such as designing lesson plans, providing feedback to learners, and enhancing classroom discussions. This is in line with Kamali’s (2014, 2021, 2023) concept of teacher metamorphosis, asserting that a teacher should transform into a package of different roles, such as examiner, and material developer, and add a dimension to it, which is AI literacy.

Regarding the challenges of incorporating ChatGPT at the micro-level, the first subtheme –diminishing teachers’ agency – lends support to the previous study by Ulla et al. (2023), acknowledging that learners may become overdependent on ChatGPT and it leads to a lack of critical thinking and innovation by learners. The next subtheme is “exacerbating technical complexities”. One of the important issues is the accuracy of the responses. The findings revealed that not every response provided by ChatGPT is trustworthy, considering the fact that inaccurate responses are frequent (Sok & Heng, 2023; Trust et al., 2023; Limna et al., 2023).

Another challenge this study could add to the literature due to its context (Iran) is “difficulty with connection to ChatGPT”. This research was done in the context of Iran, and the developers of ChatGPT banned Iran’s IP. Therefore, it is difficult for Iranian teachers and learners to access this tool easily. The source of ChatGPT-generated responses can also pose another challenge by decreasing the reliability and validity of responses (Ulla et al., 2023; Gordijn & Have, 2023; van Dis et al., 2023).

The last subtheme in this section - “reducing learners’ autonomy and encouraging plagiarism” - suggested that learners can easily use this Chatbot to do their assignments, and this increases plagiarism among them, which is in line with a few studies (e.g., Cotton et al., 2023; Mohammadkarimi, 2023; Ulla et al., 2023; Sullivan et al., 2023; Kohnke et al., 2023).

In the meso-level ecology, the benefits and challenges of AI could add to the body of knowledge in the literature. The finding for the first benefit - ChatGPT boosts classroom interaction and learners’ engagement – was consistent with a number of previous studies (Jeon & Lee, 2023; Lo, 2023; Rahman & Watanobe, 2023; Ulla et al., 2023) in a sense that it assists teachers with a versatile assistant. The study reveals a variety of tasks ChatGPT can assist teachers in, such as designing different tasks and activities, creating lesson plans, producing reading text and comprehension questions, and designing a test for classroom quizzes. Moreover, it was found that since ChatGPT can design different group activities, games, and tasks, it enhances classroom interactions and engagement. This enhanced interaction helps the quality of teaching practice and more fruitful classes. It is in line with researchers who argued that a game-based learning environment has positive impacts on language teaching and learning contexts (Demirkan, 2019; Balbay & Erkan, 2018).

The next subtheme is “creating a positive environment”. It helps teachers design different activities and games which help them in creating a positive atmosphere in their classes. In the same vein, Salim et al. (2023) found that through the application of digital games in an English language class, the motivation and learning of learners are improved. This enhanced motivation can help to create a positive atmosphere in the classroom. The last subtheme is “fostering the use of authentic material”. Koraishi (2023) considered ChatGPT as a powerful tool for material development for different purposes. ChatGPT can provide teachers with different types of material for their classes. These materials, according to our study, are authentic and reliable. Therefore, the finding of this is consistent with the findings of Koraishi (2023) and Baskara (2023).

In the challenges of ChatGPT at meso-level ecology, one of the subthemes is “fear of negative consequences”. As discussed earlier, those teachers and supervisors who show resistance toward using ChatGPT are afraid of losing their authority and power in classes and institutes. They see themselves at stake and are afraid of being replaced by new forms of technology, especially AI. Kiryakova and Angelova (2023) explained that the rise of new tools, specifically those based on AI, increases concerns that technology may replace the teacher in the classroom. However, Ausat et al. (2023) arrived at the conclusion that in the context of learning, ChatGPT can only be a tool and cannot replace the role of the teacher thoroughly. The next subtheme is “lack of teacher development program”. Based on what Kohnke et al. (2023) argued, ChatGPT is a new powerful tool that will remain for a long time. Therefore, it is suggested to learn its uses and capabilities rather than escape from it or ban its use by teachers or learners. Some of the best solutions, as shown by our study, are to have teacher training courses and professional development programs in the field of AI specifically for teachers to better use this tool. These are in line with Kamali (2024c), who recommended critical teacher education, and Kamali and Javahery (2024), who proposed peer coaching programs.

The last section deals with the benefits and challenges at the macro-level. The first subtheme is “globalization impact”. One of the important aspects of language learning is about learning the culture of the target language. Our study recommends that ChatGPT is an effective tool for transferring cultures. Since it can give valuable pieces of information about different cultures, it helps the process of transferring cultures. Accordingly, Warner (2023), discussed how teachers can use the material driven by ChatGPT about culture inside the classroom. This can help learners engage more inside the class, and get familiar with English-speaking cultures. Moreover, Kostka and Toncelli (2023) discussed a ChatGPT response regarding its abilities in language learning and teaching in which one of the ChatGPT responses was about providing information about English-speaking countries that can lead to enhancing learners’ communicative competence. The next subtheme is about “positive sociocultural shifts”. Our study argued that ChatGPT is capable of changing education, especially English language learning, positively at the macro-level. For instance, Rudolph et al. (2023) suggest that ChatGPT can offer experiential learning by providing students with various

problem-solving scenarios. Moreover, learners can enjoy personal tutoring from ChatGPT. Drawing upon various valuable functions of ChatGPT which were discussed earlier in this section, this chatbot could be capable of changing education positively if teachers and learners incorporate it in the process of learning and teaching.

The last part is about AI challenges at the macro-level. The first subtheme is about “tradition and AI”. Different issues (such as a lack of tendency to move toward technology, resistance by traditional teachers, the time-consuming process of AI acceptance, the old system which is not capable of adding AI to it, and the old-fashioned style of teaching and materials) emerged from this study. All these issues were discussed earlier in this section. The last subtheme is “AI tools’ accessibility”. Since Iran is an AI-deprived country, connecting to ChatGPT and working with it is an important problem for teachers. Iranians do not have access to ChatGPT freely due to the developers’ policies, and this is a demotivating issue for both teachers and learners.

All in all, the research questions were addressed by exploring the benefits and challenges of using ChatGPT for Iranian EFL teachers at the micro, meso, and macro levels of educational ecology. At the micro-level, benefits such as pedagogical support, facilitating learning experiences, and time management were identified, along with challenges like diminishing teachers’ agency and technical complexities. At the meso-level, benefits included enhanced classroom interaction and a positive learning environment, while challenges involved resistance to technology and a lack of teacher development programs. At the macro-level, ChatGPT’s impact on globalization and sociocultural shifts were noted, alongside challenges related to traditional educational practices and AI accessibility. These findings contribute to the literature by providing a multifaceted understanding of ChatGPT’s integration into language classrooms and offering practical insights for teachers and educators to adapt AI tools in their specific contexts.

Conclusion and implications

The present study tried to explore teachers’ beliefs about the challenges and benefits of integrating ChatGPT into language classrooms from an ecological perspective. The findings revealed that the challenges and benefits emerged in three levels of educational ecology, namely micro, meso, and macro (see Figure 1). This study reveals an innovative approach to delve into the affordances and challenges of ChatGPT use in language classrooms from teachers’ perspectives. The study’s originality also comes from its theoretical underpinning, i.e., educational ecology, which represents the complex relationship among dynamic and multifaceted variables and its insights on ChatGPT’s integration into language education offer actionable guidance for academic policy. At the micro-level, policies could advocate for AI incorporation into curriculum frameworks, with an emphasis on fostering critical thinking alongside AI usage. At the meso-level, initiatives might prioritize teacher training to optimize ChatGPT’s benefits while addressing resistance to technology. Finally, at the macro-level, policies could advocate for equitable access

to AI tools and promote research on culturally relevant AI applications. These recommendations aim to ensure effective and responsible integration of AI in language education, aligning with evolving pedagogical needs and technological advancements.

The findings of the study can help teachers see these challenges and benefits from other teachers and compare them with their own beliefs to take advantage of the benefits and minimize the challenges. Teacher educators can also design training sessions informed by these affordances and challenges as a point of departure and seek possible remedies and solutions for them. However, there are several limitations in this study that must be acknowledged despite the valuable insights it provides. First, the study relied on self-reported data through narrative frames and semi-structured interviews, which can be subject to biases and inaccuracies (Muncey, 2005; Kamali, 2024b). Second, the specific sociopolitical and technological constraints in Iran, such as restricted access to ChatGPT, may limit the generalizability of the findings to other regions where such constraints do not exist. Third, the study focused exclusively on the perspectives of teachers, potentially overlooking the experiences and viewpoints of students, administrators, and other stakeholders in the educational ecosystem. Fourth, the rapid evolution of AI technologies means that findings related to ChatGPT may quickly become outdated, necessitating ongoing research to keep pace with technological advancements and their implications for education. Finally, the impact of other forms of AI tools, such as Claude 3 and Gemini 1.5, will also need further investigation.

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Appendices

Appendix 1: Narrative frames about the use of ChatGPT in the classroom.

One of the typical challenges I experience using AI in my classes is ... because ...

One of the typical benefits I experience using AI in my classes is ... because ...

One of the typical challenges using AI has brought to me among my colleagues is ... because ...

One of the typical benefits using AI has brought to me among my colleagues is ... because ...

One of the typical challenges of using AI in my society is ... because ...

One of the typical benefits of using AI in my society is ... because ...

Appendix 2: Interview core questions.

Micro system (Individual Level):

1. Do you use ChatGPT more in your private classes or at the institute level? Why?
2. Do you think it is more useful for online or in person classes? Why?
3. What aspects or prompts of ChatGPT do you mostly use? (Which skills or sub-skills) Why?
4. What are the challenges that you face to use ChatGPT in your teaching? (E.g., language proficiency)
5. What are the benefits of using ChatGPT in your teaching? and what motivated you to use it?
6. What is the contribution of ChatGPT to your creativity/autonomy? Why and how?
7. How do you evaluate your teaching practice before and after using ChatGPT?
8. How does it affect the quality of your teaching?

Mesosystem (Interactions):

1. In your opinion, do your learners are engaged more in your classes after using ChatGPT? How?
2. Do you have any difficulties or challenges with school's supervisor or manager in using ChatGPT?
3. Do you recommend your colleagues to incorporate ChatGPT? Why? How have these interactions influenced your experience?
4. Is there any need to add ChatGPT literacy to TTCs? Why?
5. Do you compare your classes with other colleagues who do not use ChatGPT in their classes? What are the results in your point of view?
6. Have you ever discussed your experiences with ChatGPT with friends, colleagues, or family members? How did their perceptions or experiences compare to yours?

Macrosystem (societal level):

1. What are the views and attitudes toward using ChatGPT among teachers in your country?
2. How does the limited access to ChatGPT in Iran affects the use of it for English teachers?
3. What are the views and attitudes toward using ChatGPT among policymakers in your country?
4. Does the use of ChatGPT need cultural considerations? Why?
5. How can ChatGPT bring about changes in teaching practice of English teachers in your country?
6. In your view, how do cultural attitudes toward technology and language influence the general perception of AI chatbots in your society or community?
7. How do you think the widespread adoption of AI chatbots like ChatGPT could potentially impact the way languages are learned and used globally?

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AI-assisted learning applications in English courses in Vietnam

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Keywords

AI;
AI-assisted learning applications;
artificial intelligence;
English courses;
Gratification Theory;
intention to use;
perceived enjoyment.

Abstract

This paper investigates the factors influencing students' intention to use AI-assisted learning applications in English courses through the Uses and Gratification Theory lens. Utilizing a sample of English course participants, we hypothesize that social, process, content, and technology gratifications derived from using AI learning apps positively impact perceived enjoyment levels, which in turn influence students' intention to use these applications. The research model integrates these constructs, proposing direct relationships between gratifications and perceived enjoyment and an impact of perceived enjoyment on the intention to use. Data analysis, employing structural equation modeling techniques, reveals significant positive effects of social, process, content, and technology gratifications on perceived enjoyment, supporting our hypotheses. Moreover, perceived enjoyment emerges as a significant predictor of intention to use AI learning apps. These findings contribute to understanding user motivations and behaviors in adopting AI technologies for educational purposes, offering implications for educators, developers, and policymakers aiming to enhance English language learning experiences through AI-assisted platforms.

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Introduction

Artificial intelligence (AI) refers to computer systems that can perform tasks and exhibit behaviors commonly thought to require intelligence (Bhatt & Muduli, 2022). AI encompasses a wide range of capabilities, from game-playing algorithms to robotics, but natural language processing (NLP) allows systems to analyze and generate human language (Kang et al., 2020). Early NLP systems were rule-based and limited to simplistic pattern matching. In contrast, modern techniques like deep learning enable more advanced capabilities by training AI models on massive datasets to extract statistical patterns. For instance, chatbots select scripted responses using basic keyword matching, while large language models like GPT-3 can generate original, customized text (Rudolph et al., 2023). As Ifelebuegu (2024) discussed, the parametric flexibility of models like GPT-3 allows AI writing assistants to produce far more versatile and human-like text compared to rigid chatbot approaches. Major advantages include the ability to generate coherent passages in response to prompts, maintain logical consistency, adapt tone for different contexts, and even exhibit creativity. However, chatbots still surpass AI assistants in certain areas like goal-oriented dialog and accessing external knowledge. While Narrow AI, or weak AI, refers to the use of artificial intelligence technology to create a specialized system that can mimic and potentially exceed human intellect in a certain task, has proven effective for conversational tasks, AI writing assistants demonstrate more human-like language abilities by leveraging the predictive power of deep neural networks trained on vast datasets.

With the rapid development of AI technologies, AI-assisted learning applications have been increasingly used in education to enhance and support student learning experiences (Lai, 2021). These applications utilize AI algorithms to provide students with personalized and adaptive learning content, feedback, and assessments. In English language courses, AI tutors and writing assistants have effectively improved language skills like vocabulary, grammar, reading, writing, speaking, and listening (Popenici, 2023; Vargas-Murillo et al., 2023). However, adopting these emerging technologies also faces skepticism and resistance in real-world teaching and learning scenarios (Sullivan et al., 2023). Therefore, understanding students' motivations and gratifications for using or not using AI-assisted learning apps can inform strategies to promote acceptance and usage.

The uses and gratifications (U&G) theory is a relevant framework to examine users' motivations and needs for utilizing media or technologies (Gao, 2023). It assumes that users actively choose media to fulfil certain gratifications or needs (Menon, 2022). Prior U&G research on educational technologies has largely focused on general learning management systems and online learning tools (Nikolopoulou et al., 2021), while specific investigations into emerging AI-assisted applications remain scarce. Liu et al. (2016) recently adapted the U&G theory to categorize users' needs into content, technology, process, and social dimensions. However, empirical evidence lacks whether students' motivations for adopting AI learning apps align with these dimensions.

Therefore, this study aimed to apply the uses and gratifications theory to understand students' motivations and gratifications for using or avoiding AI-assisted learning apps in English classes through a survey. The four dimensions of gratifications proposed by Liu et al. (2016) were measured: content, technology, process, and social. The findings are expected to provide practical implications for promoting user acceptance of AI learning apps by targeting specific motivations and needs. From a theoretical lens, this study contributed to pioneering attempts to verify the U&G framework in revealing students' adoption considerations regarding increasingly pervasive AI learning assistants. Future research may build on the findings to further extend or specify the current gratification categorization.

The structure of this paper is organized as follows – the first section introduces the research background, gap, and objectives; the second section reviews past literature on uses and gratifications theory and AI learning apps; the third section explains the methodology; the fourth section presents results; the final section discusses findings, implications and recommendations for future research directions on this emerging area.

Literature review

Using AI-assisted learning applications to augment English language courses

AI writing assistants like Grammarly, Hemingway Editor, or Textio provide personalized feedback on improving vocabulary use, grammar, sentence structure, and overall readability when students are drafting written assignments. These automated checkers point out specific areas for improvement and offer corrected suggestions, allowing students to refine technical aspects of their English writing (Twersky & Davis, 2017). Moreover, apps like Duolingo ABC, Rosetta Stone, or Busuu contain AI chatbots that simulate conversational scenarios on diverse topics (Luo, 2022). Speaking and listening comprehension with these virtual tutors via interactive dialogue helps English learners build fluency. The chatbots adapt to difficulty levels and respond like native speakers to realistic situations. Vocabulary learning apps like Quizlet, Memrise, or Anki use spaced repetition algorithms and smart flashcard features to build each student's vocabulary (Nikishova & Kryvonosova, 2022). By tracking individuals' mastery of new words, these AI apps continuously adjust which terms to focus on practising, customizing the learning path based on actual needs and progress. This assists vocabulary retention significantly. Besides, all-in-one platforms like Speaking Pal English Tutor or Pearson English Portal automatically assess learners' abilities to recommend activities targeting weaker skills (Phillips, 2018). The more students use them, the more precisely the AI assesses gaps in listening, reading, writing, etc., to serve customized lessons. The data-driven adaptation promotes self-paced progress. Finally, to boost student engagement, programs like LearnEnglish Kids: Playtime or Duolingo incorporate gamification elements by rewarding progress and adding quests, levels, etc. (Saraswati & Purwati, 2021). Making practice seem like fun games lowers barriers and motivates more regular English usage, which is essential

for fluency.

Research framework

The uses and gratifications (U&G) theory provides the main theoretical framework for this study. The U&G theory examines people's motivations and gratifications for using a particular media or technology (Katz et al., 1973). It assumes that users actively select media to fulfil certain needs or motivations rather than passively consuming media (Raji et al., 2020). With advancements in interactive digital technologies, the U&G theory has gained resonance in understanding user acceptance, adoption, or rejection of emerging media forms (Bawack et al., 2023). Li et al. (2018); Stafford et al. (2004) pointed out three gratification dimensions including content, process, and social gratifications. Recently, researchers mentioned technology gratifications as the fourth dimension of U&G theory (Liu et al., 2016; Omar & Subramanian, 2013). This updated U&G model was applied in this study to examine key drivers of students' intention to use AI-assisted language learning applications from the lens of their motivations and perceived gratifications. In the context of AI-assisted learning applications, the Stimulus-Organism-Response (SOR) framework complements U&G theory by elucidating how external stimuli (gratifications) interact with individual cognitive and affective processes (perceived enjoyment) to influence their responses or intentions to use the AI-assisted language learning applications as they learn English. This research proposed the conceptual model from the Research framework as Figure 1.

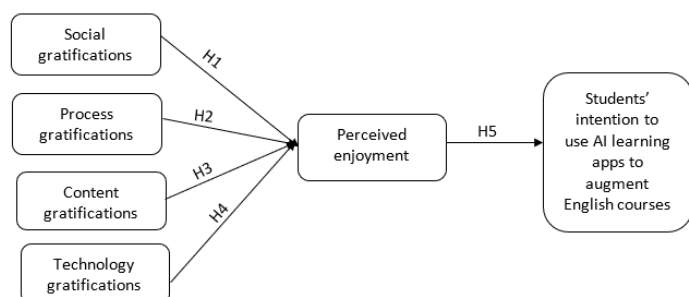


Figure 1. Research model.

Hypotheses development

Social gratifications refer to the opportunities to interact, connect, and engage with others when using technology (Kaur et al., 2020). In an educational context, the social dimensions encompass the ability to facilitate discussions, collaborate, and seek help from teachers and peers (Menon, 2022). Hussain and Shabir (2020) found that social features boost enjoyment and continued usage intention for e-learning systems and mobile learning apps by enabling greater communication and a sense of community. Similarly, AI-enabled chatbots, virtual tutors, and peer-learning functionalities may enhance social connectivity and collaborations in AI-learning apps (Shahab et al., 2023). Customized interactions can motivate learners and make learning more fulfilling and enjoyable (Ab Jalil et al., 2020). Thus, it is hypothesized:

H1: Social gratifications positively impact perceived enjoyment of using AI-assisted learning apps.

Process gratifications center around a technology or system's experienced convenience, control, and efficacy (Cutler & Danowski, 1980). In AI learning apps, process dimensions include perceived ease of use, ability to self-space learning, timely feedback, and access flexibility offered by the apps (Gerlich et al., 2015). Prior studies demonstrate that such process features significantly contributed to student enjoyment, engagement, and adoption of e-learning platforms and intelligent tutoring systems (Won et al., 2022; McLean, 2018). The automated and customized feedback improved time efficiency, allowing learners to progress faster and have more fun acquiring new skills (Gao, 2023). Thus, greater process gratifications from AI apps' interactivity and personalization capabilities can enhance users' perceived enjoyment.

H2: Process gratifications derived from using AI learning apps positively influence perceived enjoyment levels.

Content gratification refers to users receiving informative, relevant, personalized, and satisfactory content from a technology (Possler et al., 2020). For AI-assisted language apps, content dimensions include adaptive learning resources and activities tailored to ability levels and accurate, multimodal content suited for different learning styles (Chang et al., 2022). Prior research found that personalized content recommendations and customized difficulty levels based on individual progress increased engagement, motivation, and enjoyment outcomes (Alsanousi et al., 2023). The perceived relevance and usefulness of content additionally contributed to learner satisfaction and continued usage intentions (Wang et al., 2023). Therefore, AI apps providing the appropriate challenge through data-driven content adaptations can potentially enhance enjoyment and gratification.

H3: Content gratifications derived from AI learning apps positively affect students' perceived enjoyment levels.

Technology gratification encompasses the utilitarian benefits and advantages of a technology's features, convenience, interface, and overall quality (Liu et al., 2016; Omar & Subramanian, 2013). Concerning AI learning apps, AI functionalities, smart content delivery, ubiquitous access, and perceived usefulness shape technology gratification perceptions (Nkoala et al., 2023). Nkoala et al. (2023) demonstrated that outcome expectancy and perceived effectiveness of educational technologies' features, including personalization, interactivity, and convenience, enhanced their acceptance by raising users' intrinsic enjoyment and engagement (Zhang et al., 2023). Thus, AI apps high in utilitarian attributes can potentially provide greater technology gratification, indirectly contributing to enjoyment.

H4: Technology gratifications derived from AI learning apps' features positively impact students' perceived enjoyment.

Enjoyment refers to perceptions of fun, pleasure, and emotional appeal derived from technology utilization (Ledbetter et al., 2016). According to prominent technology adoption theories, perceived enjoyment is a key predictor of users' attitude formation and intended technology usage behavior across educational and consumer contexts (Saleem et al., 2023). Prior empirical studies also demonstrate that enjoyment levels experienced by students while using e-learning and mobile learning systems strongly influenced their decisions to continue usage (Gao, 2023; Khoa et al., 2021). Besides enhancing motivation and engagement, AI apps provide an immersive, game-based environment that can make the English language learning process more fulfilling and enjoyable for learners. Greater perceptions of joy and emotional appeal are likely to shape behavioral intentions to use AI learning apps.

H5: Perceived enjoyment positively impacts students' intention to use AI learning apps to augment English courses.

Research method

Sampling

A quantitative cross-sectional survey was conducted for hypothesis testing. The study population comprised university students in Vietnam who had prior experience using AI English learning apps as course supplements. A total sample of 407 valid responses was collected using purposive sampling by distributing printed and online versions of structured questionnaires to students at five major universities in Vietnam. The survey included questions on respondents' demographic information, motivations, perceived gratifications, enjoyment, and intention to use AI learning apps, in addition to constructing measurement items. Ethics approval and informed consent were obtained prior to data gathering.

Table 1. Respondent characteristics.

Characteristics		Frequency	Percent
Gender	Male	214	52.6
	Female	193	47.4
Major	Business	130	31.9
	Technology	117	28.7
	Social science	160	39.3
Apps Using Frequency per week	1 - 3	94	23.1
	4 - 6	88	21.6
	6 - 10	100	24.6
	> 10	125	30.7
Using purposes	Vocabulary builders	98	24.1
	AI writing checkers	106	26.0
	Chatbot conversations	94	23.1
	Grammar tutors	109	26.8

Of the total 407 students in the final sample, 214 (52.6%) were male, and 193 (47.4%) were female. Students' majors were business (31.9%), technology (28.7%), and social science (39.3%). Over half of them (55.3%) used AI learning apps over six times a week on average, suggesting considerable familiarity. Most frequently used apps included customized vocabulary builders (24.1%), AI writing checkers (26%), conversational chatbots (23.1%), and adaptive grammar tutors (26.8%). Thus, the profile indicates the

ability to provide valuable insights regarding adopting AI learning technologies. The information of the participants is described in Table 1.

Scale measurement

This study adopted validated multi-item scales from prior research to measure each construct in the proposed research model. Social gratifications (SG, three items), process gratifications (PG, four items), content gratifications (CG, six items of gratification of information sharing and gratification of self-documentation), and technology gratifications (TG, seven items of gratification of convenience, and gratification of medium appeal) were adapted from Liu et al. (2016). Six perceived enjoyment (PE) items were assessed through intrinsic motivation scales validated in earlier technology adoption studies (Khoa, 2020). Finally, intention to use AI learning apps (ITA) was measured using five items from Chen et al. (2021). Minor modifications were made to scale wordings tailored to AI-assisted language learning apps. All measurement items used a 5-point agreement scale ranging from "strongly disagree" to "strongly agree," with higher scores indicating more favorable perceptions.

Results

Measurement model assessment

Confirmatory factor analysis was conducted on all six constructs in the conceptual model using SmartPLS software and is presented in Table 2. Convergent validity was evident as all outer loadings (OL) exceeded 0.7 on their respective constructs (Hair Jr et al., 2016). Moreover, the average variance extracted (AVE) ranged from 0.577 to 0.763, greater than the 0.5 threshold. Additionally, the composite reliability scores (CR) were above 0.7, confirming convergent validity at the construct level. Moreover, Cronbach's alpha ranged from 0.847 to 0.939, meeting acceptable internal consistency reliability criteria.

Table 2. Reliability and convergent validity assessment.

Construct	Cronbach's alpha	Composite Reliability	Average Variance Extracted	Outer loading
CG	0.854	0.855	0.577	0.724 - 0.783
ITA	0.847	0.859	0.627	0.707 - 0.957
PE	0.889	0.901	0.648	0.724 - 0.938
PG	0.869	0.875	0.721	0.762 - 0.921
SG	0.845	0.847	0.763	0.862 - 0.884
TG	0.939	0.944	0.732	0.805 - 0.918

Discriminant validity was checked using two methods. Firstly, each construct's square root of AVE exceeded the inter-construct correlations displayed in the correlation matrix, per the Fornell-Larcker criterion (Fornell & Larcker, 2018) in Table 3. Secondly, all indicators displayed higher loadings on their allocated factors than cross-loadings, further supporting discriminant validity. Therefore, the measurement model demonstrated satisfactory quality for testing hypothesized relationships among key latent variables like social gratifications, process gratifications, content gratifications, technology gratifications, perceived enjoyment, and students' intention to use AI learning apps

to augment English courses.

Table 3. Fornell – Larcker criterion.

Constructs	CG	ITA	PE	PG	SG	TG
CG	0.760					
ITA	0.323	0.792				
PE	0.563	0.543	0.805			
PG	0.531	0.399	0.498	0.849		
SG	0.443	0.304	0.449	0.361	0.874	
TG	0.408	0.218	0.466	0.4	0.472	0.856

PLS-SEM assessment

The R^2 , f^2 , Q^2 , and VIF values are pointed out in Table 4. The structural model demonstrated substantial explanatory power, with R^2 values of 0.432 for perceived enjoyment and 0.295 for intention to use. This exceeds the minimum threshold of 0.2 for R^2 in social science research (Hair Jr et al., 2016). Stone-Geisser's Q^2 values were computed through blindfolding tests to assess predictive relevance. Q^2 was greater than zero for both endogenous constructs – perceived enjoyment ($Q^2 = 0.262$) and intention to use ($Q^2 = 0.172$) - satisfying criteria for predictive relevance. The variance inflation factor (VIF) statistics were computed and checked to assess if multi-collinearity among predictors affects results. All VIFs ranged between 1.000 and 1.584, significantly lower than the common cut-off of 5 (Hair et al., 2019); therefore, the absence of collinearity issues among research constructs was established. Perceived enjoyment has a large effect on the intention to use AI-assisted Learning applications in English courses ($f^2 = 0.418$); the rest of the relationships had small effects ($0.02 < f^2 < 0.15$).

Table 4. Result of R^2 , f^2 , Q^2 , and VIF values.

Construct	R^2	f^2		Q^2	VIF	
		ITA	PE		ITA	PE
CG			0.108			1.584
ITA	0.295			0.172		
PE	0.432	0.418		0.262	1.000	
PG			0.049			1.487
SG			0.027			1.436
TG			0.043			1.426

A PLS-SEM was applied for hypothesis testing due to the combination of categorical and continuous indicators. In Table 5, social gratifications ($\beta = 0.149$, $t = 2.564$), process gratifications ($\beta = 0.204$, $t = 3.768$), content gratifications ($\beta = 0.312$, $t = 5.554$), and technology gratifications ($\beta = 0.187$, $t = 4.298$) all had significant positive effects on perceived enjoyment of AI apps. Moreover, perceived enjoyment substantially predicted students' behavioral intentions to use AI learning apps ($\beta = 0.543$, $t = 7.562$). Therefore, all five proposed hypotheses were supported at a 1% significance level, except the hypothesis H1 at a 5% significance level). The PLS model's goodness of fit was examined using procedures from standardized root means square residual (SRMR) and exact model fit tests (Henseler et al., 2014). The SRMR was 0.049, below the 0.08 threshold, indicating a good model fit relative to correlation residuals.

Table 5. Result of PLS-SEM.

Relationship	β	t-value	Result
SG -> PE (H1)	0.149	2.564	Supported
PG -> PE (H2)	0.204	3.768	Supported
CG -> PE (H3)	0.312	5.554	Supported
TG -> PE (H4)	0.187	4.298	Supported
PE -> ITA (H5)	0.543	7.562	Supported

Conclusion

Discussion

The current study provided empirical support for adopting an updated uses and gratifications perspective to understand motivations and acceptance considerations regarding AI technologies for language learning. The four gratification dimensions analyzed - social, process, content, and technology benefits - have foundations in prior e-learning and mobile learning research. The findings align with prior studies as applications of U&G theory, which revealed watching movies on YouTube (Bakar et al., 2014) or purchasing virtual goods (Kaur et al., 2020). Moreover, in correspondence with technology acceptance research, affective reactions about flow-like, pleasurable engagement played a pivotal role in forming usage intentions (Al-Bashayreh et al., 2022; Al-Emran et al., 2020). Greater interactivity, personalization, and appeal offered by AI learning apps can cultivate perceptions of fun, control, and curiosity vital for voluntary adoption by students (Bhatt & Muduli, 2022). The empirical demonstration of cognitive and emotional mechanisms influencing usage decisions advances understanding of students' relationships with emerging intelligent technologies. While prior investigations often focused narrowly on performance and effort expectancies, this study takes a more holistic motivational stance. This discussion elaborates on the relevance and theoretical grounding of each dimension.

Social gratifications refer to the interpersonal connections and interactions enabled by AI technologies. As found in this study, students appreciate the social presence, connectedness, collaboration, and sharing facilitated by AI apps. This aligns with findings on social gratifications sought from educational technologies (Chen et al., 2019; Rathnayake & Winter, 2018). The social dimension has roots in foundational U&G theory positing that media selection and use serve social-integrative needs (Katz et al., 1973). AI technologies offer new opportunities for social gratifications by simulating human-like connections. However, ethical concerns exist around emotional manipulation and deception (Vallor, 2021). Moderation is required to balance social benefits and risks.

Process gratifications relate to the interactive nature and procedural utility of using AI apps for convenient, personalized, and guided learning. Learners value AI features like adaptive content, feedback, and scaffolding that aid self-regulation (Rathnayake & Winter, 2018). The process dimension connects to early U&G research on the seeking of participatory and functional benefits from media (Katz et al., 1973). AI leverages data-driven, responsive algorithms to optimize learning processes and trajectories. But risks around data privacy, bias, and over-reliance on AI require ongoing scrutiny (Selwyn, 2019).

Content gratifications refer to the informational and cognitive values derived from AI-generated or curated subject matter. Learners appreciate how AI delivers personalized, relevant, and stimulating content (Alam et al., 2024). This aligns with knowledge and surveillance needs in classical U&G theory (Katz et al., 1973). However, AI content raises concerns about misinformation from generative models and filter bubbles from curation algorithms (Toder Alon & Tahar, 2024). Maintaining high-quality, balanced content remains an imperative.

Technology gratifications involve the advantages of using innovatively designed, convenient, and engaging AI interfaces. New technologies often create novel experiential and hedonic gratifications (Leung, 2001). But poor usability undermines user experience (Wang et al., 2018). AI advances like speech recognition and virtual assistants offer more naturalistic and immersive interactions. However, continued refinements are required to bridge the gap between human and machine (Cowan et al., 2017).

Theoretical contribution

This pioneering study offers theoretical and practical contributions regarding the intersection of AI in education and motivational models explaining technology acceptance behaviors. Theoretically, it expands the applications of uses and gratifications theory as a fitting lens to unpack both utilitarian and enjoyment-oriented user requirements likely to be fulfilled by sophisticated AI applications and, by extension, other smart educational systems. The proposed scale development and validation to categorize social, process, content, and technology gratifications makes the traditional U&G model relevant for technology adoption research in rapidly evolving contexts. Addressing users' needs and goals is imperative, given the relative lack of motivational perspectives guiding AI education studies.

Additionally, the research delineates the affective and emotional aspects linked to AI tools through enjoyment, which strongly predicts voluntary usage intentions. The findings incorporate holistic well-being-centric measures like enjoyment, resilience, and empowerment in investigating how emerging technologies impact learning processes and outcomes. It also enriches technology adoption models used thus far by uncovering the underlying needs and gratifications that ultimately motivate perceptions of intrinsic motivation.

Managerial implication

On the practical level, the nuanced understanding of what draws students towards trying or sticking with AI learning apps has several implications. Educators and app designers can strategically build features catering to social connections, timely feedback, personalized content recommendations, and interactive elements preferred by digitally savvy learners. Fulfilling cognitive/functional needs and intrinsic enjoyment is critical for voluntary uptake. Additionally, the knowledge that enjoyment levels vary based on gender opens up possibilities for developing differentiated versions

of apps that appeal better to male or female users' interests through gamification and narrative, respectively. Addressing poor adoption levels requires diagnosing deficiencies in fulfilling user needs through in-depth uses and gratifications investigations undertaken in this study.

Limitations and further research

Although the study provides transferable insights on user motivations for emerging AI apps, findings should be interpreted considering the inherent limitations of the quantitative cross-sectional survey methodology and sample profile consisting mostly of tech-savvy undergraduate students. Wider demographic profiles may yield variations in motivational patterns. Besides reported usage frequency, actual learning improvements were not examined. Longitudinal designs can uncover evolving usage behaviors and relationships between gratifications sought and actual academic gains. Qualitative techniques can reveal additional emotional, ethical, and social dynamics that influence user adoption of rapidly advancing AI technologies as they become common fixtures in contemporary classrooms.

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Generative Artificial Intelligence in chemistry teaching: ChatGPT, Gemini, and Copilot's content responses

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Abstract

Within the past decade, enormous strides have been made related to the disruptive effect of AI in education, which has grown exponentially. AI presents itself as an emerging technology that facilitates the personalization of learning, in addition to promoting debate about educational practices in educational institutions around the world. This study aims to explore the performance and accuracy of three chatbots (ChatGPT, Gemini, and Copilot) in defining five basic chemistry concepts compared to the definitions described in the IUPAC's Compendium of Chemical Terminology. To this end, this descriptive qualitative research was carried out in three stages. The results show that the chatbots presented coherent responses to the investigated scientific concepts, in addition to being configured as resources that can be used in the teaching of chemistry and assisting in the teaching and learning processes. However, although chatbots have demonstrated potential as digital didactic resources in chemistry teaching, their implementation should be carefully monitored. In the near future, it is expected that AI chatbots will become valuable resources in education, helping students in their learning journeys and using chatbots actively and critically.

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Introduction

Digital technologies have been powerful agents of transformation in contemporary society, changing the way we interact, communicate, and learn. One of the most notable changes is the democratization of access to information and knowledge (Leite, 2018). With the expansion of the internet and the development of mobile devices, information is just a click away, enabling people from different social backgrounds to have access to educational and cultural resources that were previously only available to a few.

Furthermore, digital technologies have driven a paradigm shift in the educational model, promoting the personalization of learning and flexibility in teaching (Leite, 2022; Reis et al., 2021; Sadykov & Čtrnáctová, 2019). Online teaching platforms, educational software, digital games, and mobile applications, among others, offer the opportunity to adapt the content and methodology according to the individual needs of each student, allowing for more autonomous and effective learning. This student-centered approach has the potential to break with the limitations of traditional teaching, providing a more inclusive education adapted to the challenges of the 21st century (Leite, 2018).

With the evolution of technologies, new challenges are emerging, and one of these challenges involves the insertion of artificial intelligence (AI) into teaching and learning processes. AI has been progressively integrated into the field of education, offering a variety of benefits that aim to optimize teaching and learning processes (Farazouli et al., 2023; Leite, 2023; Pavlik, 2023). As AI becomes incorporated into education, it is important to look at the essence of human creativity in the face of the potential of algorithmic knowledge. According to Khademi (2023), advances in AI have brought significant progress and contributions to deep learning of neural networks and natural language processing and its applications. AI offers adaptive personalization, enabling students to receive immediate feedback and engage in tailored learning experiences. One of the most prominent forms of AI in education is the use of educational chatbots, automated conversational systems that interact with students to provide personalized support, answer questions, and even conduct formative assessments (Rudolph et al., 2023; Silva Neto & Leite, 2024). These chatbots can be programmed to adapt to each student's level of knowledge and individual needs, offering a more individualized and effective approach to teaching subjects such as chemistry.

Additionally, chatbots, such as ChatGPT, Gemini, and Copilot, have been used as support tools. These virtual assistants can answer questions, explain chemical concepts, and even assist in communicating and disseminating research in the area (Leite, 2023). However, it is crucial that the use of these technologies is guided by reflection to ensure that students develop critical thinking and that teachers consider AI as a complementary resource, in addition to other pedagogical strategies (Leite, 2023; Rudolph et al., 2023). Teachers can become the encouragers who will support students so that AI continues to advance in different ways than one can imagine. Teachers should keep in mind that technology will never replace people or human creativity – it is important

to recognize technological tools as a way to improve communication, connection, and creativity in this world.

On the other hand, chemistry is the science of the composition, structure, properties, and reactions of substances, their laws, and principles (Taber, 2013). Chemistry is a science that operates in the basic and applied areas (Doren & Duffy, 2016). The fundamental concepts (e.g., molecules, atoms, etc.), their structures, and properties studied in chemistry often have a wide range of applications in real life. The different research findings in chemistry are closely related to many aspects of daily life (Qian et al., 2023). Therefore, considering the importance of understanding concepts for learning chemistry, understanding the fundamental concepts and exploring their structure in the teaching of chemistry is necessary. As basic concepts are the most important part of the set of concepts, chemistry teachers can use these fundamental concepts as a general reference and implement them in teaching and learning processes.

In this context, this research will analyze the use of chatbots (ChatGPT, Gemini, and Copilot) in the definition of five chemical concepts. This investigation will make it possible to identify the potentialities and limitations of Generative Artificial Intelligence (GenAI) by evaluating its performance in the ability to answer questions involving chemistry.

Brief literature review and theoretical framework

Artificial intelligence is rapidly transforming many aspects of society, including education. In this new environment, it may seem that traditional digital skills are less important, as AI can perform many tasks more efficiently and accurately than humans. However, AI cannot completely replace the importance of digital skills, as they continue to be relevant in many aspects of education. Firstly, it is important to highlight that AI is still in its early stages of development, and, in most cases, human intervention is required to configure, program, and monitor AI systems. Therefore, people with digital skills will continue to be essential for the effective use of AI in education.

In recent years, AI has demonstrated the ability to generate fluent language, producing sentences that are increasingly difficult to distinguish from text written by people (Editorials, 2023). It is worth noting that AI only “reproduces the processes of our society, in activities for which it was trained, carrying them out faster and, often, with greater precision than a human being” (Leite, 2023, p. 916). Additionally, AI can be a valuable resource in helping students develop digital skills by offering personalized and adaptive learning experiences, providing automated feedback, and helping teachers identify areas of improvement for students.

The term *artificial intelligence* did not emerge recently. This name was created by computer scientists, mathematicians, and statisticians in the 1950s in an attempt to convince the Pentagon (American Department of Defense) to create intelligent machines (Kapur, 2023; Farazouli et al., 2023). It is important to highlight that (biological) intelligence is a property of organisms, and it depends on analogue and not digital processing. Between 0 and 1 of the computer

(of technology), the human brain fills all this space (something the computer cannot do). Thus, care must be taken when equating human and artificial intelligence, as human intelligence cannot be fully captured in accurate and machine-compatible descriptions (Rudolph et al., 2024b). But when artificial intelligence “merges” with biological intelligence, many benefits can result.

In this regard, the concept of human intelligence could be linked to Gardner’s concept of multiple intelligences. Gardner (1993) conceptualized multiple intelligences into eight distinct types: visual-spatial, linguistic-verbal, logical-mathematical, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalistic. Rudolph et al. (2024b) highlight if Gardner’s multiple intelligences are agreed upon and intelligence is not reduced to its logical-mathematical aspect, then artificial general intelligence would have to encapsulate all eight intelligences.

Biological intelligence can be defined as the ability to solve complex problems or make decisions with results that benefit the individual. For Pavlik (2023, p. 3), AI refers to “the simulation of human intelligence in machines that are programmed to think and act like humans. These machines are designed to learn from their environment and experiences and are able to adapt their behavior based on this learning.” AI concerns the performance of any of the actions, such as planning, reasoning, problem-solving, perception, knowledge presentation, creativity, etc. (Mecaj, 2022). AI is also defined as the application of statistical methods (multivariate statistics, artificial neural networks) to mine large databases and extract correlations and projections of future estimates (as if the future were to reproduce the past).

Some researchers, such as Chomsky (Chomsky et al., 2023), argue that it would be more prudent to call it artificial assistance since AI is a program that takes a collection of things that already exist. Intelligence is being able to create something new, while AI programs cannot create new things; they only make new combinations. Thus, AI would be configured as an intelligent assistant, just like washing machines, coffee makers, etc., that help you perform some tasks faster and save time that you can use for other activities. According to Popenici (2023, p. 383), “it is deceiving to say, dangerous to believe, that artificial intelligence is... intelligent. There is no creativity, no critical thinking, no depth or wisdom in what generative AI gives users after a prompt: it is just plausible text with good syntax and grammar, and this is all that it is”. It is necessary to understand what AI is and what it is not, what its true contributions are, and what is just marketing (Popenici, 2023). Furthermore, Alan Turing (1950) researched AI, which led UNESCO to recommend AI Ethics in applying machine learning (robots) to prevent abuse, fraud, and security risks (Van Wyk, 2024).

In this context, Gravel et al. (2023) warn us to be careful about the risks of trusting information generated by AI, which is sometimes very convincing quotes but often fabricated. This information appears to be constructed by merging existing references. Although GenAI holds promise for educational improvement, it is necessary to be concerned with academic integrity, with the development of critical AI literacy among

educators and students, emphasizing the need to promote an environment of responsible innovation and informed use of AI (Rudolph et al., 2024a). GenAI in education presents a “yin and yang perspective”, with threats (Technological dependence and the concentration of power; Academic integrity challenges; Dilution or automation of university teaching roles; Quality, accuracy, and ethical concerns; Erosion of graduate attributes; Graduate Employment; Privacy and surveillance; Sustainability; Regulatory and policy challenges) and opportunities (Teaching assistant; Research assistant; Feedback and Assessments; Adaptive curriculum development; Automated Grading; Creating collaborative circles; Student intervention; Administrative support; Including education; Wellbeing support) (Rudolph et al., 2024a). It is important to be aware of how AI impacts education, analyze, investigate, and reflect, in a calm but courageous way, on the role of each of the actors involved (managers, teachers, students, etc.). Nevertheless, amid the growth in the use of GenAI in education, policies for its use, an understanding of its ethical use, and comprehensive regulatory oversight are needed to ensure social well-being (Popenici, 2023; Rudolph et al., 2024a).

The integration of AI in education has proven to be a highly relevant resource for improving teaching and learning processes, thanks to its ability to personalize and provide automated feedback and more objective and accurate assessments (Castaneda, 2023). However, talking about education in times of AI implies “reflecting on the role of education in preparing people for a world in constant change, in which this technology will be present in all aspects of life: work, studies, leisure, personal relationships, etc.” (García-Peñalvo et al., 2024, p. 11). Therefore, it is important to know the benefits and risks of its use, requiring new knowledge, skills, competencies, and values for life and work in this era of AI. According to Waring (2024), universities should be debating the best way for students to use AI technologies, emphasizing the need for educational institutions to reevaluate their curricula.

In Zhai’s view (2022), it is possible to move forward with AI in education as long as we are prepared for the challenges and opportunities that this resource offers. According to Holmes and collaborators (2022) and Grassini (2023), it is necessary to face the complex challenges associated with AI in education, for example, in promoting digital education and ethics. The UNESCO report suggests that human responsibility and control must be maintained in all aspects of the use and application of AI in educational contexts or in everyday environments (Miao & Holmes, 2021). There are several ways to use AI to make learning personalized, including content adaptation, specific recommendations for each student, tailored guidance, and early identification of learning needs.

Artificial intelligence has played a significant role in transforming education, and its application in chemistry teaching could promote notable changes. AI makes it possible to adapt strategies that allow the construction of knowledge, meeting individual and collective needs. Intelligent platforms assess the pace and style of learning, adjusting content and activities according to each person’s progress and difficulties. This ensures that all students

receive the support they need to reach their full potential.

The main educational systems that use AI technologies are intelligent tutoring systems (ITS), learning management systems (LMS), intelligent educational robotics, massive open online courses (MOOCs), learning analytics (learning analysis), and chatbots (Göçmez & Okur, 2023). However, each of these applications uses AI differently, although there is great potential in its use to support tasks in the educational context, both from the perspective of the student and the teacher. Thus, tools such as chatbots, adaptive platforms, and virtual tutoring systems are shaping a more dynamic and effective educational future.

Generative AI (such as chatbots) can generate content (text, images, videos, audio, etc.) from a request, usually expressed in text written in natural language, although there are currently applications that accept multimodal inputs. GenAI is extremely powerful and is improving at a rapid rate, but it is based on large probabilistic-based model languages, which means they have no reasoning or understanding capabilities and are therefore susceptible to errors that need to be contrasted (García-Peñalvo et al., 2024; Leite, 2023). By definition, a chatbot is a computer program designed to simulate conversations with human users, especially over the Internet (King, 2023).

AI chatbots date back to the 1960s, with MIT's first ELIZA chatbot that could simulate a conversation (Farazouli et al., 2023). The ELIZA chatbot was programmed to behave like a Rogerian psychotherapist. Currently, there are different chatbots available, such as ChatGPT (<https://chat.openai.com>), Bard/Gemini (<https://gemini.google.com/app>), Bing Chat/Copilot (<https://copilot.microsoft.com>), LuzIA (<https://www.luzia.com>), Llama 2 (<https://llama.meta.com>) and Claude 2 (<https://claude.ai>) (Figure 1).



Figure 1: Chatbots.

ChatGPT is based on a large language model (LLM) called Generative Pre-trained Transformer (GPT). GPT is an artificial learning model that uses unsupervised and supervised learning techniques to understand and generate human-like language. ChatGPT, launched on November 30, 2022, by OpenAI, is capable of answering everything from simple questions to writing more complex texts (Ismail et al., 2023; Liu et al., 2021) in a language almost indistinguishable from natural human language (Leite, 2023; Ogunleye et al., 2024; Rudolph et al., 2023). ChatGPT is a conversational LLM chatbot that acts on prompting (Van Wyk, 2024). However, ChatGPT has been called a "stochastic parrot" (Arkoudas, 2023; Bender et al., 2021) since it only "approximated

the content of its replies according to its training data without a deeper understanding of such content, that this approximation also applied to numbers and references which often ended up being wrong or fictitious" (Schäfer, 2023, p. 5), with replies were often of limited quality (Gravel et al., 2023).

Bard is a large language model from Google AI, trained on a huge dataset of text and code. Bard was launched on March 21, 2023, as Google attempted to compete with ChatGPT (a competing bot produced by OpenAI). With Bard's advancements, Google renamed it Gemini on February 8, 2024 (Google, 2024). Gemini can generate text, translate languages, write different types of creative content, and answer questions in an informative way.

Copilot started under the name Bing Chat, a chatbot developed in collaboration with OpenAI (the same company that created ChatGPT). Currently, this chatbot is designed to support various tasks related to writing and productivity across various Microsoft applications (Motlagh et al., 2023). Copilot (launching November 15, 2023) uses a large language model to generate text, translate languages, create creative content, and answer questions in an informative way.

The LuzIA chatbot transforms audio into text with the help of ChatGPT's artificial intelligence. LuzIA works like ChatGPT, but the conversation takes place directly with a common cell phone contact (via WhatsApp or Telegram chat). LuzIA uses three artificial intelligence models and, based on them, is capable of unlimited interaction through text messages (GPT 3.5, from OpenAI), transforming audio inputs of up to 10 minutes into text and creating up to five images per day from text descriptions (LuzIA, 2023). Flores and Peña (2024) highlight the possibilities of using LuzIA by teachers in designing thematic content to integrate them into their planning.

Llama 2 is an open-source language model developed in partnership between Meta and Microsoft (Meta, 2024). Llama 2, an updated version of Llama 1, trained on a new mix of publicly available data (Touvron et al., 2023). Unlike previous chatbots that are available in the cloud, Llama 2 can be downloaded for free and used on a computer with a Windows system.

Finally, Claude 2 is a chatbot developed by the company Anthropic and launched in March 2023. Claude 2 is an AI system developed to assist users in carrying out tasks in a conversational way, that is, through a prompt text, the user can explain what they need from the tool, and it will return with a solution. According to Lozić and Štular (2023), a unique feature of Claude 2 is the size of its context window of 100,000 tokens, or about 75,000 words, which allows users to paste or upload large documents or entire books and ask questions based on its content. The Claude 3 (released March 19, 2024) is available in the United States, the UK, and some countries in Latin America, Africa, and Asia via a website (claude.ai) and as an application programming interface (API). The Claude 3 family of models initially offered a 200,000 tokens context window upon launch. However, all three models (Haiku, Sonnet, and Opus) are capable of accepting inputs greater than 1 million tokens (Anthropic,

2024).

AI-based chatbots take on an important role in education, as thinking about prohibiting or restricting their use does not seem to be the best solution. Chatbots can simulate conversations with students, offering individualized support, answering questions, clarifying concepts, and providing personalized feedback (Leite, 2023). The use of GenAI can either improve or harm learning processes, depending on whether it is used to augment or 'simply' delegate the execution of tasks. Educational environments (like universities and schools) can leverage the capabilities of GenAI chatbots and take advantage of creating innovative teaching and learning opportunities (Van Wyk, 2024). Ogunleye et al. (2024) aimed to assess the performance of GenAI tools in STEM-related disciplines to understand their potential impact on students' learning and development. In teaching chemistry, for example, chatbots can help understand complex formulas, solve problems, and even simulate experiments, making learning more interactive and accessible. Furthermore, chatbots can help explain abstract concepts, such as molecular structure, through interactive simulations and 3D visualizations. Furthermore, AI can be used to create games and/or augmented and virtual reality experiences, enabling chemistry teaching to be more effective.

In the literature, there are some examples that make use of chatbots in chemistry teaching (Clark, 2023; Dempere et al., 2023; Emenike & Emenike, 2023; Hallal et al., 2023; Leite, 2023). For example, ChatGPT has been used to define chemical concepts, providing coherent answers about the concepts. However, depending on the topic, AI responses may lead to difficulties in understanding for students (Leite, 2023). Dempere et al. (2023) used ChatGPT to explore the effects of AI chatbots on higher education institutions. ChatGPT was also used to answer questions (open and closed) from final exams administered in two chemistry courses (Clark, 2023). Emenike and Emenike (2024) posed related questions to ChatGPT using examples from general and organic chemistry. The authors pointed to some potential benefits and risks of ChatGPT and similar GenAI systems, such as answers to items on assignments and assessments, lab reports, tutoring systems, and text generation for papers assigned in class, for projects, or for research-related assignments. Hallal et al. (2023) used ChatGPT and Bard in understanding text-based structural notations such as condensed structures, InChi, and SMILES and in answering questions related to organic chemistry. In Dao's (2023) analysis, Bard surpassed ChatGPT and Bing Chat in chemistry discussions. In view of the above, this research will analyze the use of these three chatbots (ChatGPT, Gemini and Copilot) in the definition of five chemical concepts.

Methodology

The methodology is the item that guides the investigation process in decision-making, hypotheses, and research techniques. According to Creswell (2017), generally, not just one method or technique is applied when carrying out research. It is possible to combine two or more methods and techniques.

In this sense, to respond to the objective proposed in this research, a qualitative approach of a descriptive nature is used, as it allows the description, analysis, and evaluation of data in an articulated and in-depth way, with the researcher being its main instrument (Creswell, 2017), in addition to having a case study as a methodological design. For Johnson and Christensen (2008), this type of research aims to tell the story of a limited system (one case). The central idea of this type of study is that it is possible to analyze the system in its entirety from its parts.

Based on a case study, in which a specific event is researched in detail, the responses obtained from chatbots will be descriptively analyzed. The research was developed in three stages. In the first stage, free accounts were created in three chatbots (ChatGPT, Gemini, and Copilot). Considering that it is a digital platform with closed characteristics, it was necessary to register in the environment to access its functionalities. The selection of these chatbots was based on the findings of Silva Neto and Leite (2024), which revealed the three chatbots most chosen by students when writing a dissertation or essay.

The second stage of the research consisted of preparing and asking questions in the three chatbots. In this sense, the questions were prepared and formatted in the GenAI chat. As already described, the chatbot is a generative artificial intelligence that can produce texts from questions. Therefore, AI was used to write definitions of five chemical concepts and then analyzed their academic validity. For this, as a research method, it was determined that the definitions would refer to the chemical concepts: Atom, Electron, Mole, Molecule, and Chemical Substance. These concepts were chosen to take into account that they are commonly present in discussions involving chemistry (Childs, 2015; McGill et al., 2019; Qian et al., 2023) and are generally addressed in students' first contact with the discipline. The question asked to the chatbots was: Define "[atom; electron; mole; molecule; chemical substance]". Considering that these are large language models, all chatbot responses are generated in situ, based on the abstract relationship between words in the neural network (Kung et al., 2022). Therefore, in order to reduce memory retention bias, a new chat session was started in each chatbot for each question asked.

Finally, in the third stage, the texts produced by ChatGPT, Gemini, and Copilot were analyzed and compared with the definitions present in the Gold Book. The Gold Book is the Compendium of Chemical Terminology organized by IUPAC (International Union of Pure and Applied Chemistry), which provides internationally accepted definitions of chemical terms. The compendium (Figure 2) provides an alphabetical list of chemical concepts with definitions recommended by various IUPAC commissions – responsible for organizing nomenclatures, terminologies, symbols, and units (IUPAC, 2019). Its first version was published in 1987 by Victor Gold, hence the informal name: Gold Book.

The texts created by the chatbots were checked by plagiarism tools and AI text generation detectors such as Plagium (<https://www.plagium.com>), Smodin (<https://smodin.io/ai-content-detector>), CopySpider (<https://copyspider.com.br/main/en>), Writer.com's AI Content Detector (<https://writer.com>).

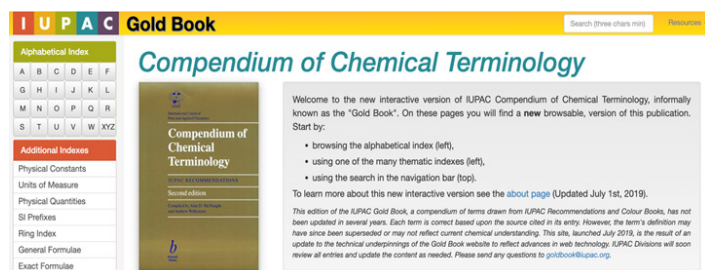


Figure 2: IUPAC Compendium of Chemical Terminology home page.

com/ai-content-detector), and GPTZero (<https://gptzero.me>). All programs used were free versions and available to the public. Plagiarism detection software completely analyzes documents in search of instances of suspected plagiarism in which the results are displayed in a detailed manner in a document, indicating all analysis criteria.

Results and discussion

In this section, the results achieved while using ChatGPT, Gemini, and Copilot will be presented. The chatbots' answers to questions about the definition of chemical concepts will be discussed. Due to the output nature of chatbots, each response made available was manually reviewed. It is emphasized that the focus of this research is not to discuss each concept presented by chatbots but rather to analyze the answers presented by GenAI and compare them according to the Compendium of Chemical Terminology.

In Leite's view (2023), the word *chemistry* has been understood by current society as something 'good' when it produces substances and materials that benefit people or as something 'bad' when it is associated with things that harm health, the environment and society. In addition to this simplistic and distorted view of chemistry, it is known that the application of chemistry can contribute to the development of society, whether in technical aspects or in social/human aspects. Therefore, observing how chemistry is present in people's daily lives, from daily activities to the development of medicines to cure a disease, has been fundamental, although it is considered difficult for students to understand. Therefore, debating the contents of chemistry in the educational context requires adequate training from the teacher that goes beyond knowing chemistry, but that the teacher knows how and why to teach it.

Currently, teachers have different teaching resources at their disposal (book, board, laboratory, notebook, computer, smartphone, internet, etc.), which requires training to use them in their pedagogical practices. In this context, the rise of GenAI has perhaps provided teachers and students with yet another digital resource to contribute to the teaching and learning processes. Nevertheless, GenAI resources also present situations that are not simple (at the moment) to be resolved, such as the ethical conduct of AI users (Holmes et al., 2022) and plagiarism (Chaka, 2023, 2024). Holmes et al. (2022) point to an ethical challenge in the use of AI in education that requires careful analysis and a considered approach since many AI resources can act in a non-

transparent way, where decisions are based on complex and less clear algorithms. For Chaka (2023), AI content detectors are not able to distinguish, in clear-cut terms, between AI-generated texts and human-produced texts. These programs make estimates in percentages or in probabilistic terms, such as probable and probability, or in combined percentages and probabilistic terms. Thus, according to Chaka (2023), AI content detectors appear not yet to be fully ready to accurately and convincingly detect AI-generated content from machine-generated texts in different contexts.

For this research, five pieces of software were used that aim to identify text produced by AI and whether there is plagiarism. Regarding plagiarism detection, the software Plagium and CopySpider were used, and the results showed that none of the texts generated were considered plagiarized. This, perhaps, is because plagiarism detectors appear to still be in the process of being refined, without the ability to differentiate between AI-generated content and human-written text in a consistent and convincing way (Chaka, 2023, 2024). For each chemical concept investigated, it will be mentioned how the software identified the content, whether generated by AI or mistakenly by humans.

Concepts are the basis of human knowledge structures (Johnson et al., 1994), and in recent years, conceptual research has received increasing attention in education (Qian et al., 2023). It is conjectured that a lack of understanding of chemical concepts impedes students' ability to solve chemical problems and impairs their understanding of the entire conceptual structure (Qian et al., 2023). Furthermore, many chemical concepts are not part of students' daily lives, making it difficult for them to make connections with these abstract and complex concepts. Thus, it is a challenge for students to assimilate new concepts into their minds to establish connections with their existing conceptual structure. According to Qian et al. (2023), many new concepts in chemistry emerged during its development, which indicates the importance of exploring chemical concepts.

Chemistry contains many basic abstract concepts that are essential to the body of knowledge. Therefore, exploring chemical concepts and understanding their relationships is crucial. However, in chemistry, it is common for different concepts to exist (Sadykov & Čtrnáctová, 2019; Tomasevic & Trivic, 2014; Upahi & Ramnarain, 2019), and in the teaching process, the teacher usually presents definitions of these concepts. It is worth noting that defining is not the same as conceptualizing. From the perspective of the Oxford Dictionary, defining consists of "that describes or shows the essential meaning of something" (Oxford Learners Dictionaries, 2024), and conceptualizing is "to form an idea of something in your mind" (Oxford Learners Dictionaries, 2024). It is understood that defining consists of the description of the properties or characteristics of an object or concept. Conceptualizing corresponds to an intellectual interpretation of an aspect of sensitive reality. The definition involves the use of nominalization, whereby processes, which normally occur as phenomena are transformed into names or nominal groups. Thus, defining means delimiting, saying what it is, and conceptualizing is about delimiting, saying what it is, but locating the object in a web of relationships. Concepts are historical human constructions that, in new

contexts, acquire new meanings. Regarding concepts, Vygotsky (2012) considers that they evolve with the meanings of words and tend to become more precise within a system of generalities. Every concept is a generalization. At the moment of assimilating a new word, term, expression, etc., the concept development process is just beginning.

In view of the above, the term defined with the aim of chatbots is taken as a reference, describing, explaining, delimiting, or saying what each requested concept is. To facilitate the presentation of the results, the responses of the three chatbots for each concept covered will be presented. Thus, the first concept that chatbots were asked to respond to was the definition of an atom.

ChatGPT defined atom as

the smallest basic unit of a chemical element. It consists of a central nucleus, composed of protons (with a positive charge) and normally neutrons (without an electrical charge), around which electrons (with a negative charge) orbit. Atoms are composed mainly of empty space, with the central nucleus concentrating almost all of the atom's mass. Atoms are the fundamental constituents of all matter and are characterized by the number of protons in their nucleus, known as the atomic number, which determines the identity of the chemical element (OpenAI, 2024).

Gemini, in addition to presenting a definition for an atom, provided information about the atom, such as atom structure, important characteristics, atomic models, the importance of atoms, and three links to "learn more". Regarding the definition, Gemini stated that

Atom is the fundamental unit of matter and the smallest fraction capable of identifying a chemical element. The term "atom" comes from Greek and means "indivisible", since, until the 19th century, it was believed that this was the smallest part of matter that existed (Gemini, 2024).

Copilot defined the atom as "the fundamental particle that makes up matter" (Copilot, 2024). This chatbot, in its response, added other information, highlighting that the atom has two main structures:

Nucleus: In the nucleus, there are protons (with a positive charge) and neutrons (without an electrical charge). These particles are responsible for most of the atomic mass and are concentrated in a small, extremely dense volume. [...] Electrosphere: The electrosphere is the peripheral region of the atom, where the electrons (with a negative charge) are located. Although the term "atom" comes from the Greek and means "indivisible", we know that it is, in fact, divided into smaller particles, known as subatomic particles (Copilot, 2024).

At the end of the answer, Copilot (2024) explained that the "concept of the atom originated in Ancient Greece, thanks to the philosophers Leucippus and Democritus, who

initially considered it as an idea". Copilot was the only one of the three chatbots that presented sources about the text produced. Gemini presented links for consultation, but Copilot informed the source that consulted the text generated by the AI.

When defining an atom, the chatbots produced a text that presents keywords that are commonly observed in the literature. The idea that the atom is an infinitely small particle (Atkins & Jones, 2007; Brown et al., 2017), which has a positive nucleus that contains protons (positively charged particles) and electrons (negatively charged particles), and that each element is composed of a single type of atom (Brown et al., 2017). In the Compendium of Chemical Terminology, an atom is "the smallest particle still characterizing a chemical element" (Book, 2014, p. 121). In their responses, the three chatbots, in addition to presenting a coherent definition of an atom, also related it to the definition of a chemical element.

Regarding the answers generated by ChatGPT, Gemini, and Copilot about the definition of an atom, by way of illustration, GPTZero identified that 3% of the ChatGPT text was produced by AI, while for Gemini, GPTZero indicated the probability of 72 % of the text was produced by AI and that 82% of the Copilot text was generated by AI (Figure 3).

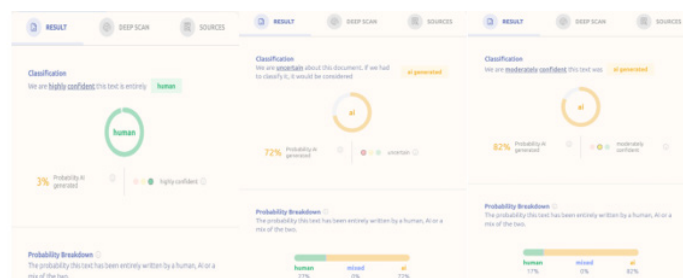


Figure 3: GPTZero analysis of the atom definition of ChatGPT, Gemini, and Copilot, respectively.

The data reveals that both Gemini and Copilot had text identified as produced by GenAI by GPTZero. Although the program presented doubts regarding the Gemini text: "We are uncertain about this document. If we had to classify it, it would be considered AI generated" (GPTZero, 2024). Writer.com's AI Content Detector software indicated that the ChatGPT text presented that 81% of the content about the atom definition was human-generated, for Copilot 88% of the text was human-generated, and for Gemini, the percentage was 72% for human-generated content. That is, for the AI content detector the three texts were produced by humans, which indicates that the software was unable to correctly detect that the text was generated by AI. In Plagium, the software reported that the text of the three chatbots was probably written by a human: "This text is very likely written by a human" (Plagium, 2024). Smodin reported that Gemini's text only was 100% AI-produced.

The second question asked ChatGPT, Gemini, and Copilot to define "electron". The answers are described in Table 1.

Table 1: Chatbots' responses to the definition of electron.

ChatGPT	Gemini	Copilot
An electron is a subatomic particle that orbits around the nucleus of an atom.	An electron is a subatomic particle with a negative electrical charge. It is one of the fundamental components of the atom, along with the proton and neutron.	The electron is a subatomic particle that makes up the atom.

The chatbots presented more information about the electron in their responses, highlighting characteristics and information about its discovery. For the chemistry terminology compendium, the electron is an "Elementary particle unaffected by the strong force with spin quantum number $1/2$, a negative elementary charge and a rest mass of $0.000\ 548\ 579\ 903(13)\ u$ " (Book, 2014, p. 477). It was observed that the answer presented by the Compendium is more complex than those described by the chatbots, although Gemini made mention of the electron's spin and its mass - "Mass: $9.109 \times 10^{-31}\ kg$ (approximately $1/1836$ of the mass of the proton)" (Gemini, 2024).

In the analysis of the texts generated by AI, the responses of the ChatGPT were considered as texts produced by humans, according to Plagium, Smodin, and AI Content Detector software. Only GPTZero identified that the text on the definition of an electron was produced by AI. Gemini had its text identified as generated by AI by all software. In the analysis of the text created by Copilot, only Plagium identified it as generated by AI.

Regarding the third question (Define Mole), ChatGPT responded that the Mole "is a unit of measurement used in chemistry to express the amount of substance present in a sample. The mole is defined as the amount of substance that contains approximately 6.022×10^{23} elementary entities, such as atoms, molecules or other particles." (OpenAI, 2024). Gemini, in addition to defining moles as a "fundamental unit of the International System of Units (SI) for the quantity of matter. It is a quantity used to count elementary entities of a substance, such as atoms, molecules, ions or electrons.", presented an analogy, which said: "Imagine that you need to count grains of sand on the beach. It would be impossible to count them one by one. The mole functions as a "counting unit" for the microscopic world, similar to the dozen (12 units) for eggs" (Gemini, 2024).

It is important to highlight that Gemini, in addition to presenting topics with information about the mole, highlighted that there is a current definition for mole: "It is important to highlight that, as of May 2019, the definition of the mole is no longer based on the mass of carbon-12. Currently, it is defined directly by Avogadro's number" (Gemini, 2024), summarizing its definition to: "The mole is an essential tool for quantifying the microscopic world, enabling precise calculations and relationships between different chemical quantities" (Gemini, 2024). Copilot presented the following definition of Mol:

One mole corresponds to approximately 6.022×10^{23} particles. This unit is one of the fundamental quantities of the International System of Units (SI). The term "mol" derives from the Latin word "moles", which means "a mass". It was introduced by the German chemist Wilhelm Ostwald (Copilot, 2024).

In the Compendium of Chemical Terminology, the definition for a mole is "the SI unit of quantity of substance. One mole contains exactly $6.022\ 140\ 76 \times 10^{23}$ elementary entities. This number is the fixed numerical value of Avogadro's constant, N_A when expressed in the unit mol^{-1} and is called Avogadro's number" (Book, 2014, p. 948). This answer is very close to that presented by ChatGPT and Gemini. Furthermore, Gemini and Copilot highlighted similar information in the definition of Mol, while ChatGPT chose to present a description of what Mol is without presenting other characteristics. However, it was observed that Gemini's response was the most generic compared to the responses from ChatGPT and Copilot.

Regarding the answer created by Copilot about the definition of mole, all software mistakenly identified it as produced by humans. Smodin and GPTZero were correct in determining that the text produced by ChatGPT was generated by AI, and only Smodin reported that the Gemini text was generated by AI.

The fourth concept asked for chatbots to define a molecule. For ChatGPT, a molecule "is a chemical entity composed of two or more atoms joined by chemical bonds." (OpenAI, 2024). Gemini and Copilot presented similar answers to the definition of a molecule: "It is a set of two or more atoms covalently linked, forming the smallest unit of a substance that maintains its chemical properties" (Gemini, 2024) and "is a set of atoms, the same or different, united by covalent bonds" (Copilot, 2024). In the compendium, a molecule is "an electrically neutral entity that consists of more than one atom ($n > 1$)" (Book, 2014, p. 958). Regarding the molecule being electrically neutral, of the three chatbots, only ChatGPT did not explain this characteristic. According to Qian et al. (2023), the lack of information can lead to students having limitations in understanding the concept, since the lack of understanding of chemical concepts impedes students' ability to solve problems.

Concerning the answers generated by ChatGPT, Gemini, and Copilot about the definition of a molecule, Smodin was the only one that correctly identified them as texts produced by AI. For AI Content Detector (Writer.com) and GPTZero, the texts produced by the three chatbots were generated by humans. It is worth noting that Plagium reported in its response that it was unable to distinguish whether the ChatGPT and Gemini text were produced by AI or by humans. The software presents the following response: "We are perplexed, this text is probably written by a human, but maybe generated by a machine" (Plagium, 2024). In the text created by Copilot, Plagium identified it as human-generated.

Finally, when defining a chemical substance, the chatbots presented more simplified answers than the Gold Book. ChatGPT highlights that a chemical substance is "a form of matter that has a defined chemical composition and distinct properties. It can be composed of molecules, atoms, or ions" (OpenAI, 2024). Gemini highlights that a "chemical substance, also called a pure substance, is a material with a defined and constant chemical composition, that is, it has specific and well-defined physical and chemical properties" (Gemini, 2024). Copilot defined a chemical substance as "any

kind of matter formed by a constant composition of chemical elements, having defined physical and chemical properties” (Copilot, 2024). According to the Compendium of Chemical Terminology, a chemical substance is a “matter of constant composition best characterized by the entities (molecules, formula units, atoms) that compose it” (Book, 2014, p. 265). In addition, it highlights that physical properties such as density, refractive index, electrical conductivity, and melting point characterize the chemical substance (IUPAC, 2019). It is observed that the definitions presented by the chatbots are simpler and aimed at a beginner audience in chemistry, but they all converged by highlighting the constant composition of the chemical substance.

For the definition of a chemical substance, Smodin was only able to detect the text produced by ChatGPT as created by AI, while Plagium identified the three chatbots that the texts were created by AI. Concerning the responses generated by ChatGPT, Gemini, and Copilot regarding the definition of chemical substance, Writer.com’s AI Content Detector and GPTZero incorrectly identified that all texts were produced by humans. Furthermore, GPTZero in response to Copilot, indicated that they were highly confident that the text is entirely human: “We are highly confident this text is entirely human” (GPTZero, 2024).

Table 2 presents a summary of the responses from AI-generated text detectors on texts produced by chatbots, indicating the probability of having been produced by a human (H) or by AI (AI).

Table 2: Responses by AI content detectors each chatbot.

Tools	Chatbot	Atom	Electron	Mole	Molecule	Chemical substance	Generated by AI
Plagium	ChatGPT	H	H	H	H/AI	AI	33.3%
	Gemini	H	AI	H	H/AI	AI	
	Copilot	H	AI	H	H	AI	
Smodin	ChatGPT	0% AI	0% AI	100% AI	0% AI	100% AI	33.3%
	Gemini	100% AI	100% AI	100% AI	0% AI	0% AI	
	Copilot	0% AI	0% AI	0% AI	0% AI	0% AI	
AI Content Detector	ChatGPT	81% H	74% H	75% H	71% H	77% H	6.7%
	Gemini	72% H	51% AI	78% H	76% H	76% H	
	Copilot	88% H	81% H	90% H	84% H	87% H	
GPTZero	ChatGPT	97% H	83% AI	91% AI	95% H	96% H	33.3%
	Gemini	72% AI	71% AI	98% H	94% H	97% H	
	Copilot	82% AI	97% H	56% H	95% H	99% H	

Regarding the programs used, it is important to highlight that Plagium does not provide a percentage in its responses, only indicating whether the text was generated by AI (This text is likely generated by a machine) or generated by a human (This text is very likely written by a human) or both (We are perplexed, this text is probably written by a human but may be generated by a machine). Copyspider only indicates whether the text is plagiarized or not. Smodin, AI content detector and GPTZero in their responses present the percentage indicating whether the text was created by AI or by a human.

The data in Table 2 reveals that, in general, the software made mistakes in detecting generated texts, identifying them as produced by humans (Figure 4). Of the five concepts

analyzed by each software (three for each chatbot), the AI Content Detector in 93.3% of the responses indicated that it was human-generated text. Smodin and GPTZero identified 66.6% of texts as produced by humans. In two responses, Plagium was unable to answer whether it was a text generated by AI or by a human, so of the fifteen analyses, eight (53.3%) considered the text as generated by a human.

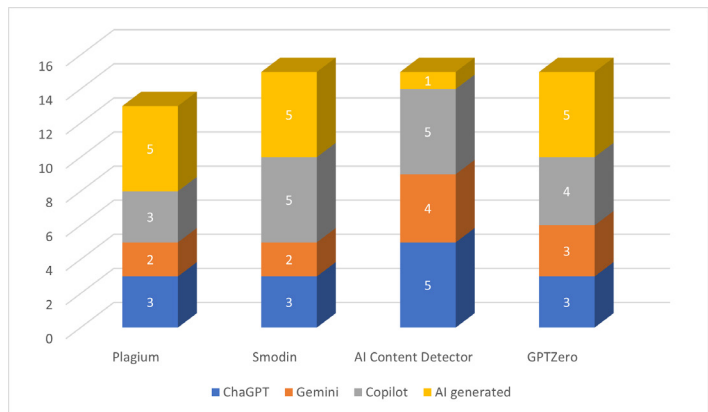


Figure 4: Quantity of texts identified as human-created by the programs (Plagium, Smodin, AI Content Detector and GPTZero) and correctly identified as AI generated.

As seen in Figure 4, Plagium incorrectly identified the text as human-generated on three out of five occasions (3/5) for ChatGPT’s responses. For Gemini’s answers, the software made mistakes on two occasions (2/5), and for Copilot, it erred three out of five times (3/5). It is possible to observe that Plagium was correct in only five instances out of a total of 15 analyses (5/15, 33.3%). Additionally, Plagium could not determine whether the ChatGPT and Gemini responses for the concept of the molecule were AI-generated (Table 2).

Among the AI content detection programs, AI Content Detector was the least successful in identifying whether the text was AI-generated, with only one correct identification (1/15, 6.7%). The other software programs (Plagium, Smodin and GPTZero) showed a low accuracy rate, about one-third (33.3%), but they were the ones that most successfully identified AI-generated content. For Chaka (2023), most AI content detectors are new, and not much research has yet been carried out to assess their efficacy, accuracy, and reliability in terms of distinguishing between content generated by chatbots and content written by humans. This is probably one of the reasons that the software, for the most part, indicated that the texts generated by GenAI were generated by humans.

With regard to the concepts presented by chatbots, Table 3 presents a summary describing the responses considered satisfactory, partially satisfactory, and unsatisfactory. Satisfactory responses (SR) were considered to be those in which the chatbots presented the same or similar definition of the concept to those observed in the Compendium of Chemical Terminology. The responses considered partially satisfactory (PS) are those in which the chatbots responded correctly to the definition of the concept but failed to present any additional information (however, its absence does not affect understanding of the concept) or provided a basic answer (simple, summarized). Those in which the

chatbot incorrectly presented the definition of the concept investigated were considered unsatisfactory responses (UR).

Table 3: Summary of chatbots' responses to define the requested concepts.

	Concept	ChatGPT	Gemini	Copilot
Answers overview	atom	SR	SR	SR
	electron	PS (basic answer)	SR	PS (basic answer)
	mole	SR	SR	SR
	molecule	PS (failed to present a characteristic of the molecule)	SR	SR
	chemical substance	PS (Provided a pragmatic/concise response)	PS (Provided a pragmatic/concise response)	PS (Provided a pragmatic/concise response)

Overall, the responses from Gemini and Copilot were mostly considered satisfactory. Among the three chatbots, when defining the five concepts, Gemini was the one that presented the most satisfactory responses (four definitions out of a total of five), followed by Copilot with three satisfactory responses. ChatGPT, in this investigation, was the chatbot that had the most partially satisfactory responses. There were three partially satisfactory responses and only two satisfactory responses. Nevertheless, none of the chatbots presented unsatisfactory responses in defining the five concepts explored.

Our results differ from the findings of Rudolph et al. (2023) who found that the performance of ChatGPT (both the free version and the commercial version) was much better than Google Bard (Gemini). However, the experiment by Rudolph et al. (2023) aimed to answer fifteen questions from different fields, and none involved defining chemical concepts. Khademi (2023, p. 79) "demonstrated with empirical data that ChatGPT-3.5 and Bard (Gemini) failed to achieve a performance comparable to human experts in rating the complexity of writing prompts". Furthermore, his study highlights that, in some applications, such as education and assessment, ChatGPT and Bard (Gemini) require further improvement and training to perform equivalent to humans. In this context, Table 4 shows a summary of the chatbots' performance, highlighting the strengths and weaknesses in the responses to the chemical concepts observed in this research.

According to Qian et al. (2023), individuals with abundant chemical knowledge or a high level of cognitive ability are able to summarize the common points of some concepts well and are not confused by the incorrect classification of a concept. In this context, with regard to the responses presented by the chatbots for the five concepts analyzed, it is understood that GenAI did not compromise the students' initial understanding in relation to the concepts described, nor did they present confusion during the definition of these concepts. The chatbots' responses proved to be organized and coherent at a basic level. According to Leite (2023), the quality of GenAI responses depends on the concept being evaluated. Holme et al. (2015) identified five categories that define conceptual understanding of general chemistry contents in higher-education (Transfer; Depth; Predict/explain; Problem solving; Translate). These categories provide a framework to understand and evaluate conceptual

Table 4: Strengths and weaknesses in chatbots' responses to the chemical concepts investigated.

	ChatGPT	Gemini	Copilot
Strengths	The answer presented is not limited to just the requested definition; Presents additional information on the requested concept.	The answer presented is not limited to just the requested definition; Presents additional information on the requested concept; Provides links related to the topic investigated (learn more).	The answer presented is not limited to just the requested definition; Presents additional information on the requested concept; Provides links related to the topic investigated (learn more); Presents the sources consulted for the texts produced; Presents images and/or formulas (when applied to the concept).
Weaknesses	Does not provide links to consult about the content investigated; Does not present the fonts used for the text produced; Presents the answers in continuous text; In some cases, it presents the answer without additional information.	It presents answers on topics that may not contribute to the understanding of the requested definition, causing an excess of information (sometimes it is not necessary at that moment).	Excessive extra information can lead the reader to have difficulty understanding the answer.

understanding in the context of chemistry education (Daher et al., 2023).

For this research, it was not assessed whether chatbots are capable of covering the five categories exposed by Holme et al. (2015) since chatbots would need to demonstrate the ability to: apply core chemistry ideas to novel chemical situations; reason about core chemistry ideas using skills that extend beyond rote memorization or algorithmic problem solving; extending situational knowledge to predict and/or explain the behavior of chemical systems; demonstrating critical thinking and reasoning while solving problems, including those involving laboratory measurements; translate across different scales and representations.

On the other hand, it is necessary to warn that there is no point in students taking ready-made responses from chatbots and memorizing them, without giving them a true meaning. Chemical concepts must be taught beyond the memorization and/or reproduction of information. It is important for students to understand chemistry and how this science can transform society, contributing to the development of critical thinking.

Conclusions and recommendations

This study presents significant contributions to advance GenAI research in the context of chemistry teaching. The findings of this study highlight the convergence in responses from AI chatbots compared to the IUPAC Compendium of Chemical Terminology for five chemical concepts (atom, electron, mole, molecule, and chemical substance). As noted, ChatGPT, Gemini, and Copilot provided satisfactory results for defining the concepts. However, these chatbots

are under development and seek to achieve high accuracy in various textual formats, including the definition of concepts. It is thus necessary to analyze each response provided by GenAI.

The knowledge gained from using chatbots points to encouraging students to try GenAI, as they can provide an efficient way to familiarize themselves with a new topic, find some additional resources, discover examples that were not covered in the classroom, and/or assist in understanding some content. When teaching chemistry, in addition to specific knowledge (in chemistry), the student will need to master philosophical, historical, psychological, and sociological knowledge.

However, it is crucial to recognize the substantial promise that chatbots hold for the field of education. Aligned with the global shift towards personalized, self-directed learning and sustainable educational systems, these resources have the potential to contribute to the knowledge construction process. Furthermore, chatbots should be understood as another resource for teachers to use in the teaching and learning processes. They are capable of providing answers to a multitude of questions, but their use must be accompanied by reflection. Human experience remains fundamental, as nothing replaces your ability to reason, contrast ideas, present critical thinking, and know which sources are being used. However, chatbots have created a feeling in society, including teachers and students, that the answers are accurate and unquestionable. Users of these technologies must validate the results generated by generative AI before applying them effectively, avoiding the use of misleading or incomplete information. A complementary relationship between GenAI and users (teachers, students, researchers, etc.) should be considered, where the use of these chatbots can expedite the analytical process without diminishing the essential role of individual experience and critical engagement (Perkins & Roe, 2024). Furthermore, as AI is further explored and improved, it is also possible that new educational methods can be developed and the full potential of chatbots in education can be used.

More research is needed to build on recent gains in academic awareness of GenAI tools for teaching and learning processes, exploring whether chatbots can contribute to building stakeholder knowledge. However, the conclusions of this exploratory study come from a small sample and cannot be generalized; therefore, a larger study must be carried out, which may produce similar or different results. Furthermore, considering the current pace of AI development, conclusions from research involving GenAI may become obsolete within a period of months, sometimes less, as when the results are published, new versions of the models that were the basis are already available for these studies. For example, when ChatGPT was launched, based on the GPT 3 model, several research studies were carried out, then studies based on GPT 3.5, then GPT 4 (ChatGPT 4) (Dis et al., 2023; Ismail et al., 2023; Lo, 2023; Ogunleye et al., 2024; Parker et al., 2024; Paul et al., 2023). Similarly, when Bard was launched, different studies-investigations were carried out on this model that (quickly) evolved into Gemini (Khademi, 2023; Luzano, 2024; Nguyễn et al., 2023; Ogunleye et al., 2024; Perera & Lankathilake, 2023). This also happened with Bing Chat, which is currently

called Copilot (Głushkova & Malinova, 2024; Motlagh et al., 2023; Rudolph et al., 2023). These research studies sought to validate and analyze the capabilities of these models in comparison to activities carried out by humans. Given the rapid advancements in GenAI capabilities, many of these conclusions have quickly become obsolete and no longer reflect the current reality.

Finally, I believe this research can help teachers and students reflect on the use of AI in the knowledge construction process. Instead of merely giving commands to chatbots, they can learn to engage in meaningful dialogue with language models and explore innovative applications of artificial intelligence in chemistry teaching. There is discouragement or disappointment when it is not possible to have a rich and contextualized interaction with the language models, and the chatbot ends up providing a wrong answer. It is necessary to stimulate these systems as we stimulate a human conversation. If we speak to an expert in a certain area and don't ask the appropriate questions, what will probably happen is that the answers or the richness of the answers will not be sustained. Therefore, it is important to know how to talk.

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Curriculum factors and sustainable artificial intelligence-driven classroom assessment. The mediating role of computer self-efficacy and digital literacy

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Abstract

The impact of artificial intelligence in education has been well documented. However, the sustainability of artificial intelligence-driven classroom assessment has not been the focus of much literature. This study sought to cover this research gap by examining the role of curriculum innovation, quality, and viability when mediated by computer self-efficacy and digital literacy in sustainable AI-driven classroom assessment. A total of 1607 respondents were used for the study. A questionnaire that was validated by experts and the psychometric properties of exploratory and confirmatory factor analysis were used to determine the structure and dimensionality of the scale. The findings of the study revealed that curriculum innovation directly affects curriculum viability, curriculum quality, digital literacy, computer self-efficacy, and sustainable AI-driven classroom assessment. At the same time, curriculum quality and viability also affect digital literacy, computer self-efficacy, and sustainable AI-driven classroom assessment. The mediation of digital literacy and computer self-efficacy in the nexus between curriculum innovation and sustainable AI-driven classroom assessment was significant. However, these mediators were insignificant in the nexus between curriculum quality and sustainable AI-driven classroom assessment. The implications of the findings were discussed, especially for policy developments.

Introduction

Artificial intelligence (AI) is one of the current digital technologies that has permeated the educational sector so deeply that teachers and students currently utilize it for diverse purposes. AI tools are currently engineered to perform human-like functions with accuracy and speed (Chai et al., 2020; Kuleto et al., 2021). Like other groundbreaking technologies: virtual and augmented reality, robotic technology, 3D printing, and advanced networking, AI today can comfortably perform functions like content generation (Qu et al., 2022), automated assessment grading (Gardner et al., 2021), supervision of examinations (Braiki et al., 2020), personalized learning (Zhai et al., 2021), intelligent tutoring (Kubsch et al., 2022; Li et al., 2023) and provision of answers to diverse questions (Ouyang et al., 2023) among others. The sophisticated characteristics of AI tools that have over time advanced from machine learning (ML) through deep learning (DL) and are now applied have led to the performance of other tasks such as language translation, visual perception, speech recognition, and decision-making with virtual tools (Zehner & Hahnel, 2023). Hence, in classroom circles, these advanced tools have, over time, played a significant role in reshaping the traditional mode of assessment with more sophisticated technologies that align with global demands and the dynamic nature of the educational ecosystem (Joosten & Cusatis, 2020).

Artificial Intelligence (AI) has also been revolutionary in assessment. AI is increasingly finding its place in classroom assessment, revolutionizing traditional methods by offering personalized learning experiences and real-time feedback. AI algorithms can analyze student data, such as test results and learning behaviors, to tailor educational content to individual needs (Blikstein, 2018). Moreover, AI-powered assessment tools can assess student performance more accurately and efficiently than manual grading, allowing educators to focus more on teaching (Akinola et al., 2020). For instance, AI can detect patterns in student responses and provide adaptive assessments that challenge students at appropriate levels (Popenici et al., 2023). This integration of AI enhances assessment practices by promoting fairness, efficiency, and personalization in educational settings. For example, language processing systems and AI algorithms can generate responses to students' essay tests and provide immediate feedback to questions raised by the learner (Luckin et al., 2024).

Furthermore, the use of AI has certain implications, given the fact that there are identified dangers associated with the use of AI. The integration of AI in classroom assessment within higher institutions brings forth several potential dangers and challenges. Firstly, concerns arise regarding the reliability and validity of AI algorithms in accurately assessing complex student work, such as essays or creative projects (Williamson et al., 2019). There is a risk that AI may not fully capture the nuances of student learning and could potentially misinterpret or penalize unconventional but valid responses (Williamson et al., 2019). Moreover, there are ethical implications surrounding data privacy and security, as AI systems require access to substantial amounts of student data, raising concerns about confidentiality and misuse (van Dijck, 2014). Furthermore, the reliance on AI for

assessment may lead to a reduction in human interaction and personalized feedback, potentially diminishing the quality of the learning experience (Williamson et al., 2019). Educators may also face challenges in understanding and interpreting AI-generated assessments, impacting their ability to effectively support student learning and development (Selwyn, 2019). These dangers underscore the importance of careful implementation and ongoing evaluation of AI technologies to mitigate risks and maximize their beneficial impact in educational settings.

However, the key question raised over time is basically the sustainability of AI-driven classroom assessment. Sustainable AI-driven classroom assessment describes the assessment practices that integrate AI tools in assessment to enhance educational outcomes while minimizing environmental impact and promoting long-term viability. This helps educators create a flexible assessment method that can foster learning, adjust to the needs and experiences of the students, and reduce resource consumption. According to Baker and Inventado (2019), using adaptive learning platforms is one notable example of sustainable AI-driven assessment because it utilizes AI algorithms to analyse students' data and provide real-time feedback that helps provide curative measures on time. Similarly, the use of AI reduces paper-pencil tests, which sometimes litter materials around the environment, thereby leading to environmental hazards. In an era where traditional methods do not promote inclusivity in testing, sustainable AI-driven assessment accommodates learners with diverse learning abilities and styles using tools like speech recognition technology, which can enable students with disabilities to participate in oral assessments on an equal footing with their peers (Peng et al., 2020).

In the Nigerian context, given the existing inequalities and the lack of access to AI tools by staff and students, there are growing concerns that this integration should not widen the existing gap (UNESCO, 2022). Similarly, the environmental impact of deploying digital infrastructures, such as increased energy consumption, must be addressed, ensuring that AI solutions align with the national agenda for sustainable development. However, despite the potential benefits, efforts by researchers to examine AI-driven assessment sustainability in Nigeria have remained few. There is limited research on how AI tools can be used today and tomorrow without compromising environmental quality, as well as how to integrate them into the curriculum so as to foster innovation and quality education (Jones & Brown, 2021). In fact, several reasons have been adduced for these disparities, which include infrastructure limitations (Oyelami & Badejo, 2020), digital divides (Ogunbodede & Iahad, 2020), financial constraints (Adedaja & Akinola, 2018), data privacy and security concerns (Ojo & Oluwatayo, 2019), curriculum alignment (Okwundu & Olugbara, 2020), and capacity building (Ezekiel et al., 2020). This emerges as a critical issue, with a shortage of expertise and technical skills among educators and administrators impeding the effective deployment and utilization of AI-driven assessment technologies.

Previous studies have attempted to examine the impact of AI on assessment (Adarkwah et al., 2023; Ifelebuegu et al., 2023; Ouyang et al., 2022). For example, the study of Owan et al. (2023) found that AI is essential in educational measurement in that it can be used in the development process of a test. Ofem et al. (2024) found that AI is beneficial for academic research in higher institutions. Rasul et al. (2023) noted that AI has proven to be beneficial to higher education students because it has been used in research support, personalized learning, data collection, and assessment practices. These studies focused more on how AI affects the educational system. It was not focused on the impact of AI on assessment or the sustainability of an AI-driven classroom. Over the years, the rise in the application of AI has raised a lot of attention and even divided schools into those that support and oppose the new technology. Adeleke and Ayo's (2020) study on the use of AI in educational assessment in Nigeria found that AI has improved grading efficiency and provides timely feedback to students. Oyelami and Aderonmu's (2018) study revealed that AI techniques impact students learning in a positive way in secondary schools, especially through personalized learning experiences and improved knowledge of the subject matter. Other studies in Nigeria have also shown that AI has effectively improved assessment practices (Ogunbodede & Iahad, 2020; Olufemi & Akinwale, 2019). Beyond Nigeria, Mbarika et al. (2019) found that AI has been able to enhance inclusivity and equity in assessment practices. Ogundele and Oyediren's (2021) study on data-driven machine learning approaches for managing sustainable development goals in Africa: A Focus on Educational Assessment. AI has been able to maximize sustainable assessment practices at the descriptive level. Huang and Rust (2018) found that AI has opportunities in sustainability practices in assessment and challenges in AI in service industries in Europe, including its potential applications in educational assessment. With their insights, these studies have not examined the impact of curriculum design in the form of curriculum innovation, curriculum quality, and viability on sustainable AI-driven assessment when mediated by computer self-efficacy and digital literacy.

Curriculum design, which in this context is conceptualized as innovation, quality, and viability, are essential educational practices that must align the needs of learners and society with global trends. The flexibility of the curriculum will help new ideas and technologies be incorporated into the system and inculcated in the learners for maximum productivity and usefulness (Adeleke & Ayo, 2020). Other researchers have noted that curriculum innovation in the era of AI-driven assessment ensures that there is educational efficacy because teachers and educators can create more personalized learning experiences that maximize individuals' needs and interests (Oyelami & Aderonmu, 2018). Moreover, a focus on quality assurance ensures that AI-driven assessment methods meet rigorous standards of validity, reliability, and fairness. This is crucial for maintaining the integrity and credibility of assessment results, thus providing reliable feedback to both students and educators. Quality assurance mechanisms, such as validation studies and psychometric analyses, help identify and address potential biases and inaccuracies inherent in AI algorithms (Olufemi & Akinwale, 2019). Additionally, assessing the viability of sustainable

AI-driven assessment involves considerations of scalability, cost-effectiveness, and long-term implementation strategies. Sustainable integration of AI technologies into the curriculum requires careful planning and investment in infrastructure, teacher training, and ongoing support systems (Ogunbodede & Iahad, 2020). Understanding the resource implications and potential challenges associated with AI adoption is essential for educational institutions seeking to maximize the benefits of these technologies while minimizing risks (Fotouhi-Ghazvini & Puteh, 2020).

The study has both theoretical and practical contributions. First, the study may help in the development of sustainable AI-driven assessment tools that can not only be efficient in the classroom but also become adaptive to environmentally and socially sustainable practices. These tools may have the capacity to provide real-time feedback as well as provide more engaging learning experiences, which can inversely improve students' learning outcomes. Secondly, the study may inform policy development based on data-driven evidence that will support sustainable AI integration in schools. These policies could be on data protection, fairness, and equity in access to technology. Educators can benefit from the practical applications of this research through enhanced professional development programmes that include training on the use of sustainable AI in classroom assessments. Additionally, curriculum designers can integrate the findings into curriculum frameworks to prepare students for an increasingly digital and AI-driven world, ensuring that sustainability concepts are embedded within core educational content. Theoretically, the findings of the study can help us understand how AI can be integrated into educational settings in a manner that promotes sustainability. This study can also promote the development of interdisciplinary theories that provide more insights from ethics, sustainability science, educational technology, and cognitive psychology, which will provide a nuanced understanding of the complex interaction between the human learning process and technology. The study, therefore sought to answer the following questions:

1. What is the direct effect of curriculum innovation on curriculum viability, curriculum quality, computer self-efficacy, digital literacy, and sustainable AI-driven assessment?
2. What is the direct effect of curriculum viability on curriculum quality, digital literacy, computer self-efficacy and sustainable AI-driven assessment?
3. How does curriculum quality directly affect digital literacy, computer self-efficacy and sustainable AI-driven assessment?
4. What is the mediating effect of computer self-efficacy and digital literacy in the linkage between curriculum designs (curriculum innovation, curriculum quality and viability) on sustainable AI-driven assessment?

Literature review

Studies of artificial intelligence in assessment

In the rapidly expanding field of educational technology, Artificial Intelligence (AI) in education represents a transformative opportunity, showcasing a wide array of tools and applications at an unprecedented level (Rudolph et al., 2023; Chaka, 2024). AI technologies can automate and enhance various facets of assessment including design, delivery, and grading (Ifelebuegu, 2023). For instance, AI can generate diverse and complex questions that assess higher-order cognitive skills, thereby reducing the manual workload for educators (Bridgeman & Liu, 2023; Gierl & Lai, 2013). Additionally, AI can personalize assessments based on individual student's needs and progress, facilitating differentiated instruction and personalized learning (Vandewaetere et al., 2011; Stahl et al., 2023). AI also plays a pivotal role in supporting collaborative assessments. AI-based analytics can track and analyze individual contributions to group tasks, simplifying the evaluation of each student's performance (Ferguson, 2012). Furthermore, AI can monitor and guide online discussions, ensuring equitable participation among students and fostering critical thinking and effective collaboration (Chan & Tsi, 2023).

However, the use of AI in authentic assessments poses challenges, including potential errors, the difficulty in programming AI to grasp nuances in human responses, and the risk of over-reliance on technology (Sevnarayan & Potter, 2024). Indeed, researchers have documented long-term effects where students may utilize AI to achieve high scores and pass exams, potentially diminishing critical thinking, research skills, and creativity (Mohammad Karimi, 2023; Rudolph et al., 2023; Sison et al., 2023). Such impacts raise questions about students' capacity to develop essential intellectual and analytical skills crucial for personal and professional growth. Moreover, implementing AI necessitates significant investments in technology and training, potentially widening the digital divide and exacerbating educational inequalities (Reich & Ruipérez-Valiente, 2019). However, there remains a scarcity of literature addressing sustainable assessments that utilize AI tools while promoting environmental sustainability, economic feasibility, and social responsibility.

Existing studies on sustainable assessment practices highlight various implications. For example, Smith et al. (2021) emphasized how AI systems can offer timely, personalized feedback to students, thereby fostering continuous learning and reducing the environmental impact associated with traditional paper-based assessments. Johnson and Lee (2020) underscored how adaptive assessments can optimize resource allocation in education, potentially minimizing the environmental footprint by reducing paper usage and energy consumption. Other studies explore sustainable implications of classroom assessment in AI environments (Chen et al., 2019; Jones & Brown, 2022; Garcia et al., 2023). However, these studies do not address how curriculum redesign, particularly in countries like Nigeria where AI integration in curricula remains limited, could further these insights. Therefore, conducting empirical research on how AI-enabled assessment practices can promote sustainable

educational outcomes in diverse contexts, including Nigeria, is essential for informing policy development and educational practice.

Studies on curriculum design

The sustainability of AI-driven assessment cannot go without some factors like curriculum innovation, quality, and viability. Curriculum development provides the learner and teachers with the experiences required to function in society (Kelly, 2009). What we know and do could be a function of the quality of the curriculum content that learners could have been exposed to. In 2018, China officially announced the integration of AI into the curricula of higher institutions (Chen & Wang, 2020). The purpose of this curriculum innovation was to ensure that opportunities are provided to both students and teachers to acquire the right skills required of a technologically driven era, which led to groups like the Advancement of Artificial Intelligence (AAAI) and the Computer Science Teachers Association (CSTA) being formed to provide the right focus (Pedró et al., 2019).

This curriculum development policy will not only help teachers function well in school but will also inspire future research into areas of ethical design that will help bridge the gaps that have already been created by most AI algorithms (Kopcha et al., 2020). It is thus true that in Nigeria, this official policy has not been made. School teachers have a routine timetable that, to an extent, is very inflexible, and the resources to advance this schedule are limited. Most of the teachers are not trained, which makes the integration of AI problematic. Improvements in this area account for innovations in the curriculum so that teachers can understand the value-driven content of AI and where it can fit into their classroom activities (Van Haneghan et al., 2015). There are three related factors, though independent but interacting significantly, that are presumed to help drive the process for sustainable AI-driven assessment. These are curriculum innovation, curriculum planning, and curriculum viability. This is what is referred to as a curriculum design in this study. There are different measures of curriculum quality determination. According to MacCarrick et al. (2010), programme evaluation, educational resources, students, faculty condition, educational programme assessment, mission objectives of the school, as well as governance and administration, are measures for determining curriculum quality. Similarly, comparing the current status of the national curriculum with global standards can also help determine the quality of the curriculum (Rezaeian et al., 2013).

Curriculum viability looks at the present state of the curriculum, determined by the degree to which the standards, inputs, and processes of the elements of the curriculum have or have not been met, and then identifies the inhibitors that affect the achievement of those standards. Curriculum viability focuses on the workability and functionality of the curriculum in delivering the standard that is met for the institution. This is why Khan (2021) quickly concludes that when schools develop standards and incorporate all inputs into the curriculum without determining its viability, they face the problem of implementation crises, which may result in student or teacher dissatisfaction and possibly curriculum

failure. Curriculum innovation, in another sense, is the frequent insertion of new programmes and policies that will keep the standards high as well as provide opportunities to meet global standards. These three factors form the nexus of curriculum design as they work collectively to ensure that the educational ecosystem is alive. The sustainability of AI-driven assessment could rest on these three measures. This is because human and societal needs are complex and ever-changing. The state-of-the-art for today may change in the future, especially as new technologies are evolving and their impacts on education are very visible. There must be a circle of inputs in the curriculum (standards), ensuring the workability of the curriculum in line with the set standards (viability) and the insertion of emerging development (innovation) so as to achieve a set of objectives (Alexander & Flutter, 2009; Haug, 2003; Niederhauser et al., 2018).

Previous studies have examined the nexus between curriculum design and the integration of AI in higher institutions. For example, the Chiu and Chai (2020) study revealed that genuine curriculum creation should encompass all four forms of curriculum design approaches coordinated by teachers' self-determination to orchestrate student learning experiences. Educational content and strategies were mostly the elements of standard but students, faculty, work environment, and technology innovation were quality inhibitors to AI integration. Basically, studies have been carried out in relation to curriculum innovation, quality, and viability with respect to different phenomena (Liu & Zhang, 2021; Chen & Wang, 2020; Brown & Smith, 2021). However, these studies have not looked at the impact of these curriculum designs on sustainable AI-driven assessment. This is a serious problem for policymaking as evidence that will guide their decision is absent or inadequate. Available studies are rather focused on the impact of AI on education as a whole. Efforts to look at curriculum quality, viability, and innovation have not been adequate. In fact, it is not to the knowledge of the researchers if such studies have been carried out in Nigeria and Africa at large.

Thus, as machine learning becomes more efficient, AI performs diverse functions in the assessment industry, which could have more effect on ethical practices because of the inherent bias that most AI tools are programmed with. Future developments will have more effect on the system due to automation and computerization of all that people need to do in the womb of assessment. These practices may also have an effect on the environment, as the resources and technology involved may be impactful. There is a need for teachers and students' knowledge of these AI technologies to increase so that what is done will help the students and the educational system at large in the present and provide measures for the future satisfaction of the system without compromising issues of data privacy, ethical consideration, security, or the standard of the educational sector. This whole effect is dependent on curriculum design (Wang et al., 2019; Piniel & Csizér et al., 2015).

Studies of online digital literacy

Digital literacy and computer self-efficacy are two vital terms that are used to refer to individuals' ability to manipulate the complex technological world that is driving all sectors of society. Digital literacy is different from technical skill, as the latter may be more focused on the management of hardware and software, but for one to be digitally literate, one must have the ability to deal with information online, understand ethical issues, copyright, and use the right digital tool for the right purpose and time for the purpose of collaboration and communication, among others (Udeogalanya, 2022).

Digital literacy is a conglomerate of skills, knowledge, and attitudes that are used to navigate the complex landscape of the digital world and are useful in everyday life. It is all-encompassing in that it ranges from functional skills to more sophisticated attributes, such as creating digital content as well as developing apps that can be used in one's profession. However, for sustainable AI-driven assessment, digital literacy is not just a function of basic functional skills like surfing the internet, typing, or editing, but strategic skills that will help one understand how an AI complex system works: interpreting generated data as well as taking decisions based on data. Since sustainable assessment is based on ensuring that the assessment that is carried out is environmentally sustainable, ethically sound, and socially responsible, digital literacy ensures that the use of AI in assessment minimizes bias, promotes equity, and supports a long-term view that benefits all stakeholders in the educational web (Mailizar et al., 2021).

Several studies have noted that to improve assessment standards that can benefit both present and future needs, digital literacy development is seen as a sine qua non to address this (Hanell, 2018; Porat et al., 2018). This is because ICT is seen as an essential factor for learning and an ingredient to cope with the demands of globalization. More so, with the positive ravaging effect of AI in the educational system, digital literacy is indispensable to the achievement of the Fourth Industrial Revolution (Williamson et al., 2019). Studies that directly explain the link between digital literacy and assessment driven by AI are limited or not available. Over time, different studies have described different aspects of digital literacy, with some focusing on the extent of the respondent's exposure to the digital environment, which may vary depending on the facility's availability and awareness of the importance of digital tools (Wu et al., 2022). Thus, the research field is heterogeneous in its measurement tools, making it difficult to compare different studies. (Alexander et al., 2017; Law et al., 2018; Vuorikari et al., 2022; Wu et al., 2022). In a recent study by Patrik (2024), the findings of the study revealed that digital literacy is fundamental to academic success. However, there are differences based on discipline in considering digital skills among participants.

Boma (2021) revealed that digital literacy is not a significant factor in determining the utilization of online platforms for instructional purposes. This was attributed to factors such as the educators' lack of skills, among others. The Łukasz (2020) study provided a description of issues related to the self-evaluation of digital literacy in using text editors, spreadsheets, and presentation and graphic software. They

also presented the respondents' experiences with e-learning and their participation in online classes while searching for information on the Internet. Mailizar et al.'s (2022) findings revealed that digital literacy and social presence significantly affected teachers' acceptance of online professional development. Yoshija (2024) revealed that AI literacy is identified as crucial, encompassing an understanding of AI technologies and their broader societal impacts.

Prompt engineering is highlighted as a key skill for eliciting specific responses from AI systems, thereby enriching educational experiences, and promoting critical thinking. Ng et al.'s (2023) study on teachers' AI digital competencies and 21st-century skills in the post-pandemic world revealed that many teachers are bereft of the skills required for effective assessment. The review of the literature has shown that extensive work has been done on digital literacy in relation to online teaching and the skills required for teachers to function well in this landscape. However, these studies, as rich as they appeared in the literature, have not focused on how these online competencies can facilitate the sustainability of assessment in the era of AI. Similarly, the studies examined have not looked at the perspective of measures acting as mediator variables in the nexus between curriculum design and sustainable AI-driven assessment. It will, therefore, be imperative to examine this nexus so as to develop appropriate interventions that can also facilitate policymaking in educational technology.

Studies on computer self-efficacy

The concept of self-efficacy stems from the works of Albert Bandura (1977), and it is used to describe a belief in one's ability to perform a particular task. Though a multi-dimensional construct, it is conceptualized here as the ability to handle tasks that are computer-related. Definitions of self-efficacy have centred on an individual's conscious conviction and confidence in his or her abilities to perform a particular task (Lunenburg, 2011; Hong et al., 2012; Su & Duo, 2012) and specifically defined situations. This judgement influences people's decisions, goals, the amount of effort expended in conducting a task, and the length of time they would persevere through obstacles and difficulties (Sam et al., 2005). The concept of computer self-efficacy has been extensively studied in the literature (Esfijani & Zamani, 2020; Graham et al., 2020). The study by Zhao et al. (2021) reported that individuals with strong computer self-efficacy show resilience during adversity.

Mailizar et al.'s (2022) study found that computer self-efficacy and social presence are two factors that predict online engagement among teachers. Nurhikmah et al. (2023) study found that students with high self-efficacy in computer skills improve better on blended learning than students with other students in higher education. Mariefe's (2022) study also found that teachers' computer self-efficacy is associated with their teaching performance in online courses. Other studies have also found that computer self-efficacy is a strong predictor of online programme sustainability and learning outcomes (Idris, 2015; Müller & Mildemberger, 2021; Zhao et al., 2021). Interestingly, these studies were mostly in relation to online learning and performance. These

variables have not been used as mediators in other studies or in the context in which they are used in this study. It is imperative, given the fact that AI is a new technology that most teachers and students may not be fully integrated into, probably due to diverse factors. The researchers are presuming that computer self-efficacy, which is more or less the ability to believe in oneself to operate the computer, may constitute a factor in the attempt to achieve sustainable AI-driven assessment. Thus, the reason for this research is to cover this gap.

Conceptual framework and hypothesis development

The researcher's framework is that sustainable AI-driven assessment is a product of not just one related factor but a set of connections with different measures that may help to achieve that objective. In this study, curriculum design, which is conceptualized in three dimensions: curriculum quality (CQ), curriculum viability (CV), and curriculum innovation (CI), are essential drivers of this phenomenon. However, other factors too could mediate this relationship, and this accounts for why digital literacy (DL) and computer self-efficacy (CE) are considered mediators to the nexus between curriculum design and sustainable AI-driven assessments (SAA). The conceptual idea is shown in Figure 1.

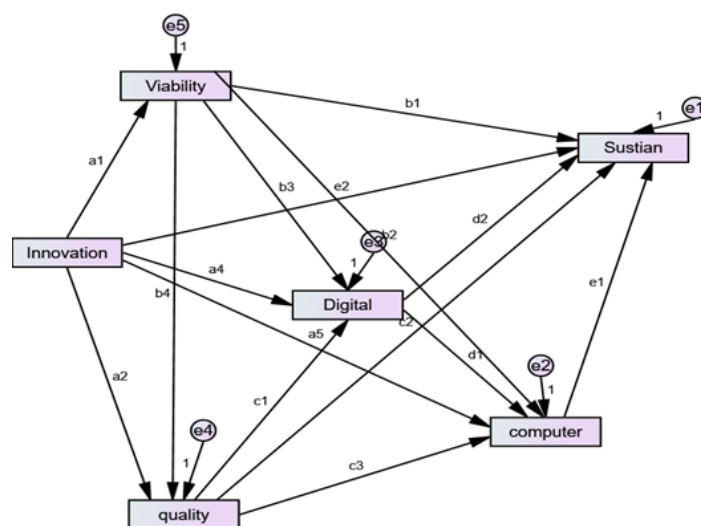


Figure 1. Conceptual framework of the linkage between curriculum design factors and sustainable AI driven assessment through computer self-efficacy and digital literacy.

Methodology

The study is a cross-sectional one since it involves a large pool of respondents that will provide information concerning the phenomenon of interest at the same time. The participants in the study are 149 higher education administrators (23 faculty deans and 126 HODs) and 1458 academic staff in the Faculty of Education across five public universities. The selection of the respondents is because these individuals are vested with the administrative position of the institutions and are knowledgeable of the type of curriculum that is engaged in teaching and learning in schools. The researchers do not consider the sampling of these units of information to collect holistic information that can influence policymaking.

Thus, a total of 1607 participants were engaged in the study.

Measures and instruments

The study involved six measures, which were three independent variables (curriculum quality, curriculum viability, and curriculum innovation) and two mediating variables (digital literacy and computer self-efficacy), while the dependent variable was sustainable AI-driven assessment. Curriculum viability refers to the effectiveness and sustainability of an educational curriculum that ensures that its content meets the needs of the learner in terms of engagement and the flexibility to adapt to diverse learning styles and evolving educational priorities. Curriculum quality refers to the standard with which the content, experiences, and designs align to stimulate students' engagement, deep understanding, and meaningfulness in achieving any objective. Curriculum innovation involves the development and implementation of new approaches, methods, or content within educational curricula to enhance learning outcomes, adapt to changing educational needs, and prepare students for the challenges of the future. Computer self-efficacy is the belief in oneself to handle computers and other related technologies effectively to complete a task. Digital literacy "refers to the ability to find, evaluate, use, and create digital information effectively, efficiently, and ethically in a digital environment. Sustainable AI-driven classroom assessment refers to the integration of artificial intelligence (AI) technology in educational assessment practices in a manner that is enduring, equitable, and beneficial for students, educators, and the learning environment.

A questionnaire that was structured by the researchers after an extensive review of the literature was used for data collection. The instrument was made up of three parts. Part A was designed to collect demographic data from the respondents. Part B, labelled "Curriculum design, computer self-efficacy, and digital literacy (CDCSDL)", was divided into five sections according to the number of sub-variables that made up the independent and mediating variables. Each of the variables was measured with five items on a four-point Likert scale of strongly agree to strongly disagree. The items were developed because of the unavailability of existing scales that would appeal to the context of the study. Sample items of curriculum viability include: "The current curriculum is relevant to the needs of the educational system". Similarly, for curriculum quality, a sample item includes: "Instructional materials and resources are relevant for the achievement of current educational needs". For curriculum innovation, the sample item includes "The current curriculum integrates emerging technologies to enhance learning experiences". More so, items for computer self-efficacy have a sample item as "I feel confident in my ability to use computer hardware and applications", while for digital literacy, a sample item includes, "I understand how to protect my data from external attacks while using digital technologies". Part 3 of the instrument labelled "sustainable artificial intelligence-driven classroom assessment (SADCA)" deals with the measurement of sustainable AI-driven assessment using ten items that were also measured on a four-point Likert-type scale. A sample item for the scale includes "The implementation of AI-driven assessment aligns with long-

term educational goals and priorities".

Validation of the instrument

The first validation of the instrument was done using three experts in curriculum and instruction and two psychometricians to assess the draft of the instrument for content validity. The assessment was based on three criteria which were clarity, suitability, and precision. The universal agreement for the scale content validity index (S-CVI) is 0.96, while the item content validity index (I-CVI) ranges from 0.89 to 0.99 based on the average ratio procedure. Thus, from the expert's assessment and quantitative analysis performed, the S-CVI for the scale was 0.97, while the I-CVI was 0.86–0.98. These values, as obtained, were within the range acceptable to experts (Zamanzadeh et al., 2015). However, some items were deleted following the recommendation of the experts, as they were adjudged to be irrelevant and unclear. Thus, the initial scale of 35 items was reduced to 33 because of the two items that were removed from the scale.

A pilot study was then carried out using a total of 200 lecturers from the computer department and curriculum and instructions from non-participating universities. Since there are 33 items in the instrument, a pilot study of 200 respondents was considered appropriate since the ratio of 1 item to 5 respondents could, according to the golden rule, be seen as adequate (Boateng et al., 2018). The responses of the respondents were used for dimensionality, factor structure checks, and convergent and divergent validities using exploratory and confirmatory factor analysis.

Ethical consideration and data collection

The study was conducted as a survey research that ordinarily meant no harm to the participants. According to the Federal Ministry of Health (2007), ethical clearance can be waived in such studies. However, the researchers, in line with best global practices, ensured that participants provided their consent before the data was collected. The researchers first explained the purpose of the study to the participants and what the data they were providing would be used for. This was to ensure that the participants had knowledge of what the study sought to achieve. Thus, there was no space for name, phone number, or email to anonymize the participants. Similarly, the instruments that were provided and responded to were locked in fireproof closets that only the lead researcher could have access to. Finally, the respondents were informed that their information would be used for publication in reputable journals. Hence, after seeking their consent and interacting with the participants, only 192 participants provided consent for this study. The copies of the questionnaire were distributed to the participants who provided consent. They were allowed to read the questions one by one to make objective responses. After that, all the answers were retrieved from the respondents and arranged for data analysis.

Results

Preliminary analysis

The preliminary analysis of the results was focused on the dimensionality, factor structure, and reliability of the study. This was done in two phases. First, the exploratory factor analysis was carried out using principal component analysis (PCA) with varimax rotation as an option. The results, as presented in Table 1, showed that for automated classroom assessment, a KMO value of 0.811 was obtained with Bartlett's test of sphericity, producing a result of $\chi^2(167) = 2321.11$, $p < .001$, which is an indication that the sample size was adequate for exploratory factor analysis to be carried out. A further inspection showed that eight items in all were deleted due to cross-loading or factor loading less than 0.5 (Costello & Osborne, 2005; Hair et al., 2019). The total variance explained for the six variables of the study was 75.55%, with sustainable AI-driven assessment contributing 22.44%, curriculum viability contributing 15.12%, curriculum quality contributing 13.67%, curriculum innovation contributing 10.77%, computer self-efficacy contributing 8.55%, and digital literacy contributing 6.00%. The reliability of each measure was established using Cronbach's alpha, and the result in Table 2 further proved that there was internal consistency in the scale.

Convergent and discriminant validity

To assess the convergent and discriminant validity of the measures, the Fornell-Larcker criterion, which uses the average variance extracted (AVE) per factor, was used (Fornell & Larcker, 1981). The basic line is that if the AVE of a factor is greater than 0.50, then convergent validity is achieved (see Eriksson et al., 2019; Lee et al., 2019). For the independent, mediating, and dependent factors, the AVE value was greater than 0.50, which is an indication that the items retained in these factors are theoretically related to their latent factors. However, Table 2 shows that the discriminant validity of the six subscales of the instruments was also based on the Fornell-Larcker criterion. According to this criterion, the subscale is diverse theoretically if the square root of the AVE for each factor is greater than their correlation with other factors (Ab Hamid et al., 2017; Hilkenmeier et al., 2020). Thus, as shown in Table 2, the bolded values in the principal diagonal of the six latent factors are greater than their correlation with other factors. Therefore, the factors are theoretically different in measuring automated assessment in the presence of technological acceptance vectors.

Confirmatory factor analysis

The confirmatory factor analysis was carried out using maximum likelihood estimation statistics. As could be seen in Table 1, Figures 2, and 3, there were not many disparities between the factor's loadings of items in the EFA and CFA. This indicates that the dimensionalities obtained and the factor loadings from the EFA are valid measures of the constructs, and the instrument is psychometrically sound. The fit indices of the confirmatory factor analysis were examined. Each of the fit indices has its strengths and

Table 1. Exploratory factor analysis.

Items	N	M	Error	SD	Skew	Kurt	λ	CFA	λ^2
CV1	250	2.17	.010	.52	2.49	2.93	0.88	0.78	.79
CV3	250	2.21	.010	.54	2.513	1.98	0.79	0.75	.63
CV4	250	2.21	.010	.53	2.437	2.79	0.80	0.78	.64
Curriculum Viability	250	8.72	.03	1.67	2.367	.38	2.48	2.32	2.06
CQ1	250	3.12	.013	.70	-3.58	-.35	.81	.79	.66
CQ3	250	3.15	.012	.63	-.206	-.27	.77	.70	.60
CQ4	250	3.05	.01	.70	-.131	-.84	.77	.73	.54
CQ5	250	3.04	.01	.64	-.040	-.61	.88	.88	.77
Curriculum Quality	250	15.49	.05	2.97	.174	-.61	3.26	3.12	2.58
CI2	250	2.93	.00	.37	-2.63	1.89	.80	.76	.64
CI3	250	2.89	.00	.49	-1.87	.06	.99	.96	.99
CI4	250	2.78	.01	.52	-.444	.40	.67	.59	.45
CI5	250	2.89	.00	.49	-1.87	1.06	.74	.69	.55
Curriculum Innovation	250	11.56	.03	1.62	-1.81	1.04	3.21	3.01	2.64
CSE2	250	2.37	.01	.65	1.48	.88	.789	.65	.62
CSE3	250	2.43	.013	.72	1.34	.23	.788	.73	.62
CSE4	250	2.24	.000	.49	1.88	.74	.670	.58	.44
CSE5	250	2.14	.00751	.39	2.59	1.29	.543	.43	.29
Computer self-efficacy	250	11.36	.04057	2.11	1.13	-.29	2.790	2.397	1.98
DL1	250	2.29	.00	.45	.91	-1.16	.699	.612	.48
DL2	250	2.66	.013	.72	.60	-.892	.612	.570	.37
DL3	250	2.84	.01	.83	.30	-1.49	.902	.863	.81
DL4	250	2.45	.01	.59	.90	-.172	.700	.620	.50
Digital literacy	250	12.56	.04	2.30	.12	-1.43	2.91	2.66	2.17
SAA1	250	2.77	.01	.89	-.22	-.747	.645	.535	.41
SAA3	250	2.53	.01	.85	-.01	-.62	.59	.524	.35
SAA4	250	2.76	.01	.86	-.23	-.62	.89	.80	.80
SAA5	250	2.58	.01	.92	-.07	-.85	.75	.63	.57
SAA6	250	2.57	.01	.90	-.04	-.77	.620	.51	.38
SAA8	250	2.53	.01	.91	-.04	-.81	.68	.52	.47
Sustainable AI assessment	250	20.94	.083	4.37	.210	1.73	4.20	3.53	3.0

Table 2. Convergent and discriminant validity (Fornell-Larcker criterion).

Constructs	AVE	α	1	2	3	4	5	6
Sustainable AI assessment	.502	.778	0.708					
Curriculum viability	.689	.702	0.213	0.830				
Curriculum quality	.602	.822	0.122	.233	0.775			
Curriculum innovation	.647	.712	.321	.102	.292	0.804		
Computer self-efficacy	.500	.734	0.321	.432	.412	-.132	0.707	
Digital literacy	.545	.774	0.211	.132	.102	.132	.432	0.738

Note: The bolded values are discriminant validity values obtained using the Fornell-Larcker criterion. AVE=average variance extracted, α =Cronbach's alpha reliability.

weaknesses. Therefore, it is not advisable that only one fit index be reported. According to Kline (2016), four fit indices such as χ^2 (Chi-Square), RMSEA (Root Mean Square Error of Approximation), "Comparative Fit Index" (CFI), and SRMR can be appropriate to decide whether to accept a CFA model. However, in this study, eight fit indices were reported, which include "Goodness-of-Fit Index" (GFI), "Normed Fit Index" (NFI), "Relative Fit Index" (RFI), "Comparative Fit Index" (CFI), HOELTER's Critical N, "Incremental Fit Index" (IFI), "Root Mean Square Error of Approximation" (RMSEA), and "Tucker-Lewis Index" (TLI). However, the RMSEA is the best measure and is often used as a condition for accepting the model. The results presented in Table 3 and Figure 2 showed that the indices are within the range of values that are used in determining the acceptability of the model and that the models are fit.

Table 3. Goodness-of-fit test of the two CFA models.

S/N	Fit indices	Threshold	CDCSDLs	SADCA
1	χ^2	$p > .05$	.121	.154
2	AGFI	$p \geq .90$	.911	.922
3	NFI	$p \geq .90$	.954	.915
4	CFI	$p \geq .90$	.933	.967
5	GFI	$p \geq .90$	.901	.943
6	TLI	$p \geq .90$	.990	.956
7	IFI	$p \geq .90$	.966	.948
8	RMSEA	$p \geq .08$	.043	.010

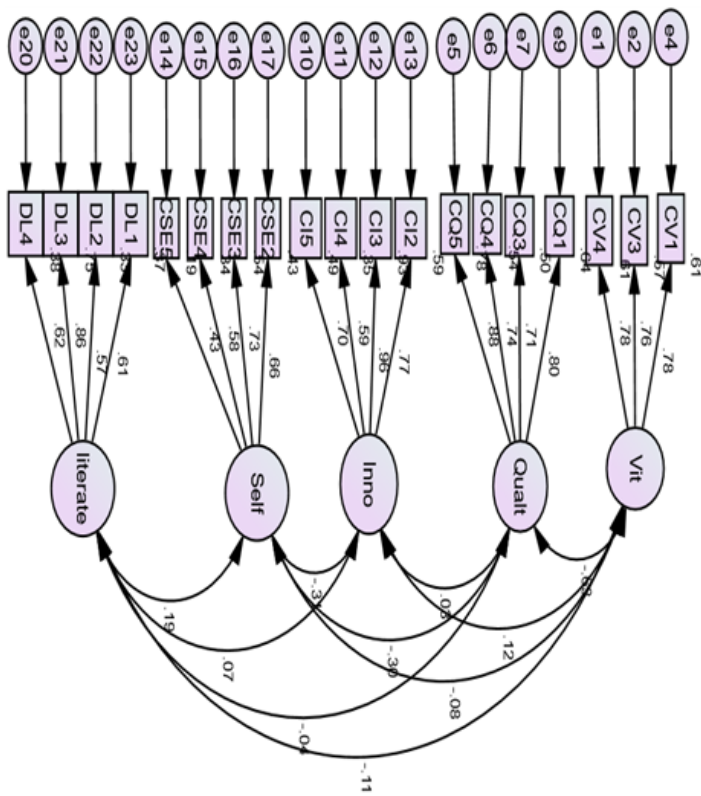


Figure 2. CFA of curriculum viability, quality, innovation, computer self-efficacy, and digital literacy.

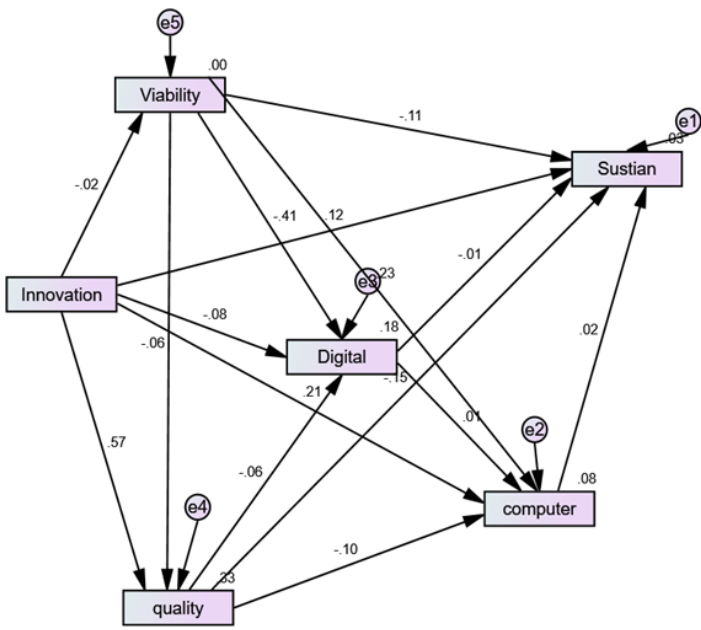


Figure 4. Structural equation of the nexus between the variables.

Hypothesis One states that curriculum innovation does not contribute directly to curriculum viability, curriculum quality, computer self-efficacy, digital literacy, and sustainable AI-driven assessment results. This is presented in Table 4. The results presented in Table 4 and Figure 4 revealed that for INN-> VIA ($\beta = -0.18$, 95% CI [-0.5, -0.1], $t = -0.82$, $p > .05$), for INN-> QUA ($\beta = 0.568$, 95% CI [0.53, 0.60], $t = 37.86$, $p < 0.001$), for INN-> COMP ($\beta = 0.211$, 95% CI [-0.16, 0.25], $t = 10.55$, $p < 0.001$), for INN-> DIGIT ($\beta = -0.18$, 95% CI [-0.11, -0.05], $t = -0.90$, $p > 0.05$) and for INN-> SUSTAIN ($\beta = 3.07$, 95% CI [-0.07, 0.15], $t = 3.07$, $p < 0.001$). This finding

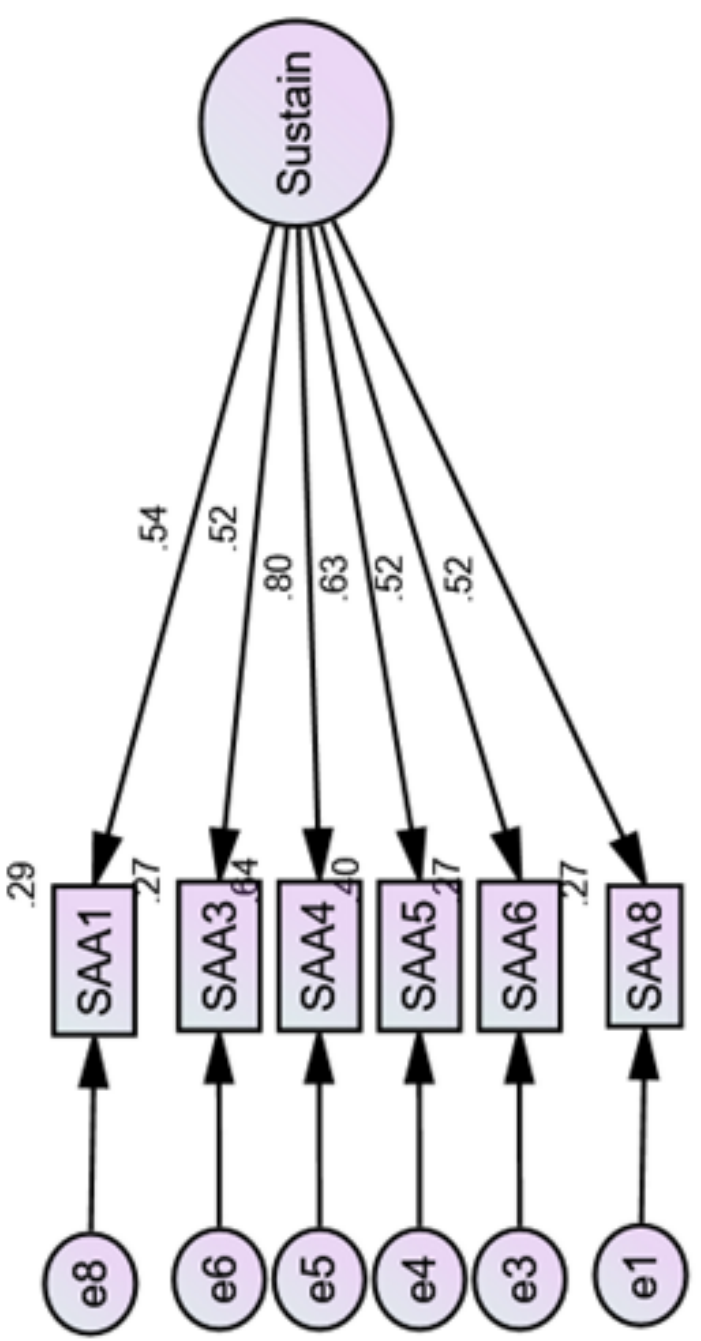


Figure 3. CFA of sustainable AI-driven classroom assessment.

implies that curriculum innovation has a direct effect on curriculum viability, curriculum quality, and sustainable AI-driven assessment. However, the effect was not significant for curriculum innovation and digital literacy.

Hypothesis Two states that curriculum viability does not contribute directly to curriculum quality, digital literacy, computer self-efficacy, and sustainable AI-driven assessment results. This is presented in Table 5. The results presented in Table 5 and Figure 4 revealed that for VIA -> QUA ($\beta = -0.59$, 95% CI [-0.8, -0.3], $t = -4.53$, $p < 0.001$), for VIA -> DIGIT ($\beta = -0.064$, 95% CI [-0.43, -0.06], $t = -4.57$, $p < .001$), for VIA -> COMP ($\beta = 0.235$, 95% CI [0.21, 0.26], $t = 14.68$, $p < 0.001$), and for VIA -> SUSTAIN ($\beta = -0.113$, 95% CI [-0.08, -0.11], $t = -3.77$, $p < 0.001$). This finding implies that curriculum viability has a direct effect on curriculum quality, digital literacy, computer efficacy, and sustainable AI-driven assessment. Thus, the null hypothesis is rejected.

Table 4. Direct effect of curriculum innovation on curriculum viability, curriculum quality, digital literacy, computer self-efficacy and sustainable AI-driven classroom assessment.

Linkages	M	β	95%CI	SD	t-cal	p-val	Remarks
INN-> VIA	-.018	-.018	-.05, .01	.022	-0.82	.342	Not significant
INN-> QUA	.568	.568	.53, .60	.015	37.86	.000	significant
INN-> COMP	.211	.211	-.16, .25	.020	10.55	.000	Significant
INN-> DIGIT	-.018	-.018	.11, .05	.020	-0.90	.000	Significant
INN-> SUSTAIN	.117	.117	.07, .15	.038	3.07	.000	Significant

INN=Curriculum innovation, VIA=Curriculum viability, QUA=Curriculum quality, DIGIT=Digital literacy, COMP=Computer self-efficacy, SUSTAIN=Sustainable AI-driven classroom assessment, M=Mean, SD=Standard deviation, CI=Confidence interval

Table 5. Direct effect of curriculum quality on digital literacy, computer self-efficacy and sustainable AI-driven classroom assessment.

Linkages	M	β	95%CI	SD	t-cal	p-val	Remarks
VIA -> QUA	-.059	-.059	-.08, -.03	.013	-4.53	.000	Significant
VIA -> DIGIT	-.064	-.064	-.43, -.39	.014	-4.57	.000	Significant
VIA -> COMP	.235	.235	.21, .26	.016	14.68	.000	Significant
VIA -> SUSTAIN	-.113	-.113	-.08, -.11	.030	-3.77	.000	Significant

VIA=Curriculum viability, QUA=Curriculum quality, DIGIT=Digital literacy, COMP=Computer self-efficacy, SUSTAIN=Sustainable AI-driven classroom assessment, M=Mean, SD=Standard deviation, CI=Confidence interval

Hypothesis Three states that curriculum quality does not contribute directly to digital literacy, computer self-efficacy, and sustainable AI-driven assessment results, as presented in Table 6. The results presented in Table 6 and Figure 4 revealed that for QUA -> DIGIT ($\beta = -0.064$, 95% CI [-0.09, -0.03], $t = -3.04$, $p < 0.001$), for QUA -> COMP ($\beta = -0.098$, 95% CI [-0.14, -0.06], $t = -4.67$, $p < .001$), and for QUA -> SUSTAIN ($\beta = 0.025$, 95% CI [-0.01, -0.03], $t = 0.62$, $p > .05$). This finding implies that curriculum quality has a direct effect on digital literacy and computer efficacy but is not significant in its relationship with sustainable AI-driven assessment. Thus, the null hypothesis is rejected for curriculum quality on digital literacy and computer efficacy but retained for sustainable AI-driven assessment.

Table 6. Direct effect of curriculum quality on digital literacy, computer self-efficacy and sustainable AI-driven classroom assessment.

Linkages	M	β	95%CI	SD	t-cal	p-val	Remarks
QUA -> DIGIT	-.064	-.064	-.09, -.03	.021	-3.04	.001	significant
QUA -> COMP	-.098	-.098	-.14, -.06	.021	-4.67	.000	Significant
QUA -> SUSTAIN	.025	.025	.01, .03	.040	0.62	.321	Not Significant

QUA=Curriculum quality, DIGIT=Digital literacy, COMP=Computer self-efficacy, SUSTAIN=Sustainable AI-driven classroom assessment, M=Mean, SD=Standard deviation, CI=Confidence interval

Hypothesis Four, which states that computer self-efficacy and digital literacy do not mediate the nexus between curriculum innovation, curriculum quality, and curriculum viability, is presented in Table 7. The result in table 7 revealed that for INN -> VIA->SUSTAIN($\beta = 0.003$, 95% CI [0.00, 0.00], $t = 3.00$, $p < 0.05$), INN -> DIGIT->SUSTAIN($\beta = -0.027$, 95% CI [-0.04, 0.01], $t = 2.45$, $p < 0.05$), for INN -> COMP->SUSTAIN($\beta = -0.055$, 95% CI [-0.08, -0.03], $t = 3.93$, $p < 0.001$). This implies that curriculum viability, digital literacy, and computer self-efficacy significantly mediate the nexus between curriculum innovation and sustainable AI-driven classroom assessment. The result also showed that for VIA -> DIGIT -> SUSTAIN ($\beta = 0.003$, 95% CI [-0.00, 0.01], $t = 3.00$, $p < 0.05$) and for VIA -> COMP -> SUSTAIN ($\beta = 0.000$, 95% CI [-0.01, 0.01], $t = 0.00$, $p > .05$). Thus, only computer self-efficacy mediates the nexus between curriculum quality and sustainable AI-driven classroom assessment, but digital literacy does not. For

QUA->DIGIT->SUSTAIN ($\beta = -0.001$, 95% CI [-0.00, 0.00], $t = -0.01$, $p > .05$) and for QUA->COMP -> SUSTAIN ($\beta = -0.004$, 95% CI [-0.00, 0.00], $t = -1.0$, $p > 0.05$). This implies that digital literacy and computer self-efficacy do not significantly mediate the relationship between curriculum quality and sustainable AI-driven classroom assessment.

Table 7. Indirect effect of digital literacy and computer self-efficacy on the nexus between curriculum variables and sustainable AI-driven classroom assessment.

Linkages	M	β	95%CI	SD	t-cal	p-val	Remarks
INN -> VIA -> SUSTAIN	.003	.003	.00, .00	.001	3.00	.003	Significant
INN -> DIGIT -> SUSTAIN	-.027	-.027	-.04, .01	.011	2.45	.021	Significant
INN -> COMP -> SUSTAIN	-.055	-.055	-.08, -.03	.014	3.93	.000	Significant
VIA -> DIGIT -> SUSTAIN	.003	.003	-.00, .01	.001	3.00	.003	Significant
VIA -> COMP -> SUSTAIN	.000	.000	-.01, .01	.006	0.00	.983	Not significant
QUA -> DIGIT -> SUSTAIN	-.001	-.001	-.00, .00	.000	-0.01	.452	Not significant
QUA -> COMP -> SUSTAIN	-.004	-.004	-.00, .00	.004	-1.00	.381	Not significant

INN=Curriculum innovation, VIA=Curriculum viability, QUA=Curriculum quality, DIGIT=Digital literacy, COMP=Computer self-efficacy, SUSTAIN=Sustainable AI-driven classroom assessment, M=Mean, SD=Standard deviation, CI=Confidence interval

Discussion of findings

The findings that curriculum innovation has a direct effect on curriculum viability and curriculum quality show the important role that innovation plays in educational landscapes. The rationale for this could be that curriculum innovation brings in new ideas and programmes that are adaptable to the needs of earners and the demands of society. Thus, where innovation, such as the use of AI in teaching and learning, is introduced, it ensures relevance and responsiveness to the changes that are occurring in society. The findings align with previous studies by researchers that have emphasized the need for a flexible curriculum that will adapt to new changes and dynamics so as to enhance viability in keeping with contemporary needs and advancements (Khan, 2021). Similarly, curriculum innovation may also impact curriculum quality because quality in the educational system is characterized by relevance and effectiveness. Where innovations that meet the demands of the learner and society, such as artificial intelligence, are integrated into the curriculum, it will enrich the experiences of the learners and promote critical thinking that will foster deeper knowledge of practices that are essential to educational development. This also aligns with the studies of Kopcha et al. (2020), who noted that schools that are innovative in their curriculum practices do not just facilitate improvement in the quality of experiences but also bring about improvement in students' academic achievement.

The findings that curriculum innovation impacts digital literacy and computer self-efficacy directly could also highlight the pivotal role of innovative practices in influencing students' acceptance of technology in learning. This could be a result when curriculum innovations that integrate technology as a vital component of students' learning expose them to experiences with digital tools. This aligns with the social learning theory of Bandura and the National Institute of Mental Health (1986), which posits that individuals' beliefs in their capabilities influence their behaviours and achievements. Thus, curriculum innovation can instil the confidence and capabilities required to handle issues with computers that may be required in all forms of assessment in both teachers and students. The findings concur with those of Martinez-Bravo et al. (2020), who highlight that curriculum innovation in digital literacy could

also arise due to the fact that integrating artificial intelligence with its diverse tools may help in acquiring digital skills required for assessment. This not only enhances students' digital competence but also prepares them for success in an increasingly digital world.

The findings that curriculum innovation has a direct effect on sustainable AI-driven classroom assessment could be a product of the fact that curriculum innovation involves the adoption of new teaching strategies, facilities, and assessment techniques that align with educational objectives and meet the needs of the teacher and students. Thus, when AI-driven tools are incorporated into the curriculum, teachers and students can leverage this to ensure that timely feedback, automated scoring, and assessment planning are carried out that satisfy both the teacher and students. AI-powered assessment systems have the capability to analyse vast amounts of data, identify patterns in student performance, and offer adaptive feedback tailored to individual learning needs. Research by Lunenburg (2011) highlights the potential of AI to enhance assessment practices by promoting fairness, accuracy, and objectivity. Similarly, AI-driven assessment has the intricate capacity to promote equity, mitigate biases, and promote inclusivity. Hong et al. (2012) noted that AI when integrated into the curriculum, could be a driving force to ensure that all forms of practices that promote inequality and insecurity in the data collected are eliminated to ensure the sustainability and efficacy of assessment practices in the classroom.

The findings that curriculum viability has a direct effect on curriculum digital literacy, computer self-efficacy, and sustainable AI-driven classroom assessments underscore the interconnectedness of various digital components that can affect learning. For example, when there is a viable curriculum that is relevant and effective in meeting the needs of the learner and society and has the ability to adapt to changes in the environment, emerging technologies, and evolving learning objectives, it serves as a foundation for delivering high-quality learning and promotes deeper learning experiences. Similarly, curriculum viability directly affects digital literacy because it embraces technological experiences that allow students to develop new skills and techniques that help them access and evaluate digital information effectively. More so, curriculum viability affects computer self-efficacy because the integration of technology practices into the curriculum provides methods and instructional practices that help students develop the beliefs and skills that give them the competence to handle software and hardware matters, which can foster how assessment is planned and executed to align with environmental best practices. The findings align with those of Eastin and LaRose (2000), who noted that exposure to technology-rich learning helps students develop self-efficacy beliefs. Finally, the findings also showed that curriculum viability influences sustainable AI-driven classroom assessment. This is because sustainable AI assessment has the capacity to ensure that assessment maintains fairness, equity, and inclusivity. Research by Jivet et al. (2017) underscores the role of curriculum innovation in facilitating the integration of AI-driven assessment tools into educational settings, ensuring their effectiveness and longevity.

The result of the analysis showed that curriculum viability mediates the nexus of curriculum innovation and sustainable AI-driven classroom assessment. The rationale could be that curriculum viability stimulates viability, adaptability, and functionality that strive to meet the needs of the evolving society and learner. The viability of the curriculum, which could result from the innovative practices that are incorporated into the curriculum, helps ensure an environment conducive to adopting practices that will foster equity, fairness, and inclusivity. This outcome is in line with previous studies that have found that curriculum innovation and viability are essential in ensuring that assessments carried out in the era of AI meet global ethical and environmental standards (Alexander & Flutter, 2009; Haug, 2003). Secondly, computer self-efficacy and digital literacy mediate the nexus between curriculum innovation and sustainable AI-driven assessment. This is because, where the curriculum integrates elements of digital literacy and elements of ICT that will build the self-beliefs of the teacher and students in handling the facilities around them, assessment activities using AI tools will be done to leverage technology for learning and evaluation purposes.

The findings that literacy mediates the link between curriculum viability and sustainable AI-driven classroom assessment suggest that students' proficiency in utilizing digital tools and resources plays a pivotal role in facilitating the integration of innovative assessment practices. However, the lack of mediation by computer self-efficacy indicates that students' confidence in their computer skills may not directly influence the relationship between curriculum viability and sustainable AI-driven assessment. Research by Niederhauser et al. (2018) underscores the significance of digital literacy in preparing students for success in the digital age. Therefore, it is logical to posit that digital literacy acts as a mediator in facilitating the adoption and implementation of sustainable AI-driven assessment practices by enhancing students' capacity to navigate digital learning environments and utilize technological tools effectively. On the other hand, computer self-efficacy does not mediate this nexus. This could be a result of the fact that the skills they possess may not act as a mediator between innovation in curriculum and sustainable AI-driven assessment. The absence of computer self-efficacy could be because there may be other factors that may serve very well in this linkage, like digital literacy, as already discussed (Eastin & LaRose, 2000).

Finally, the outcome of the study revealed that digital literacy and computer self-efficacy are not significant mediators between curriculum quality and sustainable AI-driven classroom assessment. This, according to Chiu and Chai (2020), suggests that while these two mediators are important in the information and communication technology world, they may not be too relevant in facilitating this nexus; rather, other factors may play a more significant role in the relationship between curriculum quality and sustainable AI-driven assessment. One important reason could be that AI tools are so complex that even those with digital skills may not be able to navigate them appropriately. Other factors, such as institutional support, training, and the perceived usefulness of these tools, may influence these linkages. More so, the curriculum quality in intricate dimensions may possess elements that can affect the sustainability of AI

Limitations/suggestions for further studies

The findings, like any other study, have some limitations. First, the study was a cross-sectional study that involved a sample providing information that may be biased. Longitudinal or experimental designs could provide stronger evidence for understanding the dynamics between curriculum quality, digital literacy, computer self-efficacy, and sustainable AI-driven assessment over time. Secondly, the use of these two mediators may not capture other potential mediators that could influence this relationship between curriculum quality and sustainable AI classroom assessment. The quality of the assessment tools may affect the outcome of the study as well. It is expedient that other studies re-establish the quality of this instrument that was developed by the researchers to determine its reliability and validity. The study sample may not be adequate to facilitate the generalization of the findings. A larger sample involving stakeholders could also be used for further studies in the future.

Conclusion/implications

The study's findings revealed that curriculum innovation directly affects curriculum viability, quality, digital literacy, computer self-efficacy, and sustainable AI-driven classroom assessment, while curriculum quality and viability also affect digital literacy, self-efficacy, and sustainable AI-driven classroom assessment. The mediation of digital literacy and computer self-efficacy in the nexus between curriculum innovation and sustainable AI-driven classroom assessment was significant, but these mediators were not significant in the nexus between curriculum quality and sustainable AI-driven classroom assessment. The study underscores the pivotal role of curriculum innovation and viability in shaping innovative assessment methods driven by AI. Thus, when educators and policymakers use AI, they should prioritize developing and implementing high-quality curricula that align with the needs of 21st-century learners and promote the effective use of technology in inclusive education that maintains a high level of equity and fairness. Similarly, while digital literacy and computer efficacy mediate the relationship between curriculum innovation and sustainable AI-driven classroom assessment, integrating AI into the curriculum requires that teachers and students be trained in ICT skills that will help them evaluate the quality of digital information they are exposed to. The curriculum that is developed in school should ensure that assessments that are practiced with AI mitigate all forms of bias, inequality, and data insecurity.

Data availability statement

This will be made available on reasonable request.

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Examining Google Gemini's acceptance and usage in higher education

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Keywords

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Saudi Arabia;
study discipline;
technology use;
UTAUT.

Abstract

Due to the growing use of chatbots such as ChatGPT and Google Gemini in educational contexts, there is an increasing interest in exploring the perception of students accepting and using Gemini as a unique and effective platform in their educational activities. This research examines the perceptions of Saudi Arabian higher education students towards accepting and using Gemini for academic purposes. Drawing upon the Unified Theory of Acceptance and Use of Technology (UTAUT), a self-administered questionnaire was used; 400 forms were completed and validated for analysis from seven public universities in Saudi Arabia. Structural Equation Modeling (SEM) using SmartPLS was adopted to examine the research hypotheses. The major findings agree with UTAUT and prior studies to some extent in terms of the positive influence of performance expectancy (PE), effort expectancy (EE), and social influence (SI) on students' intention to utilize Gemini, as well as the influence only of PE on the actual use of Gemini. However, the findings differ from previous research regarding the influence of facilitating conditions (FC) on students' intention to utilize Gemini; the results were significant but negative. In addition, EE, SI, and FC did not directly affect the actual use of Gemini. These results were due to the lack of valid resources, assistance, and guidance from educational authorities and external sources about the ideal use of Gemini. Furthermore, the findings exposed that BI partially mediates the connection between PE and Gemini's actual usage and fully mediates between EE and SI and Gemini's actual usage.

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Under the National Vision 2030 project, which strongly emphasizes technological integration, Saudi Arabia's educational system is experiencing radical change (Asem et al., 2024; Ismail et al., 2024). According to Perera and Lankathilake (2023), Google Gemini, a large language model to personalize instruction and supply on-demand information, offers exciting opportunities for revolutionary learning tools. Nevertheless, student acceptance and usage decisions are critical to the effectiveness of these technologies in their learning (Lee et al., 2023; Popenici et al., 2023; Popenici, 2023). In the context of higher education, Google Gemini, a state-of-the-art large language model (LLM), is a revolutionary force that affects teaching and learning (Lee et al., 2023; Perera & Lankathilake, 2023; Hasanein & Sobaih, 2023; Mardiansyah & Surya, 2024; Rudolph et al., 2024; Sobaih et al., 2024). Artificial Intelligence platforms like Google Gemini are multi-faceted in different contexts (Popenici, 2023; Metwally et al., 2024; Rane et al., 2024a). These facets in terms of educational context comprised simplicity of usage, ease of access to the platform, and rising students' academic performance (Rane et al., 2024b). A recent study by Latif and Zhai (2024) added other benefits of using AI for educational purposes, such as guiding students with their assignments, helping them comprehend critical subjects, and enhancing their mindsets by creating innovative ideas about specific topics. Moreover, AI applications can motivate students to overcome their language obstacles in terms of proofreading, grammar checking, listening as well as speaking skills (Perera & Lankathilake, 2023; Rudolph et al., 2023; Rane et al., 2024a; Carlà et al., 2024; Sevnarayan & Potter, 2024).

However, several studies have argued that using AI platforms for educational purposes does not have a specific validated framework by educational institutions for its efficient usage (Lee et al., 2023; Yeadon & Hardy, 2024). Due to the numerous features of using AI platforms, e.g., Gemini and ChatGPT, some questions remain unanswered regarding using these tools while maintaining long-term impacts (Sobaih, 2024; Mardiansyah & Surya, 2024). Recent studies (Lee et al., 2023; Mardiansyah & Surya, 2024; Sobaih, 2024) reported several issues regarding the use of AI platforms for educational purposes. One of these issues is the biased information by AI platforms, which mislead students with unverified information (Lee et al., 2023). Moreover, the complete reliance on AI platforms negatively affects students' mindsets and decreases their mind-mapping skills (Mardiansyah & Surya, 2024). In addition, generating texts for assignments or essays in a few seconds solely by AI platforms may negatively affect the quality of work and academic integrity (Sobaih, 2024).

This research study examines the perceptions of Saudi Arabian students' regarding the use of AI tools in higher education, particularly Gemini, in their educational activities. The study's theoretical framework has adopted the UTAUT to comprehend the key aspects that affect Saudi Arabian students' acceptance and usage of AI platforms, particularly Gemini, for educational purposes. Additionally, this study seeks to comprehend the role of behavioral intention (BI) in the relationship between students' acceptance of using

Gemini on their BI and its use in their education.

Literature review

Students' acceptance to use Google Gemini and BI

The UTAUT was utilized because it provides a comprehensive framework for the adoption and use of AI platforms in many contexts, particularly in education (Magsamen-Conrad et al., 2015; Venkatesh, 2022; Venkatesh et al., 2003). According to Venkatesh et al. (2003), there are four elements of the UTAUT framework: performance expectation (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC). In terms of PE, it was adopted to explore students' perception of using AI platforms e.g., using Gemini to enhance their academic performance (Brachten et al., 2021). As mentioned by numerous studies (e.g., Fagan et al., 2012; Kasilingam, 2020; Brachten et al., 2021; Al-Emran et al., 2023; Sevnarayan & Potter, 2024), students mainly rely on using AI in their challenging educational activities because of their beliefs that it may assist them in the critical activities as well as enhance their performance. With regard to EE, it indicates students' observations of how simple or difficult it is to utilize the technology. Students perceive AI platforms like Gemini to be intuitive, user-friendly, and effortlessly incorporated into daily activities, which improves their BI (Menon & Shilpa, 2023). Elements such as user interface design, overall user experience, and ease of interaction all influence students' impressions (Strzelecki, 2023; Al-Emran et al., 2023; Ashrafimoghari et al., 2024). Considering the fact that using AI platforms such as Gemini requires minimal effort, it increases the likelihood that students will incorporate it into their regular learning routines (Hasanein & Sobaih, 2023; Wang & Zhao, 2023; Chaka, 2024; Tian et al., 2024).

SI addresses how teachers and colleagues affect students' attitudes toward AI platforms, such as Gemini (Venkatesh et al., 2003; García-Peñalvo, 2024). This influence may be reflected in how students perceive others' attitudes, beliefs, and actions toward the use of Gemini in the classroom (Venkatesh, 2022). Empirical research (e.g., Menon & Shilpa, 2023) has shown that when peers use Gemini for learning, it has the ability to improve other students' BI performance. FC assesses the availability of resources necessary for efficient usage (Venkatesh et al., 2003). The FC component comprises technical mobility, access to appropriate instruction and tools, and broad incentive programs for integration (Strzelecki, 2023; Menon & Shilpa, 2023; Oye et al., 2014). Students' BI refers to their intention to utilize AI learning platforms, e.g., ChatGPT is highly impacted by their view that the learning environment provides the resources and help required for its successful implementation (Hasanein & Sobaih, 2023; Sevnarayan & Potter, 2024). A recent study by Al-Emran et al. (2023) deepens the emphasis of FC over technological facilities and improves students' ability to interact with technology by highlighting the necessity for a favourable environment that supports students' navigation in the effective usage of ChatGPT. Thus, we are prompted to develop the following hypotheses:

- H1: PE positively affect BI to use Google Gemini.
- H2: EE positively affect BI to use Google Gemini.
- H3: SI positively affect BI to use Google Gemini.
- H4: FC positively affect BI to use Google Gemini.

Students' acceptance to use Google Gemini and actual usage

A growing body of research (e.g., Al-Emran et al., 2023; Cheong et al., 2023; Asrif & Fatmi, 2024; García-Peñalvo, 2024; Ashrafimoghari et al., 2024; Sobaih et al., 2024) has examined the significance of PE (e.g., the chatbot for educational purposes, accessibility) and EE (e.g., clarity, and its compatibility with the particular requirements of the students) in predicting students' acceptance and utilization of chatbots in education, e.g., Google Gemini. According to Venkatesh (2022) and Terblanche and Kidd (2022), SI enhances the significance of behavioral intention in adopting technology. According to Chang and Park's study (2024), adopting AI chatbots, such as Google Gemini, can be strongly influenced by favorable social cues from peers in their social network who actively utilize the technology or encourage it. Furthermore, as recent research by Tian et al. (2024) demonstrated, students' decisions to use technology in their daily educational activities, such as integrating Google Gemini into their learning tasks, can be greatly influenced by recommendations, inspiration, or positive shared experiences of others. The significant influence of FC on adoption and actual usage is highlighted by earlier studies (Menon & Shilpa, 2023; Al-Emran et al., 2023; Chan & Zhou, 2023; Duong et al., 2023) evaluating Gemini's adaptability in education. In terms of the FC aspect, it contained all the infrastructure needed and assistance towards the effective use of AI platforms in an educational context (Menon & Shilpa, 2023). Therefore, we can hypothesize that:

- H5: PE positively affect Google Gemini Usage
- H6: EE positively affect Google Gemini Usage
- H7: SI positively affect Google Gemini Usage
- H8: FC positively affect Google Gemini Usage

Students' BI and actual use of Google Gemini

One of the most vital roles in comprehending the beneficial characteristics of using AI tools is to explore the relationship between students' behavioral intention to use AI platforms in educational themes (Terblanche & Kidd, 2022). Users' behavioral intention reflects their alignment toward accepting and using new innovative technology, e.g., AI platforms (Venkatesh et al., 2003). The positive behavioral intention towards students' usage of AI applications for educational purposes is considered a crucial motive for their actual usage in their daily educational tasks (Menon & Shilpa, 2023; Al-Emran et al., 2023; Duong et al., 2023; Anayat et al., 2023; Chaka, 2024). Recent studies argued that a strong positive correlation exists between students' BI and the actual use of AI in an educational context due to the

critical help needed to complete their educational activities (Chan & Zhou, 2023). Thus, drawing upon these insights, we are driven to construct this hypothesis:

- H9: BI positively affect Google Gemini Usage

The role of BI in the link between accepting and using Google Gemini

Despite the numerous studies (Yeadon & Hardy, 2024; García-Peñalvo, 2024; Sobaih et al., 2024; Tian et al., 2024; Carlà et al., 2024) that explored the crucial relationship between BI, students' accepting as well as using AI platforms e.g., Gemini in educational purposes, there is still limited research interest regarding the BI role in terms of the relationship between students' perception to accept and use Gemini in educational context. The current study tries to overcome the gap by applying the UTAUT model to postulate the following hypotheses:

- H10: BI mediates the connection between PE and Google Gemini Usage
- H11: BI mediates the connection between EE and Google Gemini Usage
- H12: BI mediates the connection between SI and Google Gemini Usage
- H13: BI mediates the connection between FC and Google Gemini Usage

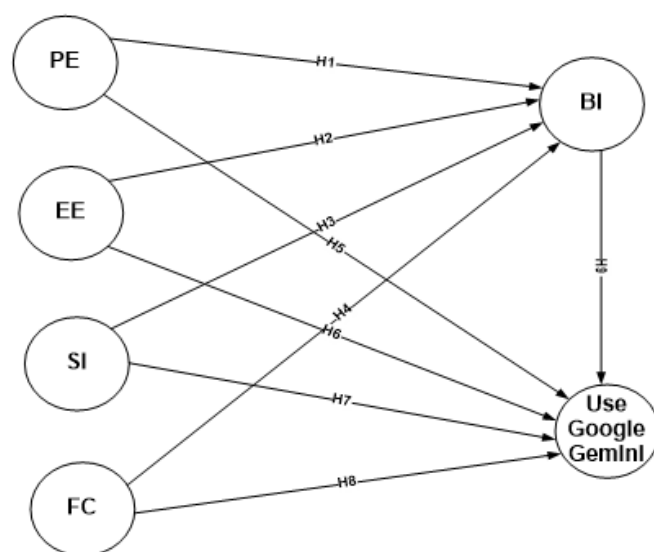


Figure 1. The conceptual model.

Methods

Participants

The population for this research is all the undergraduate college students within Saudi universities who utilize Gemini for learning. The participants of this study were students from four Saudi regions. The seven universities that were involved were part of King Faisal University (East), Taibah University (West), North Border University (North,) and

Jazan University (South). Hence, the scores indicated good participation by the students from the seven universities. Out of all the participants, we had approximately 75 students from each university. Out of 525 administered questionnaires, we collected 400 forms that were filled out completely and used for data analysis. Among these forms collected, more males participated in the given topic, with 290 participants, than female participants, with only 110 participants. If we take age groups of students, it is identified that a maximum number of 56% of students fall in the age of 19-25 years. Also, surprisingly, the social sciences and humanities students' sharing was slightly higher than that of other groups. In analysing the distribution of academic disciplines among participants, it was observed that there was higher participation from students in social sciences and humanities (250 participants) compared to those in natural, applied, and basic sciences (150 participants). The latter group included students from colleges such as the College of Science, College of Medicine, College of Pharmacy, and College of Engineering.

Measurement scales

In collecting data, this study utilized a pre-administered survey questionnaire among students. As a whole, the questionnaire form consists of three main sections. On the first page of the questionnaire, we provided some facts about the topic, the aim and the objective of the study and informed the participant to participate in the study by filling out the questionnaire voluntarily. In Part One, the questions on the participants' demographic profiles, including questions about gender and study discipline, were asked. Part Two has the scales of PE, EE, SI and FC. The scale questions were derived from Strzelecki (2023) and Strzelecki & ElArabawy (2024) and were originally developed based on the UTAUT framework introduced by Venkatesh et al. (2003). The questions used a five-point Likert scale ranging from strongly agree to strongly disagree. Part Three of the questionnaire has five variables measuring the intention and use of ChatGPT in learning, which were derived from the work of Strzelecki (2023) and Strzelecki and ElArabawy (2024). The credibility of the questionnaire form was established regarding content validity and face validity by twelve professors, and few modifications were made to the format and content of the questionnaire questions.

Data analysis

In order to verify the research hypotheses, the PLS-SEM analysis was conducted. According to Hair et al. (2019), PLS-SEM yields a lower bias estimation where the data are non-parametric. Therefore, PLS-SEM might be appropriate for analyzing data in this study. SmartPLS program Version 4 was employed for the inner and outer model estimation.

Results

Like many other quantitative studies, in order to assess research hypotheses, Henseler et al. (2009) pointed out that the researchers have to establish the convergent validity,

discriminant validity, and reliability of the constructs before performing a PLS-SEM test. As mentioned by Hair et al. (2019), acceptable levels of convergent validity comprise the outer loadings and the criterion average variance extracted (AVE) threshold equal to or greater than 0.5. The results revealed factor loading values from 0.513 to 0.955. These were higher than the minimum threshold of 0.5 (Table 1). Moreover, in Table 2, AVE values ranged from 0.661 to 0.823 (exceeding the cutoff value of 0.5). Therefore, all the constructs displayed good levels of convergent validity with 0.7, as Hair et al., 2019 recommended. Moreover, as presented in Table 3, it is clear that the square root of AVE was significantly higher than its relative correlations. Hence, discriminant validity for all the variables was achieved at acceptable levels and could be deemed adequate.

Table 1. Cross-loadings and VIF values.

	Behavior Intention	Effort Expectancy	Facilitating Conditions	Performance Expectancy	Social Influence	Use Google Gemini	VIF
BI1	0.852	-0.061	-0.206	0.124	0.315	0.749	1.838
BI2	0.904	-0.079	-0.248	0.188	0.337	0.808	2.065
BI3	0.662	-0.021	-0.156	-0.058	0.427	0.445	1.258
EE1	-0.086	0.946	0.509	0.089	-0.134	-0.100	4.295
EE2	-0.063	0.940	0.451	0.077	-0.152	-0.072	3.936
EE3	-0.044	0.920	0.444	0.074	-0.124	-0.064	4.320
EE4	-0.054	0.909	0.404	0.076	-0.127	-0.065	3.742
FC1	-0.106	0.561	0.874	-0.025	-0.042	-0.083	3.903
FC2	-0.164	0.539	0.855	-0.009	-0.058	-0.124	4.104
FC3	-0.201	0.466	0.955	-0.042	-0.072	-0.186	4.335
FC4	-0.324	0.374	0.940	-0.157	-0.066	-0.311	3.962
PE1	0.043	0.057	-0.042	0.832	-0.278	0.133	2.230
PE2	0.075	0.144	-0.040	0.767	-0.138	0.132	1.455
PE3	0.132	0.014	-0.088	0.843	-0.138	0.157	1.699
PE4	-0.064	0.001	0.079	0.513	-0.125	-0.013	1.670
SI1	0.475	-0.084	-0.069	-0.181	0.886	0.428	1.586
SI2	0.273	-0.158	-0.052	-0.188	0.799	0.237	2.108
SI3	0.263	-0.163	-0.047	-0.182	0.863	0.239	2.540
Use 1	0.738	-0.057	-0.209	0.095	0.298	0.767	1.485
Use 2	0.797	-0.072	-0.239	0.187	0.369	0.941	4.096
Use 3	0.630	-0.092	-0.143	0.206	0.317	0.875	4.259

Table 2. The validity and reliability of latent variables.

Factors	Cronbach's alpha (a)	Composite reliability (C.R.)	Average variance extracted (AVE)
Behavior Intention	0.738	0.852	0.661
Effort Expectancy	0.948	0.962	0.863
Facilitating Conditions	0.935	0.949	0.823
Performance Expectancy	0.800	0.833	0.563
Social Influence	0.820	0.886	0.722
Use Google Gemini	0.826	0.898	0.746

Table 3. Fornell–Larcker criterion matrix and HTMT results.

Dim.	AVE square root	Pearson's correlation matrix					
		1	2	3	4	5	6
1. Behavior Intention	0.813	1					
2. Effort Expectancy	0.929	-0.070	1				
3. Facilitating Conditions	0.907	-0.254	0.493	1			
4. Performance Expectancy	0.725	0.149	0.069	-0.091	1		
5. Social Influence	0.850	0.426	-0.145	-0.068	-0.183	1	
6. Use Google Gemini	0.864	0.544	-0.084	-0.232	0.208	0.382	1
HTMT							
1. Behavior Intention							
2. Effort Expectancy		0.077					
3. Facilitating Conditions		0.257	0.555				
4. Performance Expectancy		0.187	0.109	0.066			
5. Social Influence		0.523	0.177	0.072	0.305		
6. Use Google Gemini		0.449	0.093	0.215	0.182	0.426	

In PLS, the reliability of the construct should also be assessed by two more coefficients – composite reliability (CR) and Cronbach's alpha (CA). As Hair et al. (2019) noted, a CR and CR of 0.7 should be used as a measure of reliability

in identifying whether the level of reliability is excellent or not. Table 2 stated that CR and CA ranged from 0.833 (Performance Expectancy) to 0.852 (behavior intention), respectively, exceeding the cutoff value of 0.7. Accordingly, the reliability of the study's latent variables was satisfied. Likewise, to ensure the estimation of discriminant validity, the researchers employed Fornell and Larcker's, where the square root of the AVE should exceed the intercorrelation for each factor, as shown in Table 3. Furthermore, the "Heterotrait-Monotrait" (HTMT) ratio, which is admitted as a more robust approach compared to Fornell and Larcker's (1981), was examined. The probable worries regarding discriminant validity occur when HTMT scores (Table 3) surpass 0.90. As shown in Table 3, all ratios fall below 0.9, thus confirming the discriminant validity. Hair et al. (2019) also identified that the existence of multicollinearity is an issue when the variance inflation factor (VIF) exceeds the value of five as a threshold. Table 2 shows that the highest value of VIF was 4.335. Hence, the possibility of a multicollinearity issue was not a problem. Additionally, the researchers evaluated the chance of common method bias (CMB) that might occur in this paper as cross-sectional data gathered from the same respondents. To deal with this issue, Podsakoff et al. (2003) suggested that researchers would employ Harman's one-factor test. The exploratory factor analysis found that the single dimension explained 43% of the overall variance, which signaled a low likelihood of CMB. As revealed in Figure 2 and Table 4, the PLS-SEM outcomes revealed that BI was positively, directly and significantly impacted by PE ($\beta = 0.192$, $t=2.067$, $p<.001$), EE ($\beta = 0.109$, $t=2.226$, $p<.001$), and SI ($\beta = 0.466$, $t=7.523$, $p<.001$), which approve H1, H2, and H3. It is worth noting that the weak negative correlation between BI and EE in Table 3 (-0.070) and the positive and significant path coefficient in Table 4 (H2: $\beta = 0.109$) are not necessarily contradictory, considering the effects of multiple variables simultaneously. In a multivariate context, the positive impact of EE on BI might become evident when controlling for the effects of other constructs like PE, SI, and FC.

However, FC failed to positively affect BI ($\beta = -0.259$, $t=5.375$, $p<.001$), rejecting H4. Similarly, the study results signaled that PE is the only factor positively and significantly impacting Gemini Usage ($\beta = 0.102$, $t=3.067$, $p<.001$) supporting H5. Conversely, all the other factors of the UTAUT framework failed to positively and significantly impact the usage of Google Gemini by university students, rejecting H6 ($\beta = -0.028$, $t=1.158$, $p=0.247$), H7 ($\beta = 0.057$, $t=1.633$, $p=0.103$) and H8 ($\beta = -0.001$, $t=0.032$, $p=0.974$). Finally, the results showed a high positive direct impact of BI on Gemini usage ($\beta = 0.805$, $t=31.194$, $p<.001$) supporting H9.

Finally, the negative correlations observed in the Fornell-Larcker Table 3 are generally consistent with the hypotheses testing results, particularly for the relationships involving Facilitating Conditions (FC) and their negative impacts. These findings reinforce the conclusion that despite the perceived ease of use and social influence, the lack of adequate resources and support (facilitating conditions) plays a significant role in hindering the intention and actual usage of Google Gemini among students.

Table 4. Hypotheses testing results.

	Relationship	β	T statistics	P value	Results
H1	Performance Expectancy $\rightarrow$ Behavior Intention	0.192	2.067	0.039	Support
H2	Effort Expectancy $\rightarrow$ Behavior Intention	0.109	2.226	0.026	Support
H3	Social Influence $\rightarrow$ Behavior Intention	0.466	7.523	0.000	Support
H4	Facilitating Conditions $\rightarrow$ Behavior Intention	-0.259	5.375	0.000	Reject
H5	Performance Expectancy $\rightarrow$ Use Google Gemini	0.102	3.067	0.002	Support
H6	Effort Expectancy $\rightarrow$ Use Google Gemini	-0.028	1.158	0.247	Reject
H7	Social Influence $\rightarrow$ Use Google Gemini	0.057	1.633	0.103	Reject
H8	Facilitating Conditions $\rightarrow$ Use Google Gemini	-0.001	0.032	0.974	Reject
H9	Behavior Intention $\rightarrow$ Use Google Gemini	0.805	24.194	0.000	Support
Specific indirect effects					
H10	Performance Expectancy $\rightarrow$ Behavior Intention $\rightarrow$ Use Google Gemini	0.155	2.038	0.042	Support
H11	Effort Expectancy $\rightarrow$ Behavior Intention $\rightarrow$ Use Google Gemini	0.087	2.208	0.027	Support
H12	Social Influence $\rightarrow$ Behavior Intention $\rightarrow$ Use Google Gemini	0.375	6.794	0.000	Support
H13	Facilitating Conditions $\rightarrow$ Behavior Intention $\rightarrow$ Use Google Gemini	-0.208	5.206	0.000	Reject

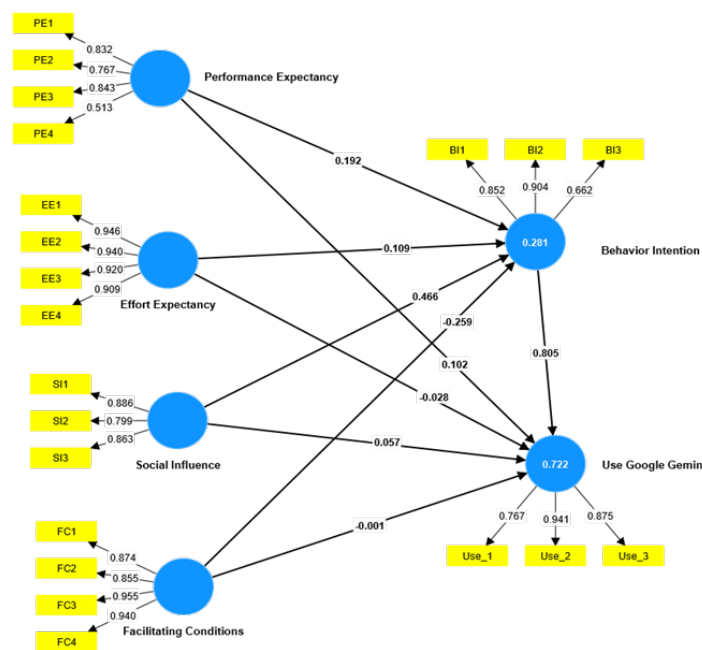


Figure 2. Results of the inner model.

As for the indirect, specific impact, the study results showed that BI could mitigate the insignificant direct impacts by mediating significantly between PE and Gemini Usage ($\beta = 0.155$, $t=2.038$, $p<.001$), which supports H10. Similarly, BI successfully mediates the relationship between EE and Gemini Usage ($\beta = 0.087$, $t=2.208$, $p<.05$), SI and Gemini Usage ($\beta = 0.375$, $t=6.794$, $p<.001$), supporting H11 and H12. However, BI failed to positively mediate the impact of FC on Gemini Usage ($\beta = -0.208$, $t=5.206$, $p<.001$), rejecting H13.

Discussion

This paper addresses students' acceptance and use of Gemini in their learning process. For this reason, the questionnaire survey developed using the UTAUT framework was directed at students in Saudi universities. The findings showed that PE has a positive but insignificant effect on the BI of students who adopt Gemini in education. As discussed earlier, PE refers to students' perception of using Gemini to enhance their academic performance (Brachten et al., 2021). However, this result confirms that students are unsure that Gemini would significantly impact their academic performance. On the other hand, the findings confirmed that PE significantly and positively impacts the BI to use Gemini in education. This aligns with previous research results that students

use the AI tool in their educational activities because they believe it may assist them in critical activities and enhance their performance (e.g., Sevnarayan & Potter, 2024).

The results also showed that EE in educational activities significantly and positively affects the BI to use Gemini. This means that EE students perceive Gemini as a simple AI tool to utilize. They perceive it as intuitive, user-friendly, and effortlessly incorporated into daily activities that stimulate the BI of students (Menon & Shilpa, 2023). This finding concurs that Gemini requires minimal effort to incorporate it into their regular learning routines like other AI tools, e.g. ChatGPT (Hasanein & Sobaih, 2023; Wang & Zhao, 2023; Chaka, 2024; Tian et al., 2024). However, the result is not in line with the UTAUT framework (Venkatesh, 2022) as EE has a negative, albeit significant impact on BI of students to adopt Gemini in educational activities. This could be because the spread of the Gemini tool among Saudi students is recent. Therefore, students' acceptance of Gemini did not directly affect their use of Gemini in their educational activities.

Regarding the effect of SI on BI to use Gemini in educational activities, there was an agreement with UTAUT and previous research (Venkatesh et al., 2003; García-Peñalvo, 2024) that the BI to use Gemini in educational activities is positively affected by SI. This means that teachers and peers have an effect on students' BI when using Gemini. Empirical research (e.g., Menon & Shilpa, 2023) has shown that when peers use Gemini for learning, it has the ability to improve other students' BI performance. On the other hand, SI's influence on Gemini's use was positive but not significant. The effect of teachers and peers was enough to stimulate the BI of students to use Gemini but not their definite use of Gemini in their education activities.

The results showed a positive and significant relationship concerning the effect of FC on BI to adopt Gemini in their teaching. This means that technical mobility, access to appropriate instruction and tools, and broad incentive programs for integration (Strzelecki, 2023; Menon & Shilpa, 2023; Oye et al., 2014) were enough to stimulate students' BI to use Gemini but were not enough to affect their actual use of Gemini in education. There was a negative but insignificant effect on the facilities and support given by institutions to students regarding AI tools, particularly Gemini. This concurs with the work of Sobaih et al. (2024), who state that the support universities in Saudi Arabia give for using AI in learning is often limited and absent. Hence, they also found FC's negative but insignificant effect on students' use of ChatGPT in their education.

This research study confirmed the mediation role of BI in the relationship between EE, PE, SI and the adoption of Gemini in teaching by university students. This result supported the UTAUT framework and the work of Sobaih et al. (2024), who confirmed a mediating role of BI in the relationship between EE, PE, SI and the adoption of AI in learning. Although EE and SI had no direct effect on the use of Gemini, BI confirmed the indirect relationship. This means that BI was able to change these relationships, reflecting its great importance in driving students' use of Gemini in learning. On the other hand, BI did not have any mediating role in linking FC and students' use of Gemini. This is because the current level of FC given

by institutions to their students was not significant enough to affect their BI in using Gemini in their education. These findings are unlike the study of Sobaih et al. (2024), which confirmed this mediation effect of FC in the link between acceptance and use of ChatGPT among Saudi students. This could be because students did not have enough support from their institutions to facilitate their use of Gemini in their education activities despite it being a new AI tool for them to use. Gemini is less common among students, and they may not have developed their BI to actually use it in their education without external support. The findings encourage scholars to undertake further studies to understand the actual usage of AI tools in education. There is a need for more studies that analyze how these tools could be better integrated into students' learning while considering their long-term consequences as well as addressing any associated ethical concerns (Sobaih, 2024).

Conclusion

This study responds to university students' growing usage of AI tools in education. The study examined students' acceptance and use of Gemini for educational activities. The study confirmed that BI to adopt Gemini is significantly affected by PE. Students believe it assists them in educational activities. On the other hand, the results showed that PE has a positive but insignificant effect on the BI of students who adopt Gemini in education. Students are not sure that Gemini would significantly affect their academic performance. On the other hand, despite EE having an insignificant effect on BI to use Gemini, it has a direct positive effect on the use of Gemini because they found its ease of access. As the individual's decisions in Saudi society are affected by peers, the BI to use Gemini is significantly affected by SI, but SI did not confirm a significant influence on the real adoption of Gemini in educational activities. In the same context, FC had a significant effect on BI to use Gemini but a significant effect on BI use, but it did not significantly affect the actual use of Gemini. The external support given to students was not enough to change the BI effect in the relationship between FC and the use of Gemini for learning. The study confirmed that BI mediates the link between EE, PE, SI and the use of Gemini by university students. The study of value is not only for Saudi higher education but also for other countries' higher education sectors.

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Appendix

Appendix A: Research Instrument

	Scale Variables and Items
	Performance Expectancy (PE) (Venkatesh et al., 2003)
PE1	"Google Gemini is an invaluable asset for enhancing my academic endeavors."
PE2	"Employing Google Gemini significantly increases the likelihood of achieving crucial objectives in academic pursuits."
PE3	"Google Gemini optimizes productivity in academic endeavors by streamlining task and project completion."
PE4	"Engaging with Google Gemini has the potential to enhance my academic performance."
	Effort Expectancy (EE) (Venkatesh et al., 2003)
EE1	"I perceive learning to use Google Gemini as straightforward."
EE2	"The interaction with Google Gemini is clear and easily understandable."
EE3	"Google Gemini boasts a user-friendly and intuitive interface."
EE4	"I effortlessly develop proficiency in utilizing Google Gemini."
	Social Influence (SI) (Venkatesh et al., 2003)
SI1	"The individuals who hold significant influence in my life strongly advocate for the use of Google Gemini."
SI2	"The people who influence my actions endorse the utilization of Google Gemini."
SI3	"The perspectives of those whom I deeply respect indicate a recommendation for incorporating Google Gemini into my activities."
	Facilitating Conditions (FC) (Venkatesh et al., 2003)
FC1	"I possess sufficient resources to effectively utilize Google Gemini."
FC2	"I have acquired the necessary skills to proficiently use Google Gemini."
FC3	"Google Gemini aligns with the technological tools I employ."
FC4	"In the event of challenges with Google Gemini, external support and assistance are readily available."
	Behavioral Intention (BI) (Ajzen and Fishbein, 1972)
BI1	"I have made the decision to persist in using Google Gemini going forward."
BI2	"I am fully committed to employing Google Gemini as an integral tool for my academic endeavors."
BI3	"I am determined to maintain a consistent usage of Google Gemini."
	Google Gemini Use (Venkatesh et al., 2012)
Use1	"I plan to apply the knowledge and skills gained from Google Gemini in my educational pursuits."
Use2	"The knowledge and skills acquired through Google Gemini will prove beneficial to my classroom endeavors."
Use3	"Utilizing Google Gemini has contributed to enhancing my academic performance."

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Paraphrase or plagiarism? Exploring EAP students' use of source material in a transnational university context

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source use.

Abstract

The relationship between paraphrase and plagiarism is complex and has been the subject of multiple research studies. However, recent advances in Generative AI (GenAI) have disrupted the standard practices of academic writing and established a renewed focus on how learners acquire skills in English writing in a higher education context. To understand the future of academic writing in the technological era, further investigation of how and why students choose to paraphrase and engage with source material is needed to guide best practices in instruction, policy, and research. This exploratory study seeks to fill this gap and provide insight into the choices English as a Second Language (ESL) student writers make in an English for Academic Purposes (EAP) context. Using a text-based interview method and custom-designed academic writing task, we examine how students engage with and make decisions about using source material. Results reveal that participants focus more on sentence-level approaches to paraphrasing and mechanistic methods of language transformation. This is partly motivated by prior learning experiences but may also be related to adopting a risk-averse approach to language use to avoid accusations of plagiarism. Furthermore, our participants expressed a low level of confidence in the ability of new technological tools to help learners acquire skills in English writing. These findings suggest that there is a need for further research exploring policies to enable experimentation in EAP programs, as well as exploring acceptance and belief in new technologies' ability to support paraphrasing and source use.

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Introduction

In this article, we report on a study of how international students in an English for Academic Purposes (EAP) program engage with source use and paraphrase using a text-based interview method. EAP programs are a useful site of study for writing development, as they are designed to give students the tools they need to participate in academic contexts and complete academic activities undertaken in English medium environments (Maniati et al., 2023). Academic writing and the use of source material is one of these key academic challenges, as this highly important skill (Du, 2019) allows students to develop persuasive arguments (Coffin, 2009), infer meaning, synthesize ideas, and avoid accusations of plagiarism or misrepresentation of authorship.

It is a pivotal time to further the current knowledge on academic writing and paraphrasing, as recent advents in GenAI technology have led to a renewed focus on the role of writing instruction. Large Language Models (LLMs) such as ChatGPT enable students to generate original written content for assessments (Perkins, 2023), which cannot reliably be detected by existing tools (Chaka, 2023; Perkins et al., 2023), while other writing tools including Digital Writing Assistants (DWAs) and Automated Paraphrasing Tools (APTs) (Roe et al., 2023) now increasingly assist with core writing activities.

New technologies which support these activities are appealing, as source use constitutes a vital area for academic success in the university context (Hirvela & Du, 2013), yet inappropriate source use among students is common (Pecorari, 2003). Inappropriate source use can result in the unaltered reproduction of source material (Lee et al., 2018) which may lead to accusations of plagiarism (Du, 2019). Limited research has shown that new technologies may help students learn to paraphrase; ChatGPT has been researched as a potential 'paraphrasing tutor' with some beneficial effects. However, at the same time, the limitations of these tools are many, including the potential of creating monocultures of knowledge (Messeri & Crockett, 2024) and producing Eurocentric worldviews (Roe, 2024). Consequently, this means that it is still essential to have the expertise and insight of a human teacher (Chui, 2023), as paraphrasing effectively requires subject-specific knowledge (Shi, 2012).

The challenge of paraphrasing and source use may be more difficult for international students and English as a Second Language (ESL) students. EAP Programs often cater to these students, who face a unique set of challenges due to academic, cultural, and linguistic differences (Hussein & Schifflbein, 2020). To participate in the Western cultural tradition of academic writing successfully, it is essential to be able to use source material while being capable of paraphrasing without breaching the normative academic conventions of plagiarism. This includes not only direct duplication of the lexis used in the original source but also the ownership of ideas as belonging to an individual as intellectual property (Mott-Smith et al., 2017). Such norms of knowledge construction are not universal but contrast to other systems of learning and knowing, and equally, research has shown there is wide individual variation in what constitutes plagiarism for both students and teachers

in different contexts (Chandrasegaran, 2000; Currie, 1998; Deckert, 1993; Pennycook, 1996; Roig, 2001; Shi, 2012; Sutherland-Smith, 2005; Thompson et al., 2013).

Complicating matters further, multiple definitions of paraphrasing exist, which may complicate instruction. Shi et al. (2018, p.1) define paraphrase as recontextualizing source information in one's own writing with a credit to the original author, although a 'good' paraphrase has been described as including an element of inference and creative thinking, in this sense, adding to the original text (Yamada, 2003). Paraphrasing is not a simple skill and, also requires contextual and subject-specific knowledge (Shi, 2012). Furthermore, evidence suggests that students who learn English as their second language find paraphrasing comparatively more difficult than native English speakers (Hirvela & Du, 2013; Keck, 2014; Keck 2006). Such is the challenge of paraphrasing that prior to the advent of GenAI tools, Automated Paraphrasing Tools (APTs) have been used by students to smoothen the process (Prentice & Kinden, 2018; Roe & Perkins, 2022).

In order to contribute to filling a gap in the literature and generate further insight into students' personal and subjective experience of paraphrasing and source use, in this research we sought to understand how international students in a pre-sessional English for Academic Purposes course (EAP) course at an Australian university branch campus in Singapore choose to paraphrase and engage with source material, as well as how they view the relationships between paraphrase, plagiarism, and source use. To achieve this aim, we recruited participants to compose a written response to a specially constructed prompt based on source material from an English-language scholarly journal. The inspiration for this project is based on the sixth task described in Pecorari's (2022) research agenda for plagiarism in EAP, which comprises asking student participants to read the same piece of source text, and then compose a written response. We prompted reflections by using text-based interviews to understand how writers engaged with the task, and our analytic approach uses hybrid thematic analysis, which incorporates a deductive and inductive dimension.

We chose Mott-Smith et al.'s (2017) categorization of four aspects of source use: the concept, sentence, discourse, and process dimensions, as a guiding reference for our deductive analysis. This is deductive as we aimed to categorize participants' understanding under an existing framework. For the inductive analysis, we used data immersion to thoroughly understand participants' responses and their interaction with source material and identify themes that helped illuminate their understanding and experience of the task. To ensure reliability, we employed a multi-coder approach, where team members independently analysed and compared interpretations, resolving any discrepancies through consensus-building. By combining deductive and inductive elements, we aimed for a comprehensive understanding of paraphrasing and source use among our participants and to develop a greater understanding of the implications of cultural, educational background on experience in learning the traditions of source use, paraphrasing and plagiarism.

Existing studies on student paraphrasing

There are multiple studies on paraphrasing with English as a Second Language (ESL) students, with most of them focusing on students from East and Southeast Asian contexts, reflecting past trends in international student enrolment. Khismawan and Widiati (2013) conducted a qualitative study to investigate Indonesian graduate students' paraphrasing practices, finding that participants used 21 cognitive and 7 metacognitive strategies. Wette (2017) examined six L2 writers in their third year of undergraduate study and found that patchwriting - where the author combines ideas and content from different sources without proper crediting and with minimal changes - and copying featured in up to three quarters of the student's results. Hirvela and Du (2013) researched undergraduate paraphrasing practice with two L2 students from mainland China, finding that both tended towards a more simplistic 'knowledge-telling' rather than 'knowledge-transforming' understanding of paraphrasing.

In this vein, Keck (2006) has written extensively on the practice of student paraphrasing, creating a framework of paraphrasing consisting of four conditions: Near Copy, Minimal Revision, Moderate Revision, and Substantial Revision. By applying this framework, Keck found that students who fell into the L2 category made greater use of Near Copies, and students who fell into the L1 (i.e., students who learn English as their first language) category made greater use of Moderate and Substantial Revisions. Following this, Keck (2014) found that novice writers leaned more heavily on parts of source material when writing than writers who had a greater amount of familiarity with academic writing. The use of such reliance on near copies may have a relationship to the expression of linguistic and phraseological complexity, as it has been demonstrated that writers develop more complex systems of multi-word combinations as they progress in their study (Esfandiari & Ahmadi, 2022). In contrast to Keck's (2006) framework, a relatively large study by Shi et al. (2018) used text-based interviews to understand the paraphrase processes of 18 graduate students and 192 discrete instances of paraphrase and found that although the participants had a shared understanding of paraphrasing, their perceptions of their own paraphrase covered many differing strategies on a spectrum from direct copy to total restructure, suggesting a wider range of paraphrase types.

Authorial stance in paraphrasing and source use, which refers to writers including their own perspective or position when paraphrasing from a source, is also a point of interest in the literature. L2 writers were found by Lee et al. (2018) to write in a non-committal way and defer to the authority of source material. As a result, it has been suggested that some students may reach a point where they are able to paraphrase linguistically in a knowledge-telling process, but cannot progress to the more challenging, additive paraphrasing process of transforming knowledge in their own words (Storch, 2012), thus failing to create what Yamada (2003) defines as a good paraphrase due to their inability to inject their own personal voice in paraphrasing.

In relation to another aspect of source use, citation practices, Mansourizadeh and Ahmad (2011) found that novice writers were less likely to use citation practice strategically to embolden their arguments but would more frequently use citation to attribute information, while McCulloch (2012) found that inappropriate use of source material can be related to a weak authorial stance. As a result, Hyland (2009) contends that assessment developers must identify better rating scales for assessing student citation practice, rather than creating an inappropriate/appropriate dichotomy of source use.

Dimensions of cultural practice have also been explored in relation to L2 students and inappropriate paraphrases. Beginning from Pennycook (1996), who asserted that notions of ownership are culturally determined, other key works include Keck (2014) stated that cultural dimensions relating to traditional strategies of memorization are one common explanation for inappropriate textual borrowing. Lin and Wen (2007) suggested that a focus on the group rather than individualism may promote social pressure as motivating academic misconduct in Taiwan, and Tuy  t (2013) suggests that perceived passivity among Vietnamese students is a feature of Confucian Heritage Culture (CHC) nations. This area is contentious as Martin (2012) found that writers who are attitudinally and behaviourally individualists plagiarize more than collectivists, regardless of background culture, while others have contested the stereotypical image of L2 students from varying backgrounds in CHC nations (Le Ha, 2004, 2006; Li & Flowerdew, 2018; Roe & Perkins, 2020). Furthermore, Gu and Brooks (2008) contend that focusing too much on culture might lead to dismissive attitudes toward learning practices among Chinese students.

Similarly, in the Japanese context, Wheeler (2009) found that Japanese students are not as accepting of plagiarism as has been suggested, and lack of understanding plays a role while cultural values do not. Yang and Lin (2009) found that Western academics may hold misconceptions about CHC educational practices, and Maxwell et al. (2008) found no relationship between local Australian and Asian international students' understanding of plagiarism or perception of how serious plagiarism was. O'Dwyer (2017) suggests that the 'CHC thesis' is limited and reductive, while Li and Flowerdew (2018) have shown through analysis of data from the 1950s to 1960s that plagiarism has not traditionally been accepted in China, while O'Dwyer (2017) points out that collectivist approaches to education are not likely to be historically grounded in Confucianism, but relate to more recent developments in industrializing East Asian nations. As such, these findings provide a tapestry of results on how notions of ownership of ideas and other related factors influence plagiarism behaviours across cultures and demonstrate the need for Culturally Responsive Teaching (CRT) (Meihami, 2023).

There is a significant body of research which has established that paraphrasing is challenging, especially so for those who are learning to do so in English as a Second Language, and that multiple processes and types of paraphrases exist. Furthermore, the relationship between paraphrase and plagiarism may be related to cultures of prior learning, but this is not necessarily the case, and caution should be used

when applying cultural explanations to learner behaviour. In identifying a gap in the literature, it can be argued that these studies have broadly examined undergraduate and graduate students, and yet there are no studies which explore how students who are currently focused on developing paraphrasing skills in an EAP course, when learners are first developing and acquiring knowledge about paraphrase. In other words, our exploratory study fills this gap by generating insights into students' experience as they undergo their initial training in how to paraphrase effectively, rather than when they have already met the prerequisite requirements for undergraduate and postgraduate study and embarked on a degree in higher education.

The relationship between academic integrity, textual borrowing, and paraphrase in source use

To situate our research in the broader body of literature regarding the relationship between paraphrase and plagiarism, a brief discussion of academic integrity is warranted. In the Western tradition, academic integrity requires dedication of oneself to the values of fairness, trust, respect, and responsibility (International Center for Academic Integrity, 2022), while Academic Dishonesty (AD) refers to the violation of these values. There are a great many reasons why students commit acts of AD, and much has been written about causative and affecting factors (Bennett, 2005; Roe, 2022). When paraphrasing and inappropriate source use are involved, it is not always clear that intentional AD has occurred, and a complicating factor is the inability of an assessor to understand whether such values have been wilfully violated, given that only the writer can truly know their intention (Pecorari, 2003). Even the modern use of GenAI tools to compose written work equally does not necessarily lead to a de facto violation of academic integrity values, if it is transparent and within the policies of the institution (Perkins, 2023). Therefore, there is a complex relationship between understanding at what point textual borrowing and paraphrasing become violations of academic values.

It has been recognized in the literature since the early 1990s that inappropriate textual borrowing is often a developmental issue that requires instruction (Deckert, 1993) and research has shown that only a minority of students are able to recognize all forms of plagiarism in their work (Hu & Lei, 2012). This is corroborated by the fact that high-achieving students in high school education can equally struggle with the demands of paraphrasing in post-secondary EAP programs (Yung & Fong, 2019). As a result, university English instructors may choose to treat instances of plagiarism as 'teachable moments' (Briggs & Kim, 2020). Compounding the issue further, there is often little differentiation between different types of plagiarism, with large quantities of direct copying being judged as equal to a missing citation (Evering & Moorman, 2012). Patchwriting, in which the deletion of individual terms or direct substitutions of synonyms is used, has also historically been considered plagiarism (Howard, 1995), despite arguments that it is an essential phase in students' development to becoming academic writers (Pecorari, 2003). This shows that there is a significant need to understand how and why students

choose whether to paraphrase (or not) and their decision-making process in doing so, especially at the earliest stages of skill acquisition as in an EAP program, as the severe consequences of plagiarism accusations, can affect students' future study and career prospects (Dawson & Overfield, 2006), while simultaneously causing embarrassment, potential exclusion from their program of study, and feelings of disgrace (Pecorari, 2003). Thus, the stakes are high for ensuring student success, and exploring students' choice-making and experiences when first attempting paraphrasing skills can contribute to clarifying this issue.

Empirical research on instruction and textual borrowing

As a result of the high stakes of plagiarism accusations, many studies have described techniques and instruments to reduce incidents of unintentional and intentional plagiarism, often through direct instruction. Barry (2006) found that students were likely to add detail to their definitions of plagiarism after engaging in practice. Landau et al. (2002) found that training helped participants identify plagiarism, and Schuetze (2004) observed that relevant homework assignments aided students in encountering fewer issues with citation and enhanced their understanding of what constituted plagiarism. Wette (2010) found that through an action research approach (N=78) students showed an improvement in several aspects of plagiarism avoidance after eight hours of instruction. Du (2019) researched the effectiveness of a unit of EAP instruction on EFL students' abilities in using source material and found an improvement which demonstrates that source use can effectively be taught, and Elander et al. (2010) found that a pedagogical intervention helped students to avoid committing acts of plagiarism accidentally by taking an approach to developing authorial identity while Perkins et al. (2020) implemented a targeted intervention to develop academic skills of students to reduce intentional and unintentional cases of academic misconduct, demonstrating a decrease of 37% in cases of detected misconduct. These studies demonstrate that training consisting of direct instruction and practice can reduce incidences of plagiarism, including unintentional plagiarism, which can be caused by inappropriate paraphrasing, regardless of whether the case is caused by past educational experience, culture of learning, or deficit in skills and knowledge regarding norms of plagiarism and integrity. However, more exploration of how learners view these relationships and experience paraphrasing and source use is required to develop a greater mutual understanding between instructor and student. The results of this could lead to more thoughtfully designed, inclusive, and effective curricula.

In brief, there has long since been a recognition that when learners paraphrase inappropriately, it is often part of a learning process, which is at odds with the common punitive approach many institutions adopt concerning plagiarism standards. Much of the research demonstrates that further, targeted instruction can help learners to avoid inappropriate paraphrase and commit fewer academic integrity violations, but little is known about how those learning to paraphrase engage with a text early in their acquisition of this skill. At the same time, new technologies such as ChatGPT offer

the potential to help with teaching certain aspects of paraphrasing, yet the teacher’s role remains essential (Chui, 2023). As a result, our study contributes to generating new insights into a body of knowledge regarding paraphrasing choices in an EAP program with international, ESL students, which can help teachers to work with new technologies from a position of understanding and insight to develop students’ paraphrasing skills.

Materials and methods

The research question we seek to address in this article is “How do students in an EAP preparatory course choose what to paraphrase in a writing task?” The overall aim is to holistically explore the choices that go into whether to paraphrase, the extent of the paraphrase chosen, and the process by which paraphrasing is undertaken among these students, in their own words. By achieving this aim, we contribute to filling a gap in the literature for such small-scale, in-depth and text-based studies on paraphrasing among EAP students and providing insight for future instruction, policies, and research in an era in which new technologies continue to disrupt traditional notions of writing.

With this aim in mind of a holistic, exploratory project, the study does not aim to specifically analyse the effectiveness of the EAP program that the participants are enrolled in, nor does it seek to typify the paraphrasing strategies chosen but does allow students to draw on aspects of that knowledge in explaining their own understanding of source use when completing a task. After obtaining ethical approval from our institution, we recruited five students to participate through self-selection sampling. While this is a small number of participants, thus making the results hard to generalize, the in-depth, resource-intensive nature of the task-based interviews meant that the five participants gave enough data to approach thematic saturation (Lowe et al., 2018). All participants were over 18 years’ old and enrolled in the EAP program with the intention of joining a university degree program at the bachelor’s level upon completion. All students had significant previous experience in academic writing and learning English in diverse contexts.

Students were recruited in the first week of a 12-week trimester. To avoid interrupting students’ study, the timed writing task and text-based interview session were arranged in a study break week when five weeks’ instruction had already taken place. The participants all had experience of studying EAP both at the institution and in their home countries.

Sample and participants

The five participants were assigned pseudonyms: Jane, Alice, Trudy, Bob, and John. The participants’ first languages included Japanese, Korean, Thai, and Chinese, and the ages of participants ranged from 18 – 36. A summary of the participants’ profiles is visible in Table 1 below.

Table 1: Participants in the study.

Participants	First Language	Self-reported English Proficiency (CEFR)
Jane	Japanese	B1
Alice	Korean	B1
Trudy	Thai	B1
Bob	Chinese	B1
John	Chinese	B1

Data collection

A writing task was custom created for the research project, and participants took part outside of regular class hours. In line with Pecorari’s (2022) research agenda, the researchers began by selecting a source around which a writing task was created. We drew on Shabitha and Mekala’s (2023) assertion that integrated writing tasks which are relatable and stimulate learner interest are more effective for developing positive affect toward the task. For this reason, we chose a common, popular topic that often appears in classroom debates: the role of smartphone use among children. The article chosen came from the Public Library of Science journal PLOS One and was an empirical article describing smartphone use among children in The Republic of Korea, published in English. We selected this article as it exemplified a typical research article in a high-profile, peer-reviewed journal in the social sciences, was available for adaptation under the Creative Commons License, and discussed a general topic (smartphone use among children) which did not require additional specialist knowledge in a subject field. Following this, we created a writing 45-minute writing task in response to a prompt regarding the text. We selected this time frame as it was used successfully in Wette (2018) and Jin et al. (2022)’s research study. We also selected a timed, written task to closely mimic the procedure of assessment commonly used in EAP courses and standardized English tests. Participants were asked to read the article for 15 minutes and then spend 30 minutes composing a response to the prompt “Should Children Be Allowed to Use Smartphones?” Participants were asked to use the source material where appropriate in their response. Following the completion of the task, semi-structured text-based interviews were conducted. Interviews were scheduled immediately after task completion, while participants were still able to recall how they engaged with the task. Table 2 provides a step-by-step outline of the research procedure.

Table 2: Research procedure.

Research Procedure Steps
1. Adaptation of academic text from PLoS One Journal and creation of a writing task and prompt.
2. Recruitment of participants via email through self-selection sampling.
3. Participants engage in a 45-minute reading into writing task.
4. Following completion, participants engage in textual interviews to investigate choices made in paraphrasing and source use.
5. Thematic analysis of interview data and cross-reference with written texts, followed by interpretation of results.

We developed a question list based on our research aim of exploring participants’ processes in using source material, and their understanding of paraphrasing and plagiarism in academic writing, which is visible in Table 3 below.

Table 3: Text-based interview core question list.

Question List	Rationale
Did you know anything about this topic before you started the task?	To establish participants’ familiarity with the subject matter.
Did you find it easy or difficult to complete the task? Why?	To contextualize the challenges the participants faced.
Can you tell me which information in the original text is similar to what you wrote? Can you show me/us where this information is in the original text?	To identify specific passages where source use had been incorporated into the written response, and whether such use constituted paraphrase or direct quotation.
Did you change the information in any way? How?	To explore how participants understood the process of source use and paraphrasing and applied it in real time.
What paraphrasing strategies have you learnt in your EAP course?	To understand participants’ knowledge of paraphrasing techniques and strategies and their appropriacy.
Were any of these useful in the task?	To understand how participants viewed and understood paraphrasing techniques.

Data analysis

Once interviews were completed, transcripts were created and refined. The interview data was analysed using a hybrid approach to thematic analysis following the framework of Fereday and Muir-Cochrane (2006) by way of QDAMiner software. Thematic analysis was selected as prior research has shown its efficacy in ELT contexts (Scheffler & Domińska, 2018; Waddington & Charikova, 2022). The hybrid approach seeks a balance between deductive coding, derived from an existing framework, and inductive coding, in which themes that emerge from participants’ discussions are identified (Fereday & Muir-Cochrane, 2006). For inductive coding, we began by reading through the transcripts and identifying initial themes, applying codes which were derived from the process of ‘seeing something’ and covered the ‘qualitative richness of the phenomenon’ (Boyatzis, 1998, p.1) and then iteratively and reflexively refining them following the procedure described by Fereday and Muir-Cochrane (2006). For the deductive aspect of our analysis, we aimed to identify whether aspects of the participants’ understanding of paraphrasing and the way in which they applied knowledge of source use belonged to one or more of Mott-Smith et al.’s (2017) dimensions of source use, as demonstrated in Table 4. We combined the inductive and deductive analysis

with close reading of the written responses and cross-referenced them to the interview transcripts. Throughout the interviews, participants were directed to passages of ‘importance’ as identified by the researchers and asked for their thoughts on how they had conducted paraphrasing or integrated source use into their answers.

Table 4: Mott-Smith et al.’s (2017) dimensions of source use.

Dimension	Elaboration
Concept	Deals with the underlying principles of source use in the Western academic context. This includes the individualistic approach to the ownership of ideas and knowledge and the value that violation of such principles constitutes plagiarism.
Sentence	Relates to the techniques of using sources in paraphrasing, creating written summaries of key points or ideas, and the use of quotations to communicate the work of others.
Discourse	How specific uses of source material take place inside a discourse community.
Process	The methods and techniques that can be used during the entire process of developing writing from source material, including reading and thinking.

Results

In this section, we report on the findings from the inductive and deductive analysis of the text-based interviews in conjunction with our analysis of the written response texts. The inductive analysis of the interview transcripts revealed that participants’ understanding of paraphrase and application during the task tended to focus firstly, and primarily, on transforming the linguistic structure of the source material and implanting it within the text to demonstrate a point. This was corroborated by close reading and examination of the written responses. Secondly, all participants had an underdeveloped understanding of the relationship between paraphrasing and plagiarism, an observation also made by Liao and Tseng (2010) in a similar study. Thirdly, from the interview data, we found that while participants were keen to engage in paraphrasing, they lacked the ability to do so as effectively as they wished or were concerned about accidentally violating the rules of plagiarism. Fourthly, participants doubted the efficacy of technology for assisting with paraphrasing.

For the deductive part of the analysis, and in relation to Mott-Smith et al.’s (2017) framework, the results of close reading of the written response, along with the analysis of interview transcripts, demonstrated that four of the five participants focused mainly on the sentence dimension and understood this to be at the core of source use and paraphrasing, and there was little understanding of the concept and discourse aspects of source use. The results of the analysis can be seen below in Table 5, and the examples are discussed along with additional excerpts and development of the themes below.

Table 5: Results table of themes and relation to Mott-Smith's Framework.

Theme	Framework Dimension	Example
Paraphrase is only a structural transformation	Sentence Dimension	Trudy: Keep some keywords if you want to paraphrase something and don't change the keywords, but you can change the other thing and mix in a new sentence.
Uncertain Interpretation of the Relationship Between Paraphrasing and Plagiarism	Sentence Dimension	Interviewer: Why do we talk about plagiarism and avoiding copying others' work? Jane: I don't really know.
Knowledge Constraints Limiting Ability to Paraphrase	Sentence Dimension	Interviewer: What do you know about plagiarism? Alice: I think also from translating too much? It can be also from reading.
Attitudes on using technology for paraphrasing	Process Dimension	Alice: Some paste it and just write it. It is not really effective to learn.

Theme 1: Paraphrase is only a structural transformation

For four of the five participants, the idea of paraphrasing referred mainly to a set of explicit techniques in manipulating language to express the same idea with or without attribution through an in-text citation. This represents a surface-level approach in which the goal of paraphrasing is broadly about changing the structure, grammar, or vocabulary while leaving the 'idea' intact. Deductively, this relates to the 'sentence' dimension of source use as identified by Mott-Smith et al. (2017). Conceptually, four of the participants did not seem to engage with the idea of altering, adding to, or using the idea in the source text to embolden or advance an argument, suggesting a reluctance to expand paraphrasing practice beyond the sentence dimension for concern about making mistakes. One participant, Jane was discussing how she had paraphrased a sentence and described her knowledge of how to paraphrase as follows:

Jane: Change the verb to a noun phrase and make the sentence active to passive. I think it's useful to do this in the citation (referring to a piece of directly reproduced text). But I didn't use it because I'm still confused with the in-text citation.

While Alice, Trudy, and Bob gave similar responses at differing points in their interviews, when asked how to paraphrase:

Alice: Changing some sentence structure and the phrasing. Using other words.

Bob: First of all I have to use - I can use synonyms, and then there are also - change the structure, order and change the word format.

Trudy: Keep some keywords if you want to paraphrase something and don't change the keywords, but you can change the other thing and mix in a new sentence.

This essentially related to a mechanistic understanding of 'converting' the language into another format while leaving the 'idea' unaltered and seemed to indicate that paraphrasing was only engaged with as an 'expectation' to avoid plagiarism but without a clear understanding of the 'concept dimension' relating to idea ownership. This however, contrasted with John, who saw paraphrasing as keeping core aspects of an idea, also using different words, but equally simplifying some aspects of 'the idea' and extending or elaborating on it with his own views, indicating a more complete understanding of the concept dimension of source use and an ability to embed authorial voice in his work. John also was able to take advanced approaches to summary writing, of which paraphrasing is a key part (Yeh et al., 2020):

Interviewer: And how did you paraphrase this section?

John: Simplified and elaborated.

Interviewer: Can you tell me how you've elaborated it?

John: Over here (*points to text*) I've just given like a little idea that smartphones help people maintain relationships, and then I've elaborated it by saying that it can be distracting and that's the reason why children should not have a smartphone.

John's response, which seems to draw on Yamada's (2003) idea of an additive paraphrase as a 'good' paraphrase, focuses on the idea of the sentence rather than the way in which it is communicated. When describing the strategy used to paraphrase a sentence about children from the source material, Alice's response demonstrates this contrast clearly:

Alice: Kind of sentence structure changing. Changing the word with a similar meaning. I tried to (change) these "children", to "young age people".

Overall, this theme suggests that when exploring the participants' understanding of paraphrase, it is strongly rooted in the sentence dimension of discourse, rather than an overall synthesis of source use. To some extent, this presents a risk when learners may be able to leverage new technologies which are effective for paraphrasing (Roe & Perkins, 2022) but do not allow for the analysis of a paraphrase from a position of subject-level knowledge, which is required for effective paraphrasing (Shi et al., 2012).

Theme 2: Uncertain interpretation of the relationship between paraphrasing and plagiarism

The second theme refers to that of uncertainty, which is somewhat to be expected at an early stage in acquiring skills in paraphrasing. However, this theme may more accurately characterize the fact that there are no clear guidelines as to what may or may not be an acceptable paraphrase, and that there is a degree of subjectivity which is difficult for learners to navigate. All participants felt a variable degree of uncertainty or confusion over what constituted an appropriate paraphrase and the role of citations and referencing, and this impacted their willingness to engage with the source text. In this sense, it can be argued that the general haziness of academic guidelines with regard to plagiarism (Abasi & Graves, 2008) contributes to student anxiety when faced with such tasks. When cross-referencing with her written response, Jane had mainly relied on direct quotations from the text. On the other hand, Jane especially understood that paraphrasing was an essential skill to avoid verbatim reproduction of others' ideas but was not sure why exactly this was an issue. This resulted in her sticking to a 'safe path' by directly quoting, regardless of the impact on style and argument in her writing. This finding suggests that an element of risk aversion plays a role in the decision not to engage in additive paraphrasing, rather than a lack of ability to do so.

Jane: (*explaining the relationship between paraphrase and plagiarism*) I think we need to (use in-text citations) to avoid academic plagiarism.

Interviewer: What's your understanding of academic plagiarism?

Jane: To copy their work.

Interviewer: Why do we talk about plagiarism and avoiding copying others' work?

Jane: I don't really know.

Similarly, Alice and Trudy demonstrated that they understood that plagiarism could result from translation, or from verbatim copying of others' work – but neither of the participants referred to the reproduction of ideas without giving due credit, again demonstrating a reliance more on the sentence dimension of source use as opposed to the concept dimension. In their written responses, this explained several paraphrased ideas which were not given in-text citations.

Interviewer: What do you know about plagiarism?

Alice: I think also from translating too much? It can be also from reading.

Trudy: It's like...copy something. To copy others - others - results? Or some other sentence. Just copy and don't use your own words.

Both Alice and Trudy felt that there was a great deal of uncertainty and ambiguity as to what characterized plagiarism and that the only way to avoid it was to rely on direct quotation or structural transformation of language. In-text citations were seen as less of a firm requirement, although the principle of 'copying' was brought up explicitly by Trudy and implicitly referenced by Alice. John was the only participant who took a values-based approach in explaining why plagiarism was unacceptable in his view and was the only participant to identify explicitly that plagiarism was based on a deceptive practice or presenting another's ideas as one's own.

John: I feel that it's really wrong to plagiarize and plagiarism can be leading to a lot of trouble. Plagiarism is when you're copying someone else's work, but you're not giving them credit and you're not informing that you've used the source. By lying that this is your own and this isn't your own, can be a form of plagiarism. And that's pretty much it.

This indicated that John had developed an understanding of paraphrasing based on general principles of academic integrity relating to the concept dimension, rather than the sentence or process dimension. In relation to cultures of previous educational experience, several participants expressed that they had been taught to paraphrase in English and in their L1 during their primary and high school education. However, this took a more codified, scientific approach which focused more on the sentence and process dimension, and teaching focused on a set of strict, mechanical techniques (e.g., if A is a noun, change it to a verb by engaging in process X, while if B is in the active voice, change it to the passive voice by engaging in process Y). In terms of contribution to the literature, this limited and mechanistic view of paraphrasing contrasts with the large variety of paraphrasing approaches and shared understanding of paraphrase identified by Shi et al. (2018), suggesting further research is needed to chart the process by which beginner students' understandings of paraphrase may develop and change as they become undergraduate and graduate students.

Theme 3: Knowledge constraints limiting the ability to paraphrase

All of the participants demonstrated an awareness that copying verbatim from the source text in the task was unacceptable. However, some indicated that they continued to employ practices they strongly doubted were correct because there were no other options available to them. In relation to the idea of patchwriting being a developmental phase (Pecorari, 2003), this finding supports the idea that students will engage in paraphrasing practices that they know are likely to violate the rules they are aware of but are yet to fully internalize. Furthermore, this may demonstrate that to avoid the potentially serious consequences of plagiarism accusations (Dawson & Overfield, 2006), beginning student-writers may recognize their lack of ability to paraphrase or cite source material correctly, and defer to strategies that they feel more confident in. This was clear when passages were highlighted for the attention of the participant, as in the following extract from Alice's interview:

Alice: Yeah, I think it's useful to use this in the citation. But I didn't use it because I'm still confused with the in-text citation.

In discussing more general reasons why paraphrasing is an obstacle for EAP learners, teaching and learning strategies frequently came up, as did past experience. Bob and Trudy referred to their peers' motivation and autonomy, and for Trudy, the teaching style of her previous learning experience in Korea played a role:

Bob: In my opinion, first of all, lack of vocabulary. Some people or some students who want to study English enthusiastically, but about 50% don't want to study English. That's why they I think they don't memorize English vocabulary.

Trudy: In Korea, teachers only follow the answer, do not do critical thinking and most people aren't interested in it. There are many methods to change it (the sentence) and change some more. In Korea, they would only say something like 'change this part from passive to active' or 'change this word like this'.

Bob identified that a lack of autonomy or determination in English is specifically related to a deficiency in vocabulary, thus leading to the idea that a greater vocabulary renders a greater ability in paraphrasing. This adds credence to the idea that GenAI tools and Automated Paraphrasing Tools (APTs) may offer a way for writers to avoid a cognitively challenging task (paraphrasing) and simply offload it to a technological tool, in the same way that a calculator may be used for a difficult calculation. This is an interesting area that warrants further study and exploration, as such an approach overlooked the inferential reasoning that a good paraphrase requires (Yamada, 2003).

Theme 4: Attitudes on using technology for paraphrasing

The final theme that was captured from the interview was more related to the process dimension, and the use of technology as an overall strategy for helping with not only paraphrasing but engaging with source use and comprehension. Interestingly, few of the students believed in the ability of technological tools to assist with writing. While all participants expressed their concern that other students on their course used technology to help them illegitimately achieve an 'acceptable' paraphrase with a minimum of effort, they doubted the ability of these tools to actually aid in language comprehension:

Jane: I think it (translation apps) is not helpful because we just put our mother language there and it cannot improve our skill. At the last time we still don't know how to paraphrase.

Alice: Some paste it and just write it. It is not really effective to learn.

Implicitly, this indicated some understanding of the concept dimension of source use and the expectations of the discourse and process aspects of source use, as participants were aware that the use of source material must be completed by themselves rather than by a third party, and

the avoidance of engaging in processes of reading, thinking, and finally writing, would not lead to success in their writing tasks.

Discussion

The development of these themes and analysis of them in relation to an established framework offers several unique findings which have relevance for EAP programs, policy, and instructors who are engaged in teaching paraphrasing and source use. Firstly, there is corroboration of the tendency for ESL students (at an early stage, at least) to rely more on knowledge-telling than knowledge-transforming paraphrases (Hirvela & Du, 2013). By this, we refer to the process by which learners choose to apply a formulaic system to paraphrase, by changing word classes (e.g. nominalization) which retains the exact same content of the original source, rather than drawing on the first source to retain some characteristics, but add to or transform some aspect of the source material's content.

Interestingly, our study demonstrates that for these participants, despite knowing some basic premises regarding academic integrity and plagiarism avoidance, the knowledge-telling approach may be a deliberate, risk-averse strategy to attempt to avoid the heavy tolls that come with a plagiarism accusation. As a result, to encourage learners to experiment with paraphrasing in EAP programs and develop an authorial voice, it may be necessary to adopt policies which recognize that these are appropriate stages of learner development (Pecorari, 2003) and view inappropriate episodes of paraphrase as 'teachable moments' (Briggs & Kim, 2020). By doing this, it is possible to help learners develop the skill of transforming source material rather than simply using mechanistic paraphrase strategies to retell the same information.

Furthermore, some evidence emerged that tendencies for previous educational experiences in participants' home cultures tended to focus on a more mechanistic approach to the teaching of paraphrasing. On the other hand, an alternative explanation for this may be the tacit dominance of structuralist or skills-based approaches to the teaching and learning of paraphrasing within EAP programs. This suggests that there should be an educational focus on ensuring curricular and pedagogic practices that explicitly target the development of students' understanding of broader concepts of why sources are used, instead of how. Further to this, our results support Sun and Soden (2021)'s recommendations to improve source use include using exemplars, providing opportunities to practice, providing scaffolding, and offering detailed feedback for tasks which vary in length and style, while we also encourage educators to explore new opportunities to engage in techniques such as Written Language (WL) (Keshanchi et al., 2022) to support the development of paraphrasing and source-use skills.

Finally, our participants' hesitance in using technology to assist in paraphrasing, and their belief in technological tools' lack of ability to provide effective guidance in paraphrasing and source use is a point that warrants further investigation.

Research has shown that technological tools may be effective for supporting paraphrasing tuition (Chui, 2023). Yet, acceptance of these tools and attitudes towards these tools among EAP students has not yet been explored. As a result, research studies should be geared towards not only understanding the potential benefits of using tools such as ChatGPT as personal tutors (Chui, 2023) but also investigating whether students truly believe that they may be effective in educating them about how to paraphrase and engage with source material.

Implications

Overall, the findings of this study have implications for curriculum development and the teaching of source use in EAP programs and open up important areas for furthering this aspect of writing as educators and institutions continue to grapple with new technological developments. The results of our study rely on a small number of participants (five), yet the discussions and analysis of the tasks that participants engaged in provided rich insights into their experience of paraphrasing. Given that our research question was "How do students in an EAP preparatory course choose what to paraphrase in a writing task?" we may answer that in this case, participants tended towards choosing aspects of the text which did not necessarily support their arguments, but that they could modify using their existing repertoire of techniques comfortably and without fear of having violated any institutional or cultural norms of academic integrity. This suggests that there is a disconnect between common university-level policies on academic integrity and text modification and the recognition that in EAP specifically, for learners to learn to paraphrase effectively, they must transition through a patchwork phase. Similarly, although our participants were sceptical of technology, we propose that they may have a place in the classroom teaching of paraphrase, if they are introduced critically and in line with the values of the institution. Indeed, research has shown that the consensus among universities and publishers now accepts the use of GenAI tools specifically in the creation of text, as long as it adheres to certain guidelines and values (Perkins & Roe, 2023a, 2023b).

Limitations

The limitations of this study relate to the fact that it is a small-scale analysis of five international students' experiences in an EAP program. Furthermore, the task that we used, although carefully designed, does not necessarily allow for the space, time, and reflection that is often required in writing academic essays, nor did it enable participants to experiment with supportive tools, writing assistants, or GenAI tools in composing their responses. In that sense, there is a question of whether the text produced can be considered a representative or authentic method of assessment. On the other hand, by tackling an established task outlined in Pecorari's (2022) research agenda, we contribute to filling this gap in the literature and call for other studies to help develop further insight into source use and paraphrase among other cultural and educational contexts.

Conclusion

In an era of rapid technological growth, internationalization, and massification of higher education, we do not expect that skills like paraphrasing will become redundant or obsolete. While technologies such as GenAI may assist and complement these fundamental skills, there is a requirement for the expertise of teachers and a 'human in the loop'. To this end, by understanding the strategies that EAP learners want to adopt when paraphrasing without the use of advanced technologies, as in this study, teachers as experts can be responsive to learners' concerns and enable them to develop. This research has demonstrated some key considerations regarding the choices made when paraphrasing or engaging with source material among international students enrolled on an EAP program, namely that even at this early stage, students may default to safe, known strategies (often typified by a mechanistic approach to paraphrasing) despite knowing it will not fulfil the criteria of a 'good' paraphrase, and learners may be hesitant or sceptical to engage in the use of technology to aid paraphrasing and source use in language learning. Our results suggest that further specific research is needed in diverse contexts to investigate how current disruptions in the teaching of writing affect students, and how educators and institutions can provide supportive policies to aid learners' ability to engage with source material.

Declaration of Interest Statement

None.

Declarations

Ethical Approval

Ethical Approval was granted by James Cook University Australia, Reference H8944.

Competing interests

The authors declare no competing interests.

Authors' contributions

Jasper Roe contributed to ideation, data analysis and writing up of the manuscript. Daniel O'Sullivan contributed to ideation, interviews, data analysis, and writing up. Pamela Arumynathan and Boby Kappen contributed to data analysis and writing up of results. All authors contributed to development of the structure and interview materials.

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Effective online material development: A micro-model taxonomy for designing simulations to maximise tertiary students' learning

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Abstract

Since the COVID-19 pandemic, the migration to teaching and learning using technology-enhanced activities has accelerated, especially in higher education. With this shift, teaching staff are required to either use commercial products or develop individual online teaching resources. However, commercial resources come with a cost, may not exist for the required topic(s), or may not suit the teaching requirements of a particular student cohort. In addition, it is common for most academics to have limited to no experience in making educationally effective interactive technology-enhanced learning resources. Thus, generated materials may lack critical features that maximise student learning experiences. To address this problem, we distilled over a decade's experience designing and implementing online educational materials for tertiary STEM and Medical and Health Science courses to develop a micro-model taxonomy. Our proposed model builds on the ASSURE and Design Thinking Macro models providing a detailed breakdown of important factors and justifications, where possible, for their inclusion in all resources. While our approach is based on the Articulate Storyline software platform, the taxonomy is software agnostic and can be applied to the design of any technology-enhanced learning resource for any course. Potential pitfalls and areas for enhancing student learning are also addressed.

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Introduction

The fourth industrial revolution and the use of artificial intelligence (AI) and virtual reality (VR) technologies for educational purposes started in the early 2010s (Chaka, 2023). VR field trips, virtual laboratories, and simulations are some examples of useful activities. These activities and teaching materials can help overcome the limitations of didactic/descriptive and authentic/real-life education and pave the way for the implementation of reflexive and transformative pedagogies as they recreate real-world characteristics of situations (Beaubien & Baker, 2017). They also allow educators to teach their students and help them develop a variety of skills including critical thinking, problem-solving, designing, co-designing, making, and producing knowledge. Furthermore, they can approximate practice, especially if the activities comply with learners' needs and are accompanied by detailed feedback that informs students of the differences between their competency and the one that is desired (Chernikova et al., 2020).

For instance, VR field trips, virtual laboratories, and simulations have been used in teaching tertiary science, technology, engineering, and mathematics (STEM) and Medical and Health Sciences courses, especially as face-to-face laboratory classes are an expensive option for universities due to the cost of specialist infrastructure and reagents. In addition, for geographically dispersed students, the cost of commuting to university can be significant, and virtual laboratories can decrease the costs. VR field trips and simulations have also been used in other disciplines, including Education (e.g., Christou, 2010), Law (e.g., McFaul & FitzGerald, 2020), and Humanities, Art, and Social Sciences (HASS) (e.g., Hutson & Olsen, 2022).

The COVID-19 pandemic forced most educational institutions to transition from face-to-face teaching to online, which has subsequently expedited the use of the previously mentioned technologies in education in the last two years. In making use of technology-enhanced resources, educators can utilise pre-existing resources, which are either developed in-house or provided by a commercial entity (Crawford et al., 2020) if they are free, match the required topic, and suit the teaching needs of the student cohort (Costabile, 2020). Otherwise, academics, who are typically time-poor and have no or limited expertise in using advanced software, are forced to generate bespoke interactive technology-enhanced learning resources which can lead to the development of resources that may not include critical features to maximise a student's learning experience.

There are several studies in the literature which have investigated this unexpected shift and the use of technology-enhanced materials from different perspectives (e.g., Al-Kahtani, 2022; Gómez-Rey et al., 2021; Saleem et al., 2021). For example, some studies have examined the efficacy of online learning resources such as simulations and have shown both positive (Birrenbach et al., 2021; Kumar et al., 2023; Ooi et al., 2022; Pryor & Park, 2024) and negative (Watermeyer et al., 2021) impacts of the use of these technologies on student's learning. Other studies have introduced macro-model taxonomies to illustrate the broad steps in designing technology-enhanced materials

for students, for example, the design thinking framework (DTF) or the ASSURE model (Smaldino et al., 2012). However, to the best of our knowledge, there are no micro-model classifications that provide specific details in this regard for use by academics.

To address this gap in the literature, we developed a micro-model taxonomy based on over ten years of experience in creating effective simulations to teach both lecture and laboratory content in tertiary STEM courses (Biochemistry, Immunology, and Microbiology) at the University of South Australia. Therefore, our research approach was a retrospective analysis of learnings from the creation of enhanced learning resources which have demonstrated impacts on student learning. These simulations were informed by continuous personal reflection and student feedback leading to iterative refinements in our approach. Our micro-model scaffolding framework identifies key points to consider when designing and developing simulation activities. To provide academics with a comprehensive approach and to make it easier to follow our micro-model taxonomy, our model is framed within the ASSURE model (Smaldino et al., 2012). While we have used Articulate Storyline, our framework is software agnostic, and it can be applied to the design of any online interactive learning resource, for any courses in STEM, Medical and Health Sciences, Education, Law, and HASS using any software platform.

The existing macro-model taxonomies

Both the DTF and ASSURE macro-model taxonomies are typically used by educators to design and integrate technology into education. The DTF, which originated from the early works of design methodologists in the 1960s, was originally an approach to problem-solving and identified the tools and methods that could be used to solve management problems in organisations (Elsbach & Stigiani, 2018). However, later, the related strategies were adapted and used in education to introduce a human-centric scaffolding model for planning content that can develop a student's critical thinking, collaboration, and problem-solving skills. The DTF is thus a suitable support for tertiary educators in 21st-century classrooms, especially when implementing constructivist and technology-enhanced learning (Dorji et al., 2020; Hennessey & Mueller, 2020; Scheer et al., 2012). The model consists of five stages: Empathise: research your users' needs; Define: state your users' needs and problems; Ideate: challenge assumptions and create ideas; Prototype: start to create solutions; Test: try your solutions out (Wolniak, 2017).

Similarly, the ASSURE model was designed to aid educators with their technology choice and integration. Students and their needs are the main points of focus. The model consists of six steps: Analyse learners; state standards and objectives; select strategies, technology, media, and materials; utilise technology, media, and materials; require learner participation; and evaluate and revise (See Table 1 for more details of each step). Both the DTF and ASSURE frameworks propose similar stages and have been widely used by educators and material developers (e.g., Bajracharya, 2019; Karakiş et al., 2016; Listiani, 2017), with the ASSURE model

being more comprehensive, introducing an evaluation and revision step. Hence, we framed our micro model taxonomy within the ASSURE macro model. Framing a micro model in a macro model classification allows us to bridge the gap between a model that has a high-level overview and introduces general steps and a model that is more focused and proposes detailed steps in designing and preparing technology-enhanced materials. This approach provides academics with a comprehensive approach that facilitates the adoption of our micro-model taxonomy. Our model builds on the ASSURE model by including an additional stage, as well as fine-level details and rationalisation of each inclusion to the model.

Table 1. Steps outlined in the ASSURE model (Smaldino et al., 2012, p. 39).

Step	Steps	Descriptions
1	Analyse learners	Analyse learners in terms of their general characteristics, entry competencies (e.g., skills and attitudes) and learning styles.
2	State standards and objectives	Define the learning standards and objectives and make them as specific as possible by including the learners' names and their related objectives, the action, and conditions (use of technology and media) that need to be taken into account, and the mastery level of the knowledge degree to which the new knowledge or skill must be mastered.
3	Select strategies, technology, media, and materials	Build a bridge between the first and second stages "by choosing appropriate instructional strategies, technology, media, and materials to achieve the objectives".
4	Utilise technology, media, and materials	Plan your teaching role by following the "5 Ps" process: "Preview the technology, media, and materials; Prepare the technology, media, and materials; Prepare the environment, Prepare the learners; and Provide the learning experience".
5	Require learner participation	Prepare activities that let them practice the new knowledge or skills and receive feedback before being formally assessed.
6	Evaluate and revise	Evaluate the lesson by examining the students' level of achievement as well as the instructional process and the use of technology and media and revise the lesson plan to address the discrepancies.

Simulations

Our micro model taxonomy was derived from over ten years of experience in developing, assessing, and disseminating the impact of interactive simulations to demonstrate key principles, processes, and practices to undergraduate STEM students (Costabile & Timms, 2020; Costabile & Birbeck, 2023; Costabile & Turkanovic, 2022; O'Flaherty & Costabile, 2020). Simulations can range from computer-generated programs that replicate key processes and lecture topics to highly authentic hospital mannequins. The technology enables learners to engage in realistic and immersive scenarios by replicating some or all aspects of a clinical situation which creates a safe educational setting for students to practice and improve their skills (Burton & Hope, 2018; Hill et al., 2024). The choice of simulation will depend on the target skill(s) and the learning context. For example, role play can be used to improve communication skills, images can be employed to instruct radiologists, or simulations and images can be combined (Chernikova et al., 2020). Simulations have also been used in educating prospective teachers on how to teach in class and communicate effectively with students (Aebersold et al., 2012).

While commercial packages can be purchased to teach students, there are great benefits for academics in developing student and content-specific simulations. These include creating custom products, focusing on specific details, adding multiple-choice questions (MCQs),

and providing immediate feedback, which can be readily modified and adapted for future changes or used in different contexts by colleagues. In addition, when properly designed, a simulation can provide background content to help guide students through fundamental principles and can question them throughout to assess their learning. Therefore, negative consequences of lecture and laboratory misalignment of content will not impact a student's learning (Costabile & Timms, 2020).

Furthermore, simulations can be deployed across different learning management systems (LMS), such as Moodle or Canvas, for effective integration into a university setting. This allows academics to collect key analytic data, including the number of times the simulation has been accessed, the responses to the MCQs, and any written feedback entered into the simulation. Student assessment results can then be recorded either in a summative or formative manner through the LMS. Academics and teaching assistants can thus track the performance of individual students and provide additional assistance when necessary. However, while there are clear advantages to this approach, most academics will lack the required knowledge of all the elements required to generate effective technology-enhanced resources. This will also include choosing the technology appropriate for the desired activity, how to use the software, and ensuring the inclusion of the complete suite of required components for effective student learning. These critical elements led to our creation of a micromodel taxonomy and checklist.

Micro-model taxonomy to design simulations

As explained, to give a better structure to our micro-model taxonomy and to facilitate inclusion of critical learning elements, for academics when designing technology-enhanced activities, our micro-model was framed within the ASSURE model. Our model is diagrammatically shown in Figure 1. A checklist outlining each of the key features that facilitate the creation of an effective learning resource is provided in the Appendix.

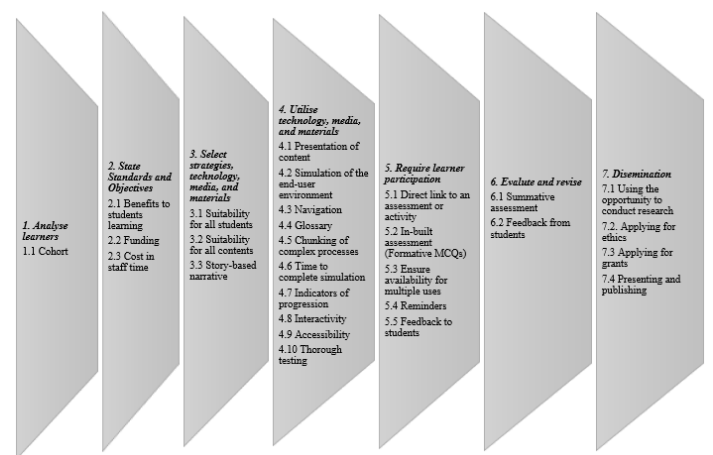


Figure 1. A diagram illustrating our proposed Micro-model taxonomy placed within the ASSURE model.

Detailed explanation of the proposed micro-model stages

Analyse learners

Cohort

Each learning resource should be designed based on a clear understanding of the cohort's learning needs and the educator's objectives based on discipline or end-user needs. Academics should identify the year level of students for which their material(s) will be used, i.e., 1st, 2nd, 3rd, etc. This will define their cohort's competencies and hence determine the level of required details. If all cohorts will be accessing the activities, they should be designed in a way that each cohort can access individual sections, and this can be distinguished within the materials using tabs, buttons, icons, etc., that allow students to select their level-related content. The learning resources can also be duplicated for use by senior students, with advanced content hidden or removed for first-year students. In addition, sufficient and appropriate background knowledge should be provided to ensure learning and progression through the simulation for all students.

State standards and objectives

Benefits to students learning

What are the benefits to student learning through the provision of an interactive learning resource, such as a simulation? Learning resources, such as simulations should be designed to be interactive, with the students required to participate in as many stages as possible. This learning can occur both inside and outside of classrooms, allowing students to control when and where the learning takes place, an opportunity most students value highly. In alignment with this idea, technology-enhanced materials are accessible anywhere, at any time, and should be able to be completed in under 30 minutes. Given the online nature of the teaching, a stable internet connection is required, which may not be true in all cases.

The provision of background information or a case study can make the activity more engaging. The inclusion of this background information is particularly useful when content is delivered out of sequence with other didactic teaching methods. For example, due to timetabling constraints, we typically teach the experimental principles of enzyme kinetics in a laboratory session before the content is presented in lectures midway through the semester. Therefore, students may be under-prepared for this learning opportunity. In this case, the use of a simulation proved to be an effective way to deliver the content to students who undertook their laboratory course early in the semester yet were not able to listen to the lecture content (Costabile & Timms, 2020).

Once generated, the activities can be used by students in related fields (e.g., immunology, nursing, pharmacy, midwifery). This can help to distribute the initial cost, as well as time requirements from the staff member. In addition, more students can benefit from each learning resource.

Once generated, the activities can also be modified to deliver content that is related but different from the initial activity. This can reduce the costs and time that is needed for the development of future activities.

The activity can also augment situations where 'real-world' testing is not possible. This is particularly true when time is limited, and the required resources are not available within an institution. In addition, for example, it could be argued that using a simulation can replicate the key stages authentically so that direct interaction in a laboratory setting may not be necessary to ensure students' understanding and full learning experience. This can help with safety and costs and can cover the limited availability of equipment or specialist skills in the laboratory.

Funding

There will be a cost in generating simulations using a commercial platform. However, in many cases, an institution may already have a license for this software or have educational designers who have expertise and access to the software. If not, academics can seek funding through the institution, granting bodies, or other philanthropic means. We have noted that an educationally effective simulation that takes a student approximately 15 minutes to complete will cost approximately 2,000 to 3,000 USD to generate. In addition, there is longevity in the simulations that are generated, particularly when they are focused on a topic or content that is central to student learning, for example, monoclonal antibody production (Costabile & Turkanovic, 2022). In this example, the fundamentals of the approach have not changed since its discovery in 1975 and continue to be used, so the learning resource will remain valid for many years without detriment to the student experience.

Cost in staff time

There is also a cost associated with staff time. There are two feasible options for academics; they can learn to use the software and develop their materials and activities. This has been our experience, and it can be a rewarding approach. However, with the constraints on academic time and productivity, the other option is to use an educational designer. Most universities will have an educational designer who can generate the materials faster and with fewer issues than an academic staff member learning to use the software. In addition, since they are employed by a university, the cost may be absorbed by the unit or faculty.

Select strategies, technology, media, and materials

The traditional presentation of content via lectures can be viewed as boring and disengaging for students. For some academics, the shift from face-to-face to online means converting their written material to PowerPoint, leading to "death by PowerPoint" (Sharp et al., 2019). Thus, when an educator wishes to try a new learning approach such as an interactive simulation, for the resource to be effective, it must be designed to achieve its learning objectives.

Suitability for all students

Students learn through multiple modalities and may have a preference for visual, auditory, writing, or kinaesthetic approaches (Fleming, 1995). In practice, students will make use of multiple aspects as part of their learning approach. The materials and activities should be designed to include as many activities as possible to ensure an active learning approach. For example, images can be added for visuals, audio can be used to provide instructions through the online characters, students can enter responses by typing into a simulation, and kinaesthetic requires them to use the mouse to engage with the simulation prompts.

Suitability for all content

A key question when embarking on developing interactive learning resources relates to the suitability of the content for the chosen approach. Based on our experience, we would argue that most, if not all, content can be taught using a simulation; however, for some content, the approach may not be immediately apparent and may require lateral thinking. But the question is: Are there any better options? In some instances, the use of a simulation and how best to engage students may not be immediately identifiable. This can be challenging, but at the same time, it can be highly rewarding with the development of an approach that is novel yet highly targeted to the content and the student population. One approach that we have used effectively is generating a simulation that is relevant to the topic being covered with a strong, relevant narrative. For example, when teaching hemolytic disease of the newborn (HDN), we placed the student in the role of a gynaecologist dealing with a first-time mother (Costabile & Birbeck, 2023). Doing so clearly defines the role of the student, establishes the content area in the discipline, highlights the importance of the subject matter, and facilitates the linking of content previously presented in class. As suggested by the name, linking the concept to be demonstrated/taught to a story provides relevance to the topic and enhances student engagement. This can be aided by using animated characters, which can be utilised to develop the context of the situation.

Choice of platforms

An academic's choice of platform should be based on the content of the lesson which will be covered. Articulate Storyline (more recently, Storyline 360) is a commonly used software platform designed to generate interactive learning resources, such as simulations. This software is popular due to its simple learning curve and interface based on Microsoft PowerPoint, as well as its large user support community. The software can generate simulations that range from simple to complex, covering all aspects of student learning. However, if the content is simple and more text-based, the use of alternative platforms, such as H5P, may be suitable. If the process is more procedural, such as demonstrating a principle or steps in a laboratory setting, then an Articulate Storyline or Unity-based simulation can be used. If a situational topic needs to be covered, then VR/AR interactions can make the learning even more tangible

for students. Each approach will also have cost, time, and resource implications that should be considered.

Utilise technology, media, and material

According to Smaldino et al. (2012, p. 39), it is important to follow the "5 Ps" process: "Preview the technology, media, and materials; Prepare the technology, media, and materials; Prepare the environment, Prepare the learners; and Provide the learning experience", in other words, implement it/them.

Presentation of content (vary for engagement)

Information should be presented in more than one way. For example, use a combination of written text, audio explanations, video files, graphs, and diagrams, as well as more visually stimulating approaches such as whiteboard animations. The diversity of material presentation can make the learning resource more engaging and cater to diverse learning styles.

Simulate the end-user environment

A simple approach that can be used to embed the content within the simulation and enhance the relationship with the students is using a visual background relevant to the topic. Depending on the end-user environment, the visual interaction of the simulation should be developed to mirror that environment. For example, for STEM students, the use of a laboratory notebook (Figure 2) or laboratory setting (Figure 3) can help make the simulation appear more realistic, allowing students to place the theory of the process into a realistic virtual setting. Therefore, after choosing the story-based narrative simulation as the technology in the case of the HDN, to keep the graphics that relate to the story highly relevant, we used a hospital setting.

Navigation

Once a narrative and its related visual representation have been developed, it is important to design a simple and clear mode of navigation. Most students will not have encountered interactive simulations as a learning aid previously. Hence, clear instructions must be provided as to how the materials and activities behave and how the students should navigate the simulation. These instructions should be in both written and audio/video format. The audio can be either a computer-generated voice or a human voice recording. With the recent advances in artificial intelligence, realistic computer-generated voices can be readily generated and modified. They vary in their quality, but great strides have been made in the degree to which the audio now matches a human voice. Delays in timing can be introduced to help make the audio sound more human-like. Key aspects in navigating a simulation include how to advance and return to a previous slide in the simulation, how to restart the simulation, and how to skip to a certain section (if a purposeful part of the design). It can be useful to use tabs, buttons, or visual icons on the home page to allow the student to skip to a

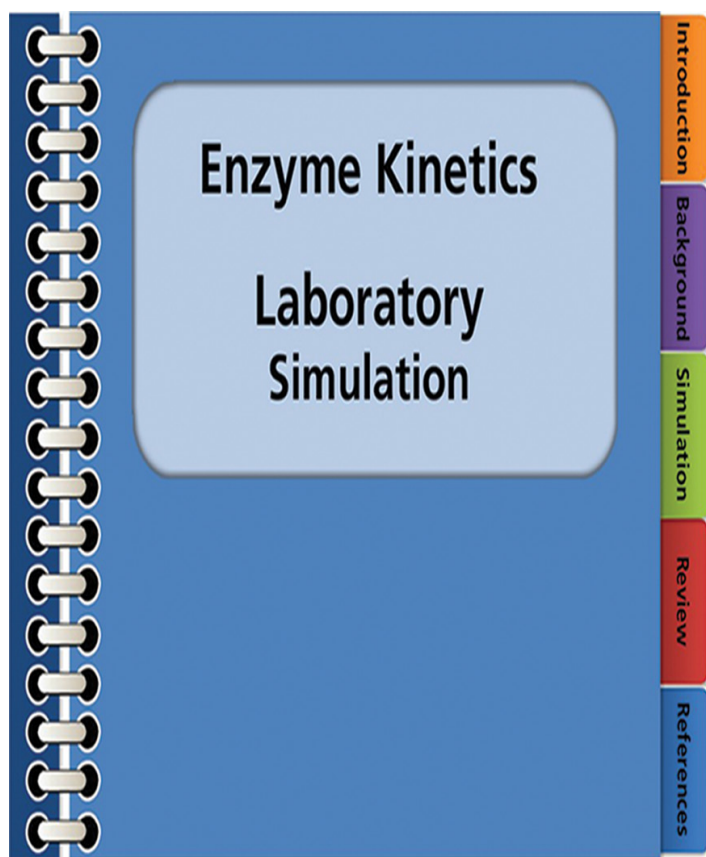


Figure 2. Simulation making use of a laboratory notebook graphic for a Biochemistry topic.

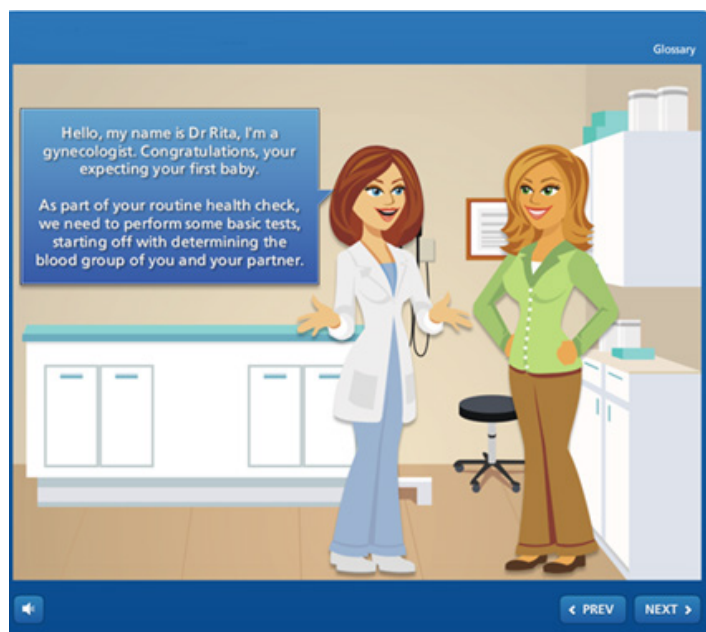


Figure 3. Simulation making use of a laboratory setting for an Immunology topic (O'Flaherty & Costabile, 2020; Costabile, 2020).

particular section. This approach is particularly useful when background information is provided in a simulation, such as in a laboratory setting. However, this approach may not be required for all simulations.

Glossary

In most disciplines, and especially in STEM, there will be terminologies that will be unfamiliar to students and hence pose a learning hurdle. For example, the diverse terminology used in immunology is a major learning challenge for medical students (Haidaris & Frelinger, 2019). As a result, the introduction of unfamiliar terms or terms that students have only heard once or twice previously can pose a learning challenge. A straightforward way to overcome this issue is to include a glossary of common terms. Students can use this glossary throughout the simulation to better understand the meaning of key terms. It is important to only include the terms that are relevant to the materials or the content and to resist the temptation to include more than is required. To summarise, it is imperative to consider the relevance of the terms to the particular situation when determining which terms to include or exclude.

Chunking of complex processes

The principal consideration for using interactive simulations is to teach a single concept to students. In most cases, this concept will be challenging to understand, cannot be readily demonstrated in class through interactions, or is a new idea or topic being taught to senior students. Given that the content will be complex, it is important to divide the content into smaller topics or manageable stages, referred to as "chunking" (Thalmann et al., 2019; Van de Pol et al., 2010). Chunking "reduces the load on working memory via retrieval of a compact chunk representation from long-term memory [...] and frees up capacity for subsequently encoded material" (Thalmann et al., 2019, p. 37). For example, the process of making monoclonal antibodies (mAb) includes seven discrete stages. Each stage can be a "chunk" and covered in the required level of detail. Within each stage, material can be cut into even smaller chunks, as required. In our example, these steps follow the same steps seen in a real laboratory setting by reinforcing the content further and aligning it to real-world practice. This practice is key when a student enters the work environment.

Time to complete a simulation

With the shift to online education, it has become more apparent that we are all time-poor, and there are multiple sources of distractions for students, such as the Internet, social media, mobile phones, etc. Thus, academics must treat student time as precious and make a simulation only if required. Academics must resist the temptation to include all elements of a topic in a single online material and activity. From a practical point of view, materials that are too long, require more time to develop, are more expensive to develop, and have more potential interactions that need to be checked. From a student perspective, students can and do lose focus if the simulation is too long, and this will affect their level of engagement (Chamberlain et al., 2014). Therefore, if a large amount of information is to be presented, it is preferable to generate several smaller learning resources as opposed to one large unit. From our experience, each learning resource and its activities should

take approximately 20 minutes to be completed by a well-prepared, competent student. Students with a better grasp of the content will require less time, while unprepared students can still complete while maintaining engagement.

Indicators of progression

As explained earlier, consistent with the idea of chunking (addressing a single concept and topic in each material) and the necessity of avoiding including additional and irrelevant content, each resource should take approximately 15-20 minutes (maximum) to complete by a student following the instructions and understanding the content. For the student to know how far they have progressed through the activities, indicators of progression, such as a simple timeline, a time clock indicating the slide number, or a series of dots that progressively are filled until the end of the simulation is reached, can be effective in communicating this information. This approach can help enhance student engagement and ensure they complete the work.

Interactivity

When academics use materials that are available online, they may not cover the exact topic required, they may not cover it at the same depth required by the academic, nor can it be readily modified by the user. When considering video presentations as a substitute, one major disadvantage to this approach is the “passive” nature of any learning. Students are not tasked to be “actively” involved in the learning activity, which has been widely demonstrated to be key to learning (Freeman et al., 2014). In contrast, user-developed materials and activities (e.g., simulations) inherently require the involvement of the student, making it a much more engaging and active process (Costabile et al., 2024). Ensuring student engagement and learning of content in this way is challenging hence making the approach interactive and more academically engaging. Making the materials interactive allows the academic to ask students to make choices that are related to the content as often as required throughout the interaction. This places the students in charge of their learning, and they will be active rather than passive participants, such as when watching a video. As we will discuss later, this also provides the opportunity for immediate or delayed feedback to the students as they progress through the simulation.

Accessibility

We have recently argued that simulations are effective pedagogical tools for courses with a significant amount of content typically delivered in a didactic manner (Costabile et al., 2024). We argue that concepts that impose a high cognitive load or are threshold learning concepts need to be taught using active learning strategies, such as a simulation. Given that these topics are likely to be conceptually difficult for students, the content must be presented in a simple-to-understand manner, yet still retain the rigour required within the discipline. Thus, any materials and activities that are generated must be easy for the student to use. Issues

with navigating new learning technologies are known to reduce student engagement (Bourgonjon et al., 2010).

Thorough testing

For an optimal end-user experience, all materials and activities must undergo thorough testing to ensure that all connections, links, and actions occur as expected. We suggest that the author(s) include testing, which is undertaken by someone from outside the field and/or less familiar with the content since they are likely to make interactions that might not be expected. This approach can be highly effective in identifying outcomes that may not be predicted by the educational designer. Otherwise, erroneous outcomes can confuse students, lead to their dissatisfaction with the materials and activities, and distract them from their learning.

Require learner participation

According to Smaldino et al. (2012), it is important that educators prepare activities that let students practice the new knowledge or skills and receive feedback before being formally assessed. For example, in a simulation, students should be provided with choices and have consequences for these choices. In addition, presenting immediate feedback following a choice is highly beneficial to student learning as it immediately strengthens the concept under investigation.

Direct link to a particular topic or activity (e.g., laboratory session)

Interactive learning resources should be designed around a particular topic. Doing so provides context and assists the student in focusing on a single idea or theme. It also validates that the simulation is focussed on student learning and not being developed only for an academic’s interest. Ensure the link is clear to a lecture topic and/or an assessment item for best engagement. This can also then be used as a means of assessing the impact of the simulation on student learning, as explained previously.

In-built assessment (Formative MCQs)

Upon completion of the material, it is useful for students to evaluate their knowledge and understanding of the content. One approach that can be used effectively is the inclusion of MCQs. The opportunity for students to assess their understanding via MCQs is highly valued (Balasubramanian et al., 2006; Grossman & Conelius, 2015). MCQs allow students to determine whether they have fully understood the content and to identify aspects that may require further clarification and determine if they should repeat the simulation. MCQs are particularly useful when used in a formative manner, as this can encourage students to attempt multiple times with no impact on their final grade. It is suggested that between ten to 20 MCQs are included, as too few are unlikely to cover all the content.

Ensure availability for multiple uses (unless for an assessment)
As noted above, MCQs are important for students to assess their understanding of the content. But it is also important that they are allowed to undertake multiple attempts at a question, as this allows the student to gain feedback on all the possible answers. This is a valuable learning opportunity for the student during the initial phases of teaching and learning. The only time where this might not be an option is if the questions are part of a formal assessment. In our experience, we have observed that students use our simulations multiple times during a study period, ranging from two accessions up to even sixteen accessions per student.

Feedback to students

Within a simulation setting, two major forms of feedback should be provided to students. Feedback, such as MCQs, numerical answers, or any other forms of selection, is encouraged while a student is engaging with an interactive element. This feedback guides the user in determining the correct answer to a question. After the students have selected an option in the simulation, immediate detailed feedback should be provided. Studies have shown that learning is enhanced by immediate feedback (Dihoff et al., 2004; Pardo et al., 2019). Importantly, feedback should be provided for both correct and incorrect choices. Feedback for a correct choice allows for further validation of the rationale for the choice, while feedback after an incorrect choice provides the opportunity for clarification of the common errors in the content. It has been our experience that when students are given the opportunity of unlimited attempts, they purposely select incorrect answers to be able to view all the possible feedback options; further highlighting this as an excellent learning opportunity.

Reminders

The teaching staff need to be proactive in informing students about the rationale for the benefits of using a simulation for their learning. In most cases, this requires multiple reminders, which can be either verbal or automated via email. Hence, academics should encourage students to make use of the materials and activities.

Evaluate and revise

Once the simulation has been introduced, its impact on student learning objectives must be assessed. This can be achieved through a mixed-methods approach that uses quantitative measures of student performance in an assessable component, as well as qualitative student feedback. This information can be used to modify the content and ensure that it meets the student end user's needs.

Summative assessment

MCQs can be used in a summative manner, as they facilitate capturing student marks. When the content is being delivered to students, MCQs should be asked in a staged manner. That is, the concept of the term is delivered, and then a follow-up question is used to delve deeper into the understanding of the concept/terminology.

Feedback from students

While academics and educational developers can develop a simulation that operates as expected, they cannot predict all the possible interactions and feedback from the students' perspectives. Hence, student end users should be provided with the opportunity to provide feedback to the academic on all aspects of the simulation, such as ease of use, presentation of concepts, effectiveness in explaining key concepts, and formative MCQs. This feedback can and should be used to refine the simulation. Aspects that may not be clear to the students will be readily relayed back to the academic, and these can then be improved in future iterations. Feedback can come in multiple forms, including Likert scale and questionnaire-based feedback. In addition, focus groups can be used to delve deeper into the students' perspective of the simulation's benefits. Students' feedback can also be used to identify other areas that may benefit from a similar intervention that may not be immediately recognised by the teaching academics.

Dissemination

Using the opportunity to conduct research

As is true for all educational activities, it is unlikely that every student will engage in this alternative teaching approach. While this might be discouraging for academics, it does provide an alternative opportunity to assess the impact of these types of educational activities on student learning, i.e., to assess the efficacy of the simulation. Students who do not use the learning resource can be considered a default, control group to which the assessments of the students who engaged with the simulation can be compared. The necessary data can be collected after the first iteration of materials and activities, and it can be used to validate their use for future student cohorts. In one of our cases with the design and use of simulations, our data has been included in a laboratory manual as further evidence of the benefit of the technology for student learning.

Applying for ethics

With all research, institutional approval is required for all planned activities. At the University of South Australia, activities that are designed for the improvement of the course and will not be published can occur without formal human research ethical clearance. However, the inclusion of a dissemination strategy moves the work into the realm of scholarship of teaching and learning and hence requires full human ethics clearance.

Applying for grants

The outcome of the learning research can be used as the basis for applying for institutional and external grant funding to support the activities of the educator and their discipline area. This is beneficial to the scholarly profile of the individual and/or team, contributing to future promotion applications and recognition within the University and more widely.

Presenting and publishing

Lastly, the staff members can disseminate their findings at local, national, and international levels through poster or conference presentations, and publish their work in conference proceedings and peer-reviewed publications. How to undertake this process is beyond the scope of this manuscript; however, the reader should look for educational-focused publications within their discipline to provide advice on education-focused research. In the Biochemistry and Immunology disciplines, the reader can access journals including CBE-Life Sciences, Biochemistry and Molecular Biology Education, Immunology and Cell Biology, Journal of Microbiology and Biology Education, and Journal of Physiology Education.

Conclusion

Within the last two decades, the use of technology-enhanced materials that advance both face-to-face and online learning has been in high demand due to its benefits. In this manuscript, we shared our ten years of experience in creating interactive, online simulations for teaching undergraduate lecture and laboratory content by developing a micro-model taxonomy. The taxonomy was framed within the ASSURE macro model for better classification and more effective use by educators. Our model provides a comprehensive approach to developing effective online/face-to-face technology-enhanced resources and simulations. Each stage in our taxonomy was the result of hard-earned experience and while this paper discussed those stages, the real learning and benefit of this paper is for others to learn from this experience, avoiding potential errors while developing future learning resources.

Therefore, we wish to also share three key learnings that we identified beyond our micro-model taxonomy:

Learning 1: Do not make it about the teaching or the teacher

Our early ventures into simulations were well-intentioned but they focussed on trying to encourage students to access content, albeit in more interesting and interactive ways. However, without being explicit about why a learner should engage and how the simulation motivates a learner, the technical quality of the simulation was irrelevant. Without establishing personal and learning relevance, particularly around assessment, you create a simulation that looks professional, but students do not use to facilitate their learning.

Learning 2: It is not about the technology

The proliferation of educational or technological applications with their diverse features can be enticing. There have been instances where colleagues have spent an immense amount of time developing VR simulations that are engaging. However, without access to the required headsets, students in rural and remote locations could not access the learning resource. Therefore, academics should choose the simplest technological tool that fits their purpose and enables learning to occur. In short, developed technological tools that are inappropriate can function as barriers to successful learning.

Learning 3: It must be sustainable

The budget for creating an online learning application or simulation is commonly small; however, academics should consider what will happen when funding is unavailable. Sustainability is critical in a university setting and can be manifested in diverse ways, such as by prioritising efficient processes and improving time and money management. For example, colleagues developed a third-party simulation that allowed students to practice and access realistic laboratory experiments. A budget was allocated for two years and there was an institutional appetite to continue funding this development well beyond two years. However, following a change in leadership, funding was no longer readily available, and all the data that had been generated was confined to the third-party application. This action required re-generating all learning resources in an "open" platform, which required a large investment of staff time and associated costs.

Overall, creating effective technology-enhanced learning activities is complex and time-consuming; therefore, we recommend that academics use our proposed taxonomy along with the preparation checklist to make sure that they have followed the necessary procedures in their work. Finally, our micro-model taxonomy contributes to the body of knowledge concerning online/face-to-face technology-enhanced education not only in STEM and Health and Medical Sciences but also in Education, Law, and HASS as there are great benefits to using our taxonomy for both tertiary educators and students. It can ensure educators meet the highest possible standards with the design and use of the materials and activities, which in turn means enhancing students' learning. It also creates SoTL opportunities as staff can then disseminate their findings to colleagues.

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Appendix (Preparation checklist)

This checklist is designed to aid educators in designing their active simulation approach. Not all boxes will be ticked, but the provision of boxes will aid in the design and implementation of an active learning approach that uses most if not all best practices identified in our manuscript.

- ☐ Identification of Cohort(s)
- ☐ Funding identified
 - ☐ Grants (Institutional or External)
 - ☐ Individual scholarship
- ☐ Simple design
 - ☐ Designed to be suitable for all students
 - ☐ Designed to be suitable for required content
- ☐ Choice of material Story-based narrative identified
 - ☐ Relevant to chosen narrative
- ☐ Choice of application to use
 - ☐ HSP
 - ☐ Storyline 360
 - ☐ Unity
 - ☐ Other
- ☐ Presentation of content
- ☐ Simulate the end-user environment
- ☐ Clear navigation approach
- ☐ Includes Glossary for relevant terms
- ☐ Complex processes are presented in smaller chunks
- ☐ Estimated student time for completion has been determined
- ☐ Visual indicators of progression included
- ☐ Interactive elements included throughout
- ☐ Accessible via LMS
- ☐ All permutations tested before implementation
- ☐ Assessment activities included
 - ☐ Formative
 - ☐ Summative
- ☐ Feedback included throughout
- ☐ Ensure availability for multiple uses
- ☐ Communication strategy identified
 - ☐ Verbal Reminder
 - ☐ Email Reminder
- ☐ Feedback from students
- ☐ Dissemination strategy in place
 - ☐ Using the opportunity to conduct research
 - ☐ Applying for grants
 - ☐ Applying for ethics
 - ☐ Local unit level
 - ☐ Poster
 - ☐ Conference presentation
 - ☐ Publication

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"Useful, not just in the professional world but in everyday life" - Exploring a non-STEM student's experience in a tertiary-level data analytics unit

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student self-perception.

Abstract

This study investigates the transformation in student knowledge pertaining to the study area of 'data analytics', and the building of confidence, specifically in non-STEM students, to analyse, interpret, manipulate, and present data to a range of stakeholders using *Microsoft Excel*. The context of the study is a newly developed, centrally delivered undergraduate data analytics unit, within which a pre-and post-course survey was embedded. These surveys were administered to students across three separate semesters: S2 2022, S1 2023, and S2 2023. The confidence of both non-STEM and STEM students in conducting data analysis was captured. The findings indicate that students benefit from an immersive curriculum where they are exposed to both an understanding of data analytics in a broad global and social context, characterised by rapid technological change, as well as opportunities to master technical skills utilised through *Microsoft Excel*. The results demystify the notion that non-STEM students are less capable of expanding their depth of knowledge and technological skill development outside their discipline of choice. These results are important in the context of graduate employability and the importance of digital literacy in a rapidly changing world of work.

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Introduction

According to the Australian Government Department of Education (2023), the world of work continues to change rapidly, defined by advancing technology and increased automation of tasks and roles. Adapting to this change requires those studying at Australian universities to be more proficient in Science, Technology, Engineering, and Mathematics (STEM)-based skill areas, and in the context of the present study, skills that fall under the broad umbrella of data analytics. This need has become more significant and urgent for Australian graduates as we near the second quarter of the twenty-first century. In 2003, only four countries significantly outperformed Australia in mathematics-based skill proficiency at the tertiary level, and by 2018, this number had reached 23 (Australian Government Department of Education, 2023).

To address this issue, Murdoch University has drawn on funding from the National Priorities and Industry Linkages Fund (NPILF), which is the Australian Federal Government's allocation of grants to Australian universities to develop programmes, units, initiatives, and industry partnerships that support the development of job-ready graduates, and specifically, the development of STEM skills in those graduates. As part of Murdoch University's utilisation of this funding, a 'data analytics unit' was designed specifically for non-STEM students to boost employability skills for enhanced career readiness. This unit was delivered for the first time in August 2022.

The unit, MSP202 *The search for everything: Data analytics and storytelling in the twenty-first century*, while developed for predominantly non-STEM students, did not exclude those undertaking STEM degrees. It was an opportunity to not only develop data analytics literacy but also to examine and understand the impact of data analytics in the context of their own career and the world of work more broadly. The unit exposes students to some of the ethical issues that surround data collection, operationalising of data, and data surveillance, as well as providing a learning space within which the development of technical skills in data manipulation and conversion of data to meet the expectations and needs of key stakeholders can flourish. The unit is unique because these opportunities for skill development sit outside what non-STEM students would normally be exposed to within their undergraduate degree. Foregrounding rapid social change and a broad cultural shift towards appreciation for the weight and influence of data, the principal emphasis of the unit is on social impact, ethics, and being able to apply data analysis skills and present data-driven insights using *Microsoft Excel*.

Considering the non-STEM target cohort, students traditionally unfamiliar with data-driven platforms such as PowerBI and Tableau, *Microsoft Excel* was chosen as the software central to the student's learning experience. From a teaching and pedagogical perspective, *Microsoft Excel* was judged as a robust platform for students unfamiliar with formulae, numerical functions, and mathematics, while also being universal enough and proficient for the needs of those undertaking STEM degrees, who would likely form a moderate-sized percentage of the cohort each semester.

Further, *Microsoft Excel* is convenient due to its availability, low cost, and ubiquitous nature in contemporary workplaces (Rubin & Abrams, 2015). It can be used to clean, manipulate, organise, and present data. This offered students a supported introduction to the world of data analytics, constituting a readily identified, industry-preferred digital literacy platform.

Aim

Foregrounding student self-assessment, the broad aim of this study was to examine the extent to which a unit designed to support and facilitate data analysis skill development in a predominately non-STEM cohort could offer a learning environment and set of resources that would meet this objective. The core aim was to assess how a cohort of students studying both entirely online (external) and in a face-to-face (internal blended learning) environment perceived and understood the growing influence of data analytics in both their professional and personal spheres.

Broadly, the study constitutes an exploratory analysis of:

1. Non-STEM students' capacity to develop data analysis skills.
2. Growth and transformation in the cohort's understanding of the growing importance of data analytics in the context of the world of work and rapid technological development.
3. Growth and transformation in the cohort's capacity and confidence to apply data analytics.

The analysis that follows is divided into five sections. The first comprises a review of relevant literature outlining the key concepts underpinning this study. Within this section, the research covering employability and employability skill development, curriculum design, digital and data literacy, as well as student self-perception is presented. The second section summarises the methodology, including a comprehensive participant profile. Following this, 'findings' presents the analysed data from the pre-and post-surveys offered to students as part of the delivery of MSP202. The paper concludes with an appraisal of the significance of these findings, recommendations for future research, and an acknowledgement of the study's limitations.

Literature review

Widespread and rapid advances in technology have impacted production processes and social structures and altered the way we live, engage, work, and learn (Bikse et al., 2022; Khan et al., 2022). The context of major technological advancement – automation, robotisation and artificial intelligence – has invoked a new way of perceiving the world and triggered a change in economic and social structures (Bikse et al., 2022). The advent of generative AI in tertiary education has been particularly transformative, sparking analysis concerning how to respond to rapidly advancing technology from a teaching standpoint, in the context of academic misconduct, and even for academics reviewing literature (Ismail et al.,

2023; Mills et al., 2023; Sullivan et al., 2023). The way we work requires new and quickly changing skillsets for both established workers and university graduates seeking entry into the job market. As technology takes over routinised and automatable processes, work turns towards more human-centred, meaningful, and creative applications with rapid growth in the need for highly skilled workers who can both use and create new technologies (Bikse et al., 2022; Khan et al., 2022). These changes constitute a significant ontological shift that forms the practical basis for this study.

Underpinning the increasing labour market demand for 'work-ready' 'digitally literate' graduates is a strong industry narrative that suggests students transitioning to the workplace are not well prepared (Xu et al., 2022). Industry and government stakeholders expect graduates with skills such as communication, creative thinking, problem-solving, self-management, and adaptability to ensure economic competitiveness (Siivonen et al., 2023). This gap between labour market demand and university graduates' ability to arrive on the job with the skills needed to perform has placed an increased need for higher education to offer employability-focused pedagogies for meeting the immediacy of these changes (Bikse et al., 2022; Paterson, 2017; Suleman, 2017). In this way, employability embedded in higher education courses can be construed as a direct response to industry needs and a distinct pedagogical shift from 'knowing' to 'doing' (Paterson, 2017). As such, employability and employability skills (also known as 'soft' or 'human' skills) have become an area of international relevance with growing academic interest (Ruge & McCormack, 2017).

Employability

While university stakeholders such as governments and industry employers increasingly demand work-ready graduates, students also expect positive career and work outcomes as a direct result of their educational investment (Siivonen et al., 2023; Ruge & McCormack, 2017). Employability is a broad multidimensional concept mostly related to the ability to secure and remain in employment (Xu et al., 2022). While not straightforward and lacking consensus, definitions of graduate employability involve a set of assumptions about ability and the requirements of employment (Nghia et al., 2022; Suleman, 2017). Yorke (2017), however, emphasises that employability is not the same as employment. Nghia et al. (2022) agree and stress that graduate employability is a lifelong process of developing and using various forms of capital to attain employment, thrive, and remain competitive and employable as individuals progress through their careers. As such, graduate employability should consider all aspects that make graduates able to attain lifelong employment as well as the ability to create jobs for themselves and others.

To understand and conceptualise the employability domain, various frameworks have been developed to broaden the understanding of graduate employability and to enhance student transition from higher education to the job market. Ali (2016) collates three sets of employability skills based on basic academic skills (reading, writing, oral communication

and listening, science and mathematics), higher-order thinking skills (learning, reasoning, creative thinking, decision making and problem-solving) and personal qualities (self-confidence, self-control, social skills and so forth). Tomlinson (2017) conceptualises the multidimensionality of employability in terms of capital – human, social, cultural, identity and psychological – as a useful way of highlighting the various components held within it. Nghia et al. (2022) focus on human capital development, that is, the abilities or expertise that enhance work performance and personal attributes such as age, education, training, and skills, which are often considered the foundation of graduate success. Despite such perspectives being highly contested (Yorke, 2017), employability as the 'possession of skills' is the most dominant adoption by several stakeholders, including employers, policymakers, and academics (Nghia et al., 2022). In the Australian context of this study, a prevailing belief in the 'possession of skills' appears to underpin the creation of the National Priorities and Industry Linkages Fund (NPILF) as a way to meet a STEM-based area of need in non-STEM graduates.

Employability skills

A focus on defining employability skills, placing them in specific social and cultural contexts, and assessing their importance for university graduates, continues to garner attention in both the education sphere and the world of work more broadly. A crystallised and consistent list of employability skills used across Australian universities has not yet been developed, with most tertiary institutions adapting a globally recognised list to suit their student body. The influences are varied. The World Economic Forum's Future of Jobs Report (2023) lists the top ten employability skills on the rise: creative thinking, analytical thinking, technological literacy, curiosity and lifelong learning, resilience, flexibility and agility, systems thinking, AI and big data, motivation and self-awareness, talent management and service orientation and customer service (p. 39). Each skill can be considered part of a broader mosaic and should be understood as coalescing with other skills, depending on the time and place within which they are employed.

Acknowledging that these skills are various connections and sub-sets, there have been several attempts to develop employability skill frameworks incorporating the skills and personal attributes necessary for work success (Scarinci et al., 2023). Frameworks defining employability skills or graduate attributes generally derive from national skills frameworks (Jackson, 2014). The Australian Chamber of Commerce and Industry (ACCI), for example, developed an employability skills framework with eight key skills and personal attributes for worker success, which includes communication, teamwork, problem-solving, initiative and enterprise, planning and organisation, self-management, learning, and technology skills. Murdoch University adapted the Work Skill Development Framework for student employability skills developed by Bandaranaike and Wilson (2009) to focus on the eight subsets of Self-Management, Initiative, Enterprise and Entrepreneurship, Teamwork and Leadership Potential, Critical/Creative Thinking and Problem Solving, Communication and Interpersonal, Learning and

Applying Knowledge, Planning and Organisation and Financial and Digital Literacy (Murdoch University, 2023). Various institutional attempts at developing a bespoke skills framework, Jackson (2014) argues, have influenced different higher education approaches to employability skill development from stand-alone bolt-on learning programmes to incorporating work experience and work-integrated learning programmes as either complementary to study or alternative development options.

Curriculum

The Higher Education Standards Framework (2015) requires employability skills to be included as part of the learning outcomes for degree courses (Scarinci et al., 2023). A growing body of higher education literature from Engineering to Tourism shows various intra-disciplinary attempts to define an employability skills framework from which curriculum and pedagogy can be derived (Scarinci et al., 2023; Khan et al., 2022; McHenry & Krishnan, 2022; Aliu et al., 2021; Scott & Willison, 2021; Adeyinka-Ojo, 2018; Cake et al., 2018; Ruge & McCormack, 2017). Several studies have emerged to fill the research gap of understanding the 'how' of teaching employability and the need to ensure student engagement and ongoing reflection of their own skill set, where there might be room for improvement, and what skills they can continue to bolster (Ruge & McCormack, 2017). Alongside providing students with the opportunity to develop these skills, learning environments are now being integrated with technologies that underpin contemporary pedagogies and teaching practices (Le et al., 2022).

In their study of graduate employability for the building and construction industry, Ruge and McCormack (2017) suggest that the development of employability skills is best facilitated through discipline-based curriculum design linking university and industry expectations. Through the process of interweaving learning contexts and assessments, this embedding of employability skills development within disciplines allows students to develop metacognition for academic and professional purposes. Constructive alignment of assessment and scaffolded learning, as well as a "constructive, explicit, reflective teaching approach", encourages students to reflect on their skill development (p. 365). Interestingly, there is a scarcity of literature documenting the existence and success of centrally delivered tertiary units undertaken by multidisciplinary cohorts. The extent to which this focused learning environment made up of a largely homogenous cohort in terms of disciplinary expertise hinders or supports a student's ability to develop their graduate employability has not yet been explored in great depth within the academic literature.

Concurrent with understanding which employability skills are being privileged within a given educational context and how they should be embedded in the curriculum is the caveat that even when students can successfully develop the relevant employability skills, there exist numerous social, cultural, and political variables that may present as barriers to employment success or career advancement relevant to their study area. The curricular process may facilitate the development of prerequisites but does not guarantee it

(Yorke, 2017). These other factors may include characteristics pertaining to the graduates themselves, the availability of jobs in any given market, and/or the changing world of work in the era of generative AI.

Digital literacy

Digital literacy skills are relevant to employability insofar as attempts to improve one's proficiency aim to improve employability (Khan et al., 2022). While digital literacy is generally considered an employability skill, there are few useful frameworks or guidelines for higher education to prepare graduates for the future workforce. Khan et al. (2022) describe important differences between *digital skills* and *digital literacy*, which are not interchangeable. Digital skills are defined as:

"[A] collection of abilities that allow people to use digital devices, networks and communication applications to create and exchange information, connect and collaborate, and solve problems to improve their lives, learning, work and social activities" (p. 49).

Digital literacy builds on that functional foundation (the what and the how of digital skills) to include the why, when, who, and for whom. Thus, digital literacy is considered a set of competencies guiding the use of digital devices, including accessing, evaluating, applying, and synthesising data and creating new knowledge (Khan et al., 2022).

Potential employers increasingly expect new graduates to arrive on the job digitally literate and with the ability to review and analyse data, manipulate spreadsheets, and communicate findings and key recommendations for purpose (Khan et al., 2022; Kroes et al., 2013). However, Khan et al. (2022) point out that an exclusively workplace-focused view of the usefulness of this skill set is far too narrow and that being digitally literate is also about developing a set of fundamental skills that will apply more broadly to modern life.

Data analytics

To be digitally literate and develop the skills that would bolster one's ability to conduct analyses of a variety of data, students need to be active participants and purposeful in selecting and using information, generating new knowledge, and sharing that knowledge (Khan et al., 2022). Student learning of digital literacy and any resulting impact on academic performance and employability is still in its relative infancy. While some studies suggest a mostly positive impact on academic performance, there is little to no research focused on the relationship between digital literacy and employability (Khan et al., 2022). This is surprising given the substantial impact that the collection, aggregation, and analysis of data is having on virtually all industries in the contemporary world of work. Despite the high demand for digital and data literacy in higher education content, there is still a limited focus on data analytics, learning outcomes and employability in academic research.

In their study exploring predictors of academic success in a blended learning environment, Musabirov et al. (2019) point out that while high market demand for data science competency attracts students from different disciplines, including non-STEM, it tends to create a student cohort with diverse skill capacities depending on their major disciplinary exposure to data and data skills. Considering several factors related to initial mathematical knowledge, the traits of education programmes, blended learning engagement (whether the engagement was online or offline) and peer connections, they found that social sciences and humanities programmes' students had lower achievement in data analytics learning activities than students from economics, management, and other STEM programmes (Musabirov et al., 2019, p. 71).

The notion that non-STEM students are less equipped to engage with data analytics is not new. Vittengl and Vittengl (2022) suggest that despite having statistical analysis embedded in the psychology curriculum, psychology students find that "acquisition and generalisation of data analysis skills are perennial challenges". Sports science on the other hand, is an industry leading the way in data analytics (Kaluzny, 2021). As the analysis of data becomes normalised in both professional and personal realms, one might expect that a disciplinary equalisation of sorts will take shape in the tertiary sector, with commensurate emphasis across degree structures on developing data analysis skills alongside subject-specific knowledge acquisition.

Student self-perception

Broadly, the ability of graduates who are ready to enter the labour market is dependent on their *perceived employability* within a specific market (Nghia et al., 2022). Perceived employability relates to both internal and external factors: internal is the perception of one's knowledge, skills, abilities, and job search capability; while external is related to factors such as demand for expertise, institutional prestige, and overall labour market conditions (Nghia et al., 2022).

Based on the work of Vanhercke et al. (2015), who found that if employees perceive themselves as employable, they were more focused on accessing knowledge and resources to become more employable, Nghia et al. (2022) locate perceived employability as critical to the graduate transition to work and translating employment outcomes. Le et al. (2022) highlight a similarly delicate balance between a student's perceived level of digital literacy, motivation for engaging in the learning environment, and academic performance. However, in contrast, they found that students with a self-perception of high digital literacy (HDL) did not necessarily translate into the realms of high academic achievement in this space, in comparison to those who perceived themselves as having low digital literacy (LDL). There are few studies exploring the relationship between a student's ability to demonstrate employability and their employment outcomes (Nghia et al., 2022).

Methodology

The analysis central to this study is exploratory in nature. Through addressing the nationwide need to develop STEM capability in tertiary Australian students, regardless of their discipline of choice, MSP202 *The search for everything: Data analytics and storytelling in the twenty-first century*, offered students the chance to clean raw data sets, create pivot tables using *Microsoft Excel*, uncover insights through analysis of data, and pair those insights with story, discourse, and narrative in presentations to key internal and external stakeholders. To assess both proficiency in conducting data analysis and student attitudes towards data surveillance, ethics, the way data is collected, organised, and operationalised in their personal and professional spheres, and the importance of Big Data in the twenty-first-century world of work, a two-stage survey was developed and administered (see Appendix B).

Structured around twelve weekly topics, MSP202 students were invited in Weeks 1 and 12 to complete a survey containing a mix of multiple-choice questions, short answer questions, and questions that required a numerical response. As mentioned above, these questions sought to understand and uncover insights relating to skill development and the world of data analytics more broadly, and the mixed nature of the question structure yielded valuable qualitative and quantitative data for analysis.

In both stages of the survey, the Moodle 'Quiz' tool was used to source responses from students. As participants engaged with the survey in Week 1, they were presented with a Consent and Plain Language Statement (see Appendix A) regarding the nature of the research being undertaken and its purpose. This approach received prior approval from Murdoch University's Human Research and Ethics Committee. Recruitment took place through the unit itself, which the students enrolled in as part of their degree. As such, the study avoided traditional recruitment methods such as snowball sampling, flyers, and emails, with participation promoted as entirely voluntary and not connected to grade-related outcomes in the unit itself.

Data was collected across three semester deliveries: Semester 2, 2022 and Semesters 1 and 2, 2023. Each survey took between 10 and 20 minutes to complete, with the Week 1 iteration focused on student self-appraisals of their data analysis skills, their understanding of issues pertaining to data surveillance, the impact of data analytics on both their professional and personal spheres, and the potential real-world benefits of data analytics in the twenty-first century. The purpose of the Week 12 survey was to assess how/if the responses provided in Week 1 had transformed over the course of the student's time in the unit.

The surveys yielded both qualitative and quantitative data, and multiple methods of analysis were employed to understand these results. For qualitative responses, a mix of thematic and content analysis methods was used to assess the presence of consistent themes across the cohort of students. It was anticipated that students might share similar concerns, for instance, about Uber's tracking of GPS data or the use of personal information to influence political

outcomes, and so the purpose of qualitative analysis was to assess, summarise, and tease out the presence and nature of these concerns. With regards to quantitative responses provided by our cohort of students, we utilised basic methods of quantitative analysis, namely, assessing mean responses across the cohort, outliers, and changes over time.

Participants

The voluntary nature of the data collection process yielded a high percentage of students completing the Week 1 survey but not the Week 12 follow-up. This complexity necessitates a detailed summary of the participants who ultimately took part in this study.

A summary of the participants engaging in this study is divided into two parts: (1) the broader sample of the MSP202 student cohort who completed the Week 1 survey and (2) a smaller group of students who completed both Week 1 and Week 12 across the three semesters.

The broad sample of participants that took part in this study were 157 undergraduate students enrolled on the second-year unit titled MSP202 *The search for everything: Data analytics and storytelling in the twenty-first century*. Of these 157 students, 101 were female and 56 were male. A total of 73 students enrolled in the online version of the unit, while 84 studied on campus, predominantly face-to-face. Roughly 76% of the sample, or 120 of the 157 participants, were from non-STEM degrees, a figure that is commensurate with the expectations of the learning designers. Thirty-five separate degrees were represented in the sample, with Business ($n=31$), Criminology ($n=21$), Science ($n=15$), and Psychology ($n=10$) offering the largest enrolment numbers. Participation was consistent across each of the three semesters through which data was collected, as summarised in Figure 1 below.

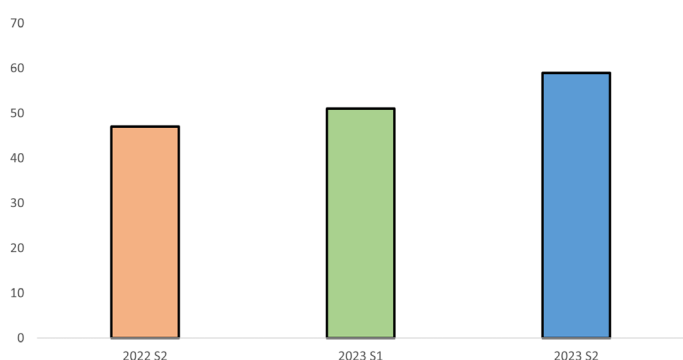


Figure 1. Participants by offering.

Of the overall sample of 157 who engaged with either the Week 1 or Week 12 surveys, 151 completed Week 1 in full, 30 completed just Week 12, and 24 completed both. The small percentage of respondents who completed both pre- and post-surveys presents a limitation of the study, addressed later in this paper.

The smaller sub-sample of 24 participants who completed both Week 1 and Week 12 surveys in MSP202 form the second set of data. This group forms the focus of analysis in the remainder of this paper. Of this sample of 24, a total

of 19 were female, and five were male; 10 studied online while 14 took part face-to-face; 19 students came from non-STEM degrees, while a total of five students were STEM undergraduates. A breakdown of the degrees from which this smaller sample was drawn can be seen in Figure 2 below.

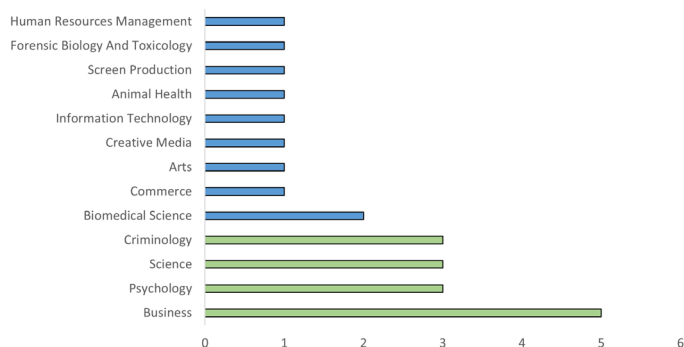


Figure 2. Participants by degree.

Some of the dichotomies identified above, including gender, study period, study mode, and degree type (STEM vs. non-STEM, for instance), provide a rich grounding for comparative analysis. While the 19 non-STEM versus five (5) STEM participants is not evenly balanced, as a preliminary and largely exploratory study, it remains useful to ask how non-STEM students might fare in developing data literacy skills (in particular, a capacity to analyse data using *Microsoft Excel*) and assessing at the same time, how the STEM group responded to the same learning materials, of which they are presumably more familiar.

The 24 students, drawn from the broader sample of 157, are presented in the findings as case studies (using pseudonyms) through which the transformation of students' perceptions, knowledge and ability pertaining to data analytics is explored.

Findings

Overwhelmingly, for the case study group, self-appraisal of data analytics capability and proficiency in using Microsoft Excel for conducting data analysis showed improvement over the duration of the unit for both STEM and non-STEM students. On a scale of 1-10, with 10 meaning 'very high proficiency' and 1 meaning 'very low proficiency', participants were asked to self-rate, (1) their data analysis skills and (2) their proficiency in using Microsoft Excel. Figure 3 provides a summary of self-appraisal scores for data analysis proficiency, measured in both Week 1 and Week 12.

Figure 3 illustrates consistent self-rated improvement for this group of participants. The group's aggregated mean for self-rating data analysis skills was 5.08 in Week 1, improving to 7.62 by the conclusion of the semester. In just one instance, for Participant Dana, the self-rating declined, though this might be owing to an over-appraisal of their proficiency at the time of completing the Week 1 survey. These figures suggest that the principal purpose of the learning experience – to offer students a chance to develop STEM skill capability – is being fulfilled. Figure 4 examines the same results but for the non-STEM cohort.

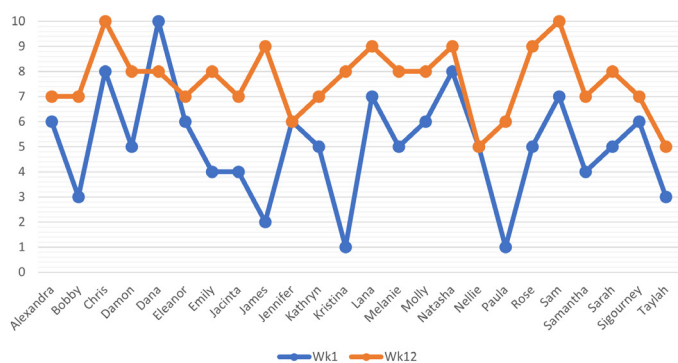


Figure 3. Data analytics proficiency, Week 1 and Week 12.

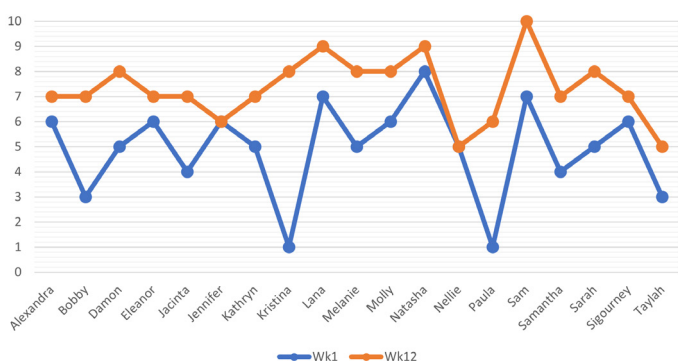


Figure 4. Data analytics proficiency, Week 1 and Week 12, non-STEM participants.

While the purpose of this study was not to evaluate the 'impact' or 'success' of a tertiary-level unit aimed at building data analysis skills, the findings presented in Figures 3 and 4 are significant when considered in the context of the research pertaining to non-STEM students and their perceived inability to be able to work with and acquire STEM-based knowledge and skills (Vittengl & Vittengl, 2022). In addition, Figure 3 indicates that the learning experience was useful for both STEM and non-STEM cohorts, suggesting that the disparate needs of diverse groups of students can be met within a singular learning experience. The findings pertaining exclusively to non-STEM students, documented in Figure 4, provide a visual summary of an aggregated mean improvement from 4.89 to 7.31 across the duration of the semester, and no individual cases where the two-stage – Week 1 and Week 12 – self-appraisal of data analytics skills declined. For some participants, namely, Kristina, Paula, and Bobby, the improvement is substantial.

Participants were also asked to self-rate their proficiency in using *Microsoft Excel* both in Weeks 1 and 12 of the semester, and the results were similar to the findings detailed in Figures 3 and 4 above. Over the duration of the semester, participants reported increased confidence in using *Microsoft Excel* for data analysis. The uniformity of this increase is evident with roughly 74% of participants in the sample of 24 reporting an increase in confidence/self-rating. There were four cases where participants (all of whom were from STEM degree programmes) reported a decrease in self-rated proficiency using *Microsoft Excel*. Possible reasons for this are discussed in the following section of this paper. Overall, the aggregated mean for the sample of 24 students

improved from 5.41 to 7.29, and these findings are depicted in Figure 5, below. Figure 6 depicts the same evaluation of *Microsoft Excel* proficiency, but for the non-STEM cohort, with these numbers showing a mean aggregated improvement from 4.89 in Week 1 to 7.31 in Week 12.

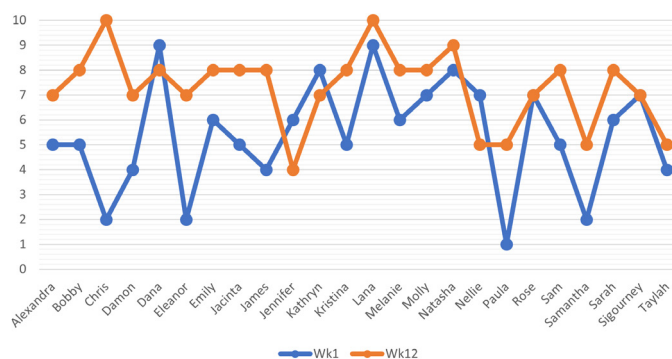


Figure 5. Microsoft Excel proficiency, Week 1 and Week 12.

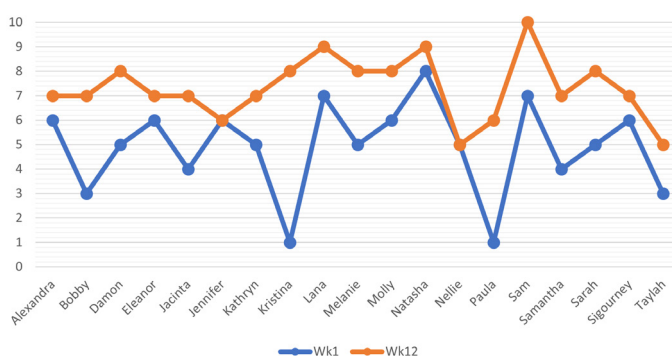


Figure 6. Microsoft Excel proficiency, Week 1 and Week 12, non-STEM participants.

For the non-STEM cohort exclusively, all participants reported a positive or neutral increase in *Microsoft Excel* proficiency, as indicated in Figure 6.

Figure 7 examines gender and data analytics proficiency (again, defined as a broader appraisal of student proficiency and comfort in multiple aspects of the data analytics process), while Figure 8 does the same, but exclusively for student proficiency in using *Microsoft Excel*.

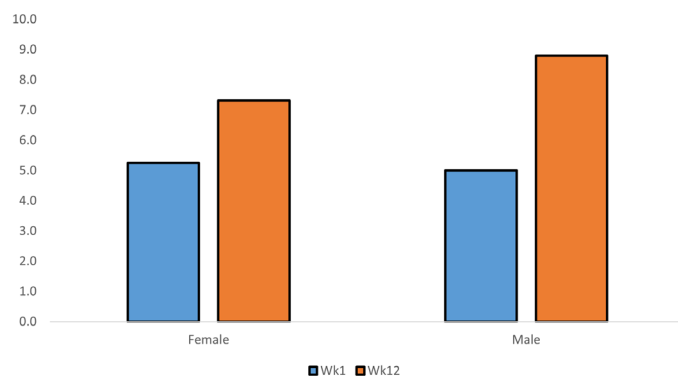


Figure 7. Gender and analytics proficiency, Week 1 and Week 12.

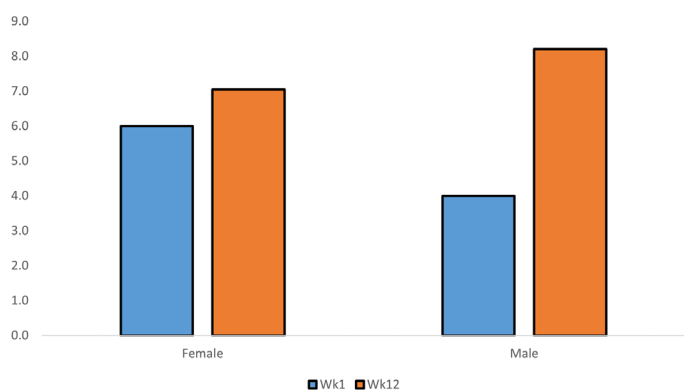


Figure 8. Gender and Microsoft Excel proficiency, Week 1 and Week 12.

At the start of the semester, female participants reported a marginally higher level of self-rated proficiency in Data Analytics (which can be seen in Figure 7). More considerable was the disparity in self-rating across males and females for *Microsoft Excel* proficiency, as depicted in Figure 8. However, by Week 12, males reported higher proficiency ratings for both Data Analytics and *Microsoft Excel* skill sets. The significance of these findings and hypotheses that could explain the trends depicted above would make a suitable potential study for future scholars interested in examining the intersection between data analysis skills and gender.

In totality, the findings depicted above suggest that students are placing emphasis on developing skills that are more closely aligned with what is becoming increasingly desirable in the world of work, notably digital literacy skills. They also suggest that despite the measure being a self-rating of proficiency, students are developing these skills successfully. These findings were supported by an examination of the sample's views on their own employability skills, notably, which ones were their strongest and which needed the most development.

The larger sample of 157 students was asked to rate their three strongest employability skills and the three employability skills that they believed contained the most significant room for growth and improvement. The list provided to participants consisted of the nine employability skills identified by Murdoch University as those to be used across career learning units, and these were: *Critical, Creative Thinking and Problem Solving*; *Planning and Organisation*; *Teamwork and Leadership*; *Digital Literacy*; *Initiative and Entrepreneurship*; *Verbal, Written and Interpersonal Communication*; *Learning and Applying Knowledge*; *Self-Management*; and *Financial Literacy*. In both instances where students reported on their strengths and areas where there was room for growth, the perceived importance of developing data literacy amongst the student population was apparent. These results are represented in Figure 9 and Figure 10 below.

The sample of 157 students responded to a question pertaining to the current state of their employability skills and, with regards to Figure 9, were asked to list their top three most proficient skills. A total of 24% of responses from students nominated Critical Thinking, Creative Thinking and



Figure 9. Employability skills (strengths).

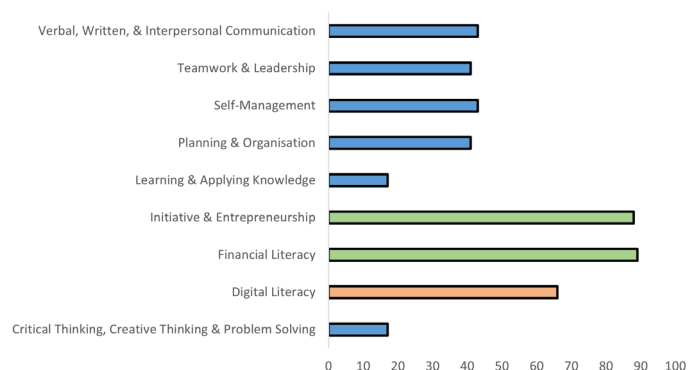


Figure 10. Employability skills (growth areas).

Problem Solving as their most proficient skills, while 16% of responses saw Planning and Organisation as the second most frequently cited skill. In the context of the present study, Digital Literacy and Financial Literacy were the least frequently identified employability skills, with 5% and 3% of responses respectively.

The findings depicted in Figure 10 offer support for those presented in Figure 9; students perceived *Digital Literacy* as one of the most pressing employability skills in need of development, alongside *Financial Literacy* and *Initiative and Entrepreneurship*. When we pair these results with the self-ratings from the sub-sample of 24 participants who completed the pre- and post-surveys in Weeks 1 and 12, we are presented with a picture of a group of students who understand the need to develop their digital literacy skills, and then a commensurate emphasis on improving in that domain, aligned with the identified need. While the results in Figures 9 and 10 are the inverse of each other, they reflect a cohort that saw digital literacy in great need of growth and, not surprisingly, not prominent in their list of strongest employability skills.

The significance of the findings depicted above becomes more pronounced when considering the qualitative responses documenting the sample's lack of experience in working with data and conducting data analysis. One participant commented that their only foray into understanding data prior to engaging with the unit had been on 'census night', while another simply responded 'I have little background in data analytics'. These comments were reflective of a commonality across the larger sample's ($n = 157$) response to this question:

'I have basically no prior knowledge of data analytics. I believe I did a little bit in maths in year 12'.

'This unit is the first time I have engaged with data analytics'.

'I haven't had much experience with data until I started this degree. Being involved in data is interesting and also challenging at times'.

At the close of each teaching period, participants were asked 'What has been the most transformational idea, concept, reading, lecture ... you have engaged with throughout your time in this unit, and why?' A mix of responses highlighted the value of data manipulation, presentation skills and professional and personal development. Importantly, there was no significant difference in thematic underpinnings across gender, study mode, offering, or the STEM / non-STEM divide.

Three participants reported that the *Microsoft Excel* skills they developed were of greatest benefit to their career trajectory and efficacy in a particular line of work. One participant pointed to the transferability of the skill acquisition in other units.

'I think Topic 6 – manipulating data has been the most significant, as I have now started using those techniques I've learned in data handling for other units'.

Other participants focused on 'storytelling' and the presenting of data-driven insights as the aspect of the learning experience of greatest benefit. Below are extracts from two students who spoke extensively about the skills of greatest value that the learning experience had provided them with the opportunity to develop:

'I would have to say Topic 10 relevant to presenting data and this is because I found it to be the topic of which I am most interested in learning and applying within my career. I think that the bonus content especially offered some valuable insight into where I need to improve. The main readings and workshop were valuable for the development of my presenting skills. I am most grateful for Robert Dolan's works and the content relevant to his paper on effective presentation skills.

'Becoming a data story-teller' ... was pretty significant and impactful in learning how to tell the story of everything I've learned or any initiative I want to take professional or informally in educating those around me inside and outside of my academic field. It ... gave me a good ... basis for how I should approach conversations, presentations and education in bringing up topics of mental health. Learning how to make the presentation of information flow, with the right language to suit your audience, relevant statistics and the strong emphasis of a story is a framework that can be used in any context ... Learning how to

do that is a skill I will keep developing and is very vital to what I want to achieve in my field, education on the psychology of humans.'

These two extracts reflect the broader sentiment within the sample of 24 participants around the development of data analysis skills is more than just the cleaning of and manipulation of raw data and, importantly, its impact on the likelihood of career success for the learner in question. This speaks to a broad and deep level of investment in the learning experience, and we suggest that this investment has been – at least in part – informed by an awareness of the 'weight' of data in the personal and professional lives of human beings. The majority of qualitative responses from participants spoke directly to this dual impact.

This [data] affects everything from the world's economy to how we save money online, there is no doubt that the emergence of new data has a positive impact on our lives. It allows us to track our personal health, dietary habits and bank statements through a smart phone. Collecting and analysing personal data allows us take better control of our life by understanding it better. It can improve our work, habits, relationships and health, and help us focus on what's important to us, to achieve our goals.

Addressing mental health. Tech companies' health and related health focus has increased in the last few years due to the identification process. We produce so much data about ourselves now, with this ontological taking place tech companies are able to capitalise on this which also gives us more mental health-focused programmes, and apps, and eased work constraints.

This suggests a transformative learning experience in which participants understand the impact across both professional and personal spheres in a way that is "useful, not just in the professional world but in everyday life." In the penultimate section of this study, the significance of these findings and recommendations for future scholars are presented.

Significance of findings

The purpose of this study was two-fold. First, we sought to examine non-STEM students' capacity to develop data analysis skills, and second, we measured growth and transformation in the cohort's understanding of the growing importance of data analytics in both professional and personal contexts. As outlined in the introduction to this paper, this two-fold purpose was tested within a second-year undergraduate data analytics unit and a broad socio-cultural backdrop that has privileged the development of digital literacy in a rapidly changing work context. In 2003, four countries significantly outperformed Australia in mathematics-based skill proficiency at the tertiary level, and by 2018, this number had reached 23 (Australian Government Department of Education, 2023). Australian universities continue to develop learning material that seeks to address this deficit.

The study's central finding can be summarised as a 'triad of employability awareness' as illustrated in Figure 11. Students understand the need to develop their digital literacy skills; they perceive it as a gap in their own skill set and importantly, they connect this need with a real-world socio-cultural evolution towards managing data across both professional and personal domains. Finally, they take this awareness into the learning experience itself and, in the main, improve both their data analytics proficiency and their use of *Microsoft Excel*. In this sense, learning was transformative as students present as highly self-aware and able to cognitively manage their position within the world of work through the development of data analytics skills, alongside an appreciation for the use of information technology, and generative AI. In short, they were aware of the human aspects of work, of the activities humans do well and need to continue doing well, namely, storytelling.

The first aspect of the triad, depicted in Figures 9 and 10, is the sample's appraisal of their strongest employability skills and those in greatest need of growth. Just 5% of the sample of 157 participants identified Digital Literacy as one of their strongest employability skills. This awareness of a need to develop digital literacy skills fuels the second part of the triad, which comes from the qualitative responses summarised in the previous section. The common thread within this set of responses was a comprehensive awareness of the need to develop data analytics skills to meet demands within their personal and professional domains. When this awareness of digital literacy as an area for personal growth is paired with an understanding of the demand for this set of skills in the workplace, what results is the third and final part of our triad: improved data analysis and *Microsoft Excel* skills.

The study found that self-appraisal of data analytics capability and proficiency in using *Microsoft Excel* to conduct data analysis showed improvement over the duration of the unit for both STEM and non-STEM cohorts. Curriculum focused on student awareness and development of digital literacy had a positive impact on students' perceived self-efficacy. This supports Le et al.'s (2022) recommendation that a greater emphasis placed on supporting student awareness and development of digital literacy often enhances academic success. This includes an emphasis on non-academic skill development such as "self-regulated learning, motivational beliefs, cognitive engagement, and resource management" (p, 318). Importantly, these transferable skills lead to academic success and greater employability.

The second major finding was, to some degree, unexpected. The study indicates that the disparate needs of diverse cohorts can be met within a singular learning experience. For both STEM and non-STEM cohorts, the study found improvements in the self-appraisals of data analytics skills as well as *Microsoft Excel* skills. While the improvements were more uniform for the non-STEM cohort, the results show that a unit designed to support and facilitate data analysis skill development in a predominantly non-STEM cohort had provided a learning opportunity and set of resources that achieved this objective.

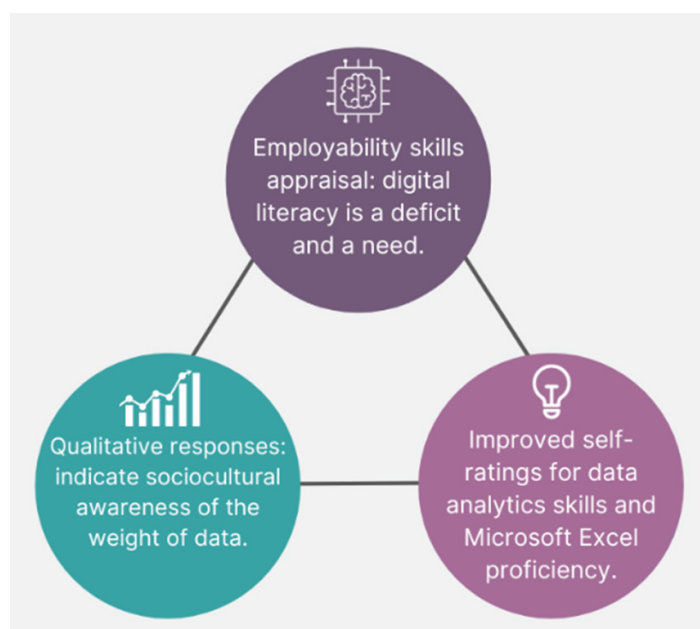


Figure 11. The triad of employability awareness.

Interestingly, this objective was also achieved for the small STEM cohort enrolled in MSP202. These results demystify the perceived inability of non-STEM students to shift their attention towards developing skills and acquiring knowledge in the STEM space. They offer a learning and teaching model as well as a plan for curriculum development that can be replicated in other learning environments to reinforce ongoing student success, both academically and in terms of their employability as graduates.

The findings support that "constructively aligned assessment designed to activate student-led learning is able to facilitate generic and early professional skill development" (Ruge & McCormack, 2017, p. 380). It further suggests that a constructively aligned curriculum developed for data analytical skills may have a broader learning impact on self-perception and engagement. However, it challenges the notion that employability skill development is best embedded through discipline-based curriculum design (Ruge & McCormack, 2017) and posits the need for further research into employability and employability skill development in multi-disciplinary learning environments.

Recommendations

The findings presented in this study have both learning and research-focused implications. From a curriculum development standpoint at tertiary institutions in Australia, the findings support a movement towards embracing and believing in the capacity for non-STEM students to engage with (and master) content and skills that would traditionally fall outside the domain of their degree of choice. The prevailing cultural view that a non-STEM student is less capable with numbers has not been supported by the data presented in this study; rather, non-STEM students show both an awareness of the need to develop STEM skills and a capacity to do so at a professional level. While the overall sample size is small (an outcome that will be examined in the section that follows), the results are uniform and consistent enough across three semesters in 2022 and 2023 to indicate

that non-STEM students have the capacity to develop STEM-based skills literacy, particularly when their awareness of the need for data literacy in both professional and personal spheres is apparent. This has potential implications for the inverse relationship of the one examined in this study, specifically, STEM students who are studying subjects in the Arts arena: history, philosophy, sociology, and creative media.

In light of this recommendation, future scholars should seek to expand on the findings presented in this study, replicating the survey for both STEM and non-STEM cohorts. Larger sample sizes would be preferable, and findings that suggest students can learn effectively outside their degree of choice could herald a new era for the development of a more holistic and employable student. Our broad cohort for the present study was 157 undergraduate students in total, with 24 from this larger group having completed both stages of our survey across Weeks 1 and 12. A study that delves more deeply into the nuances and tapestry of non-STEM student engagement with STEM content would benefit from a larger sample size, with the obvious implication being a greater capacity to generalise cohort change over time in digital literacy, *Microsoft Excel* skills, and a range of other employability skills. As discussed above, the same approach could be applied to a STEM-based cohort and their engagement with 'Social Science' content. An adjustment to the methodological approach utilised in this study might be beneficial in procuring this larger sample, with one potential area for change being the pre- and post-survey design. While a dual survey focus allows the research to assess change over time, when the nature of the survey is voluntary, asking busy students to complete one at the beginning of the semester and one during exam time will always be challenging. An exploration of ways to develop a singular survey yet still maintain an assessment of skills development over time would be a worthy pursuit.

Limitations

As an exploratory study, there were a few limitations. The most significant was in relation to the voluntary nature of the pre- and post-course surveys, which impacted the depth and breadth of data collected between 2022 and 2023. The Consent and Plain Language Statement reinforced for students enrolled in MSP202 that the information they provided in Weeks 1 and 12 was (a) not tied in any way to their overall grade within the unit and (b) was not compulsory. As such, enthusiastic students in Week 1 of the semester frequently completed the pre-survey embedded in the LMS for students, and this informed our broader sample of 157 students. However, far fewer students completed the Week 12 post-survey, which was designed to assess change over the course of the student's time in the unit. As such, our broader sample of 157 narrowed to 24, comprised of 19 non-STEM students and five (5) from the STEM cohort, which impacted the certainty with which the results can be presented.

Concluding comment

This study is the first of its kind in the academic literature to consider student perceptions of data analytics skill development from a multidisciplinary standpoint, incorporating both STEM and non-STEM perspectives, and to consider more broadly the impact of this learning within a social context. An ongoing evaluation of data analytics skill development and digital literacy, more broadly, should take into account the rapidly changing world of work, particularly the changes that are informed by the proliferation of artificial intelligence language models such as OpenAI's ChatGPT, which was introduced in November 2022. Scholars assessing the depth of organisational resilience at tertiary learning institutions following the major disruption of COVID-19 (Shafi & Middleton, 2024), have surely been met with a disruption of commensurate significance. While at the time of writing, the vast majority of contemporary students access the non-subscriber version of ChatGPT as their primary language processing model, models that can work with Microsoft Excel, clean and manipulate data, and visualise data for a variety of purposes, may have a significant impact on the validity and relevance of curriculum central to the unit examined in this study. These technological developments call into question the necessity for non-STEM students to develop digital literacy skills, and this study found that student perception of their own employability skill needs is aligned with what matters socio-culturally and in the world of work. This has a profound impact on student willingness to engage with data analytics content and their success in developing these skills. This space is certainly worthy of ongoing scrutiny and awareness.

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Appendices

Appendix A

CONSENT AND PLAIN LANGUAGE STATEMENT

Project Title

An Appraisal of Data Analytics Skill Development in Tertiary Students at One West-Coast Australian University

Principal Investigator/s

Dr Samuel Teague (Lecturer, Career Learning) – Samuel.Teague@murdoch.edu.au
Dr Alasdair Dempsey (Senior Lecturer, Exercise Science) – Alasdair.Dempsey@murdoch.edu.au
Dr Ellen Greenham (Lecturer, Career Learning) – E.Greenham@murdoch.edu.au
Dr Sarah Courtis (Associate Lecturer, Career Learning) – S.Courtis@murdoch.edu.au
Dr Robert Payne (Associate Lecturer, Career Learning) – Robert.Payne@murdoch.edu.au
Dr Kim Hudson (Associate Lecturer, Career Learning) – K.Hudson@murdoch.edu.au

Invitation

According to the Australian Government Department of Education, Skills and Employment (2021), the world of work continues to change rapidly, defined by advancing technology and increased automation of tasks and roles. To keep up, students studying at Australian higher education institutions must become better versed in STEM areas. Australia is losing ground in competing with other nations in the areas of Science, Technology, Engineering, and Mathematics. In 2003, four countries significantly outperformed Australia in mathematics. In 2018, a total of 23 did.

To address this issue, a Data Analytics unit has been created that will sit in the Career Learning Spine as its fourth unit offered to students to boost employability skills for career readiness. Its specific purpose will be to offer students the opportunity to develop data analysis skills, knowledge, and awareness.

The current research is being conducted to investigate the extent to which this unit supports data analysis skill development, and also explores concerns students may or may not have about data surveillance and the way data analytics is transforming both our professional and personal lives.

What are the requirements for participating?

You are eligible to participate in this study if you are over 18 years of age and a current Australian resident/citizen. Further, participants must be enrolled in *MSP202 - The Search for Everything: Data Analytics and Storytelling in the Twenty-First Century*.

What does taking part mean for me?

If you choose to partake in this research, you will be asked a series of questions both at the beginning of your time in this unit, and at its conclusion, pertaining to your data analysis skills, how they have developed over time, and any concerns you may or may not have about data surveillance and the way data analytics is transforming both our professional and personal lives.

Do I have to take part in the study?

Participation in this study is voluntary. However, your participation will assist us in understanding more fully how data analysis skills are developed in this unit, and areas of concern that students may or may not have about how data analytics is transforming our professional and personal lives. Written consent in the form of a signature from participants is not required in this study as engagement with this document and completion of the questionnaires implies your consent to participate in this research. Should you wish to withdraw your consent for engaging with this project at any point, data/information provided in the questionnaires will be deleted immediately.

Your responses to the questionnaires embedded in the unit will be de-identified. Participants can withdraw consent from participating in this study up until the de-identification process has been complete. Should you wish to withdraw from the study before this point, please notify Dr Kim Hudson – K.Hudson@murdoch.edu.au – and your responses will be removed.

Risks and Potential Benefits

There are no foreseeable risks for participating in this research. However, should any negatives effects be [experience](#), please contact the Dr Kim Hudson, who can guide you to the appropriate services. She can be contacted at K.Hudson@murdoch.edu.au

There are no direct benefits to participants in this study, and no payment is made to those completing questionnaires. However, findings will contribute to our understanding of the way students develop data analysis skills in a Higher Education unit, therefore, indirect benefits may occur for you if you have a specific interest in data analysis skill development and understanding more fully how data analytics is transforming both our professional and personal spheres.

What will happen to the information collected during the study?

All data provided to the Principal Investigators will be deidentified, with all demographic information being removed. This data is de-identified by the Principal Investigator – Dr Samuel Teague. In addition, all information we receive from you will remain confidential. All information provided by participants will be coded, filed, and retained on password-protected computers accessible only by the researchers. At the conclusion of the study, data will be retained for five years in accordance with X University's Human Research and Ethics Committee requirements, and potentially re-used and re-engaged with for the purposes of comparing how multiple cohorts of students engage with the unit over time.

What will happen to the results of the study?

The results of the study will inform continual unit improvement and curriculum development for the Data Analytics unit you are currently undertaking. It is anticipated that at least one peer-reviewed article will be published in a journal. Participants will be notified once the study has been completed and provided with an executive summary of the data provided by participants as well as access to any peer-reviewed publications that have been approved in relevant journals.

What if I have a complaint or concerns?

If you wish to discuss concerns or complaints pertaining to any aspect of this project, or you have questions about being a research participant in general, please contact:

Human Research Ethics Committee (HREC)
X University
90 South Street – Murdoch WA 6150
Phone: 9360 6000
Email: ethics@murdoch.edu.au

Thank you for choosing to participate in this study. Clicking next indicates your consent to participate, please close this browser if you do not wish to participate.

QUESTIONNAIRE

Project Title

An Appraisal of Data Analytics Skill Development in Tertiary Students at One West-Coast Australian University

Principal Investigator/s

Dr Samuel Teague (Lecturer, Career Learning)
 Dr Alasdair Dempsey (Senior Lecturer, Exercise Science)
 Dr Ellen Greenham (Lecturer, Career Learning)
 Dr Sarah Courtis (Associate Lecturer, Career Learning)
 Dr Kim Hudson (Associate Lecturer, Career Learning)
 Dr Robert Payne (Associate Lecturer, Career Learning)

STAGE ONE

1. Describe your history of engaging with and learning about data analytics.
2. On a scale of 1-10, with 10 meaning 'very high proficiency' and 1 meaning 'very low proficiency', how would you rate your data analysis skills?
3. When did you first become aware that data is influencing nearly all aspects of our professional and personal lives? Was there a specific moment in time or event that lead to this realisation?
4. On a scale of 1-10, with 10 meaning 'very high impact' and 1 meaning 'very low impact', how significant do you believe data analytics has been (and will continue to be) in transforming the industry you hope to work in after completing your degree?
5. On a scale of 1-10, with 10 meaning 'very high proficiency' and 1 meaning 'very low proficiency', how would you rate your Microsoft Excel skills?
6. Units in X University's Career Learning Spine offer students the chance to develop a range of skills. From the list of nine employability skills provided below, which would you identify as your THREE strongest skills?
7. Units in X University's Career Learning Spine offer students the chance to develop a range of skills. From the list of nine employability skills provided below, which would you identify as your THREE weakest skills?
8. Data surveillance refers broadly to the tracking of individual behaviour, decision-making, GPS movements, and biological characteristics at any given time. These processes might occur when you're logging into Facebook and liking photos posted by friends, when you're ordering food using your UberEats app, or even when you're exercising and your smartwatch is providing feedback on your heart rate and blood pressure. On a scale of 1-10, with 10 meaning 'deeply concerned' and 1 meaning 'not concerned at all', how concerned are you about data surveillance in an increasingly virtual world?
9. Which of the following apps would you feel most hesitant in engaging with via your Smartphone or other portable device? (Multiple responses are permitted here. If you wish to avoid all ten of these apps, please tick all 10 options. Similarly, if you would continue to engage with all 10 apps, without hesitation, please tick no boxes).
10. What have you gained from this unit, in terms of the development of your skills, increasing depth of knowledge, and understanding of our social world?
11. On a scale of 1-10, with 10 meaning 'very curious' and 1 meaning 'not curious at all', how interested are you in learning more about data analytics and developing skills in this particular domain moving into the future?
12. Identify three words that come to mind when you see the phrase 'data analytics'.
1. On a scale of 1-10, with 10 meaning 'very high proficiency' and 1 meaning 'very low proficiency', how would you rate your data analysis skills?
2. On a scale of 1-10, with 10 meaning 'very high impact' and 1 meaning 'very low impact', how significant do you believe data analytics has been (and will continue to be) in transforming the industry you hope to work in after completing your degree?
3. Units in X University's Career Learning Spine offer students the chance to develop a range of skills. From the list of nine employability skills provided below, which would you identify as your THREE strongest skills?
4. Units in X University's Career Learning Spine offer students the chance to develop a range of skills. From the list of nine employability skills provided below, which would you identify as your THREE weakest skills?
5. Which of the following apps would you feel most hesitant in engaging with via your Smartphone or other portable device after learning about data surveillance in this unit? (Multiple responses are permitted here. If you wish to avoid all ten of these apps, please tick all 10 options. Similarly, if you would continue to engage with all 10 apps, without hesitation, please tick no boxes).
6. What have you gained from this unit, in terms of the development of your skills, increasing depth of knowledge, and understanding of our social world?
7. Data surveillance refers broadly to the tracking of individual behaviour, decision-making, GPS movements, and biological characteristics at any given time. These processes might occur when you're logging into Facebook and liking photos posted by friends, when you're ordering food using your UberEats app, or even when you're exercising and your smartwatch is providing feedback on your heart rate and blood pressure. On a scale of 1-10, with 10 meaning 'deeply concerned' and 1 meaning 'not concerned at all', how concerned are you about data surveillance in an increasingly virtual world?
8. On a scale of 1-10, with 10 meaning 'very curious' and 1 meaning 'not curious at all', how interested are you in learning more about data analytics and developing skills in this particular domain moving into the future?
9. On a scale of 1-10, with 10 meaning 'very high proficiency' and 1 meaning 'very low proficiency', how would you rate your Microsoft Excel skills?
10. Of the twelve topics covered this semester in The Search for Everything, which has been the most significant for you in terms of your learning experience and knowledge development, and why?
11. Throughout your time in this unit, you have engaged with readings, videos, lectures, quizzes, discussion forums, and live workshops with your peers. Within those forums and experiences, you've engaged with concepts, processes, data analysis methods, socio-political theories, Microsoft Excel, and much, much more. What has been the most transformational idea, concept, reading, lecture, video, etc. that you have engaged with throughout your time in this unit, and why?
12. What do you see as the most positive impact data analytics could have (or already has) on our professional and/or personal lives?
13. Identify three words that come to mind when you see the phrase 'data analytics'.



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Statistically speaking, are students situationally engaged and motivated in the statistics classroom?

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Keywords

Flow;
mathematics;
situational engagement;
statistics;
United Arab Emirates.

Abstract

The aim of the present exploratory study was to examine students' situational engagement and motivation in the statistics classroom at Zayed University, in Dubai, United Arab Emirates (UAE). Two instruments were used for this purpose: a) experience sampling method (ESM), and b) the validated Mathematics Motivation Questionnaire (MMQ). This study employed two samples, at the undergraduate level (2nd and 4th Semesters). Participants consisted of 100 students enrolled in Statistics I and Statistics II (Probability and Structure of Randomness). The results indicate that, apart from challenge and effort, emotional engagement is not significantly different across different activities. The results also indicate increases in intrinsic value and utility value and decreases in test anxiety. Finally, results indicate higher engagement and effort when social interaction is purposely planned and fostered, such as in small groups. On the contrary, individual class activities seem to generate slightly lower levels of engagement and effort. These findings have significant implications for educators and researchers who seek to enhance students' engagement and motivation in their statistics courses.

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Introduction

The study of student situational engagement and motivation is gaining increased traction in the research literature (Tan et al., 2021; Rivera & Garden, 2021). Situational engagement is contextual and is often described as moments in time when students are entirely focused on a teaching and learning activity (Inkinen et al., 2020) and experience important levels of challenge, skill, and interest (Schneider et al., 2016). A considerable amount of literature has been published on engagement. These studies have, however, mainly focused on overall engagement, cognitive, behavioural, or emotional engagement in regular classrooms at the undergraduate level (Mendini & Peter, 2018). More recently, several studies have begun to examine *momentary engagement* in science classes and *optimal learning moments* (Upadaya et al., 2021; Tang et al., 2020; Rosenberg et al., 2020; Dietrich et al., 2019; Janna et al., 2019; Schmidt et al., 2018; Schneider et al., 2016).

In fact, Inkinen et al. (2020) posited that students experienced elevated levels of situational engagement during approximately 15% of the time spent in the classroom. What is less clear is what happens during the remaining 85% of the time. Although there is emerging qualitative and quantitative research on situational engagement and motivation in various disciplines and published research in which motivation and/or engagement in the mathematics classroom at university level were investigated, assessed, or measured (Hammad et al., 2022; Lim et al., 2022; Park & Han, 2021; Tossavainen et al., 2021; Goldin, 2017; Sundre et al., 2012), a search of the literature revealed a paucity of studies which (a) seek to answer the research questions and (b) use the methodology set for this study 1. at tertiary level, 2. in the statistics classroom, and 3. in the context of the UAE. The present study seeks to address this gap, as it contributes to literature (1) by combining situational measures of engagement in the mathematics/statistics classroom using the Experience Sampling Method (ESM) and the Mathematics Motivation Questionnaire (MMQ).

This article has been divided into five sections. The first section deals with the literature review and gives a brief overview of situational engagement and motivation. The second section is concerned with methodology. Section Three presents and analyses the results. The fourth section discusses the results and presents its limitations. Section Five concludes the study.

Related research

Situational engagement

Research on situational engagement originates from the concept of *flow*, "the experience of complete absorption in the present moment" (Nakamura & Csikszentmihalyi, 2009, p. 195). According to flow theory, a flow moment emerges when there is an activity with clear goals and immediate feedback. It requires a dynamic fragile equilibrium of intensely focused concentration, driven by interest (in the subject area, topic, domain, teaching and learning activity), perceived skill/capabilities, and challenge (tasks that provide

opportunities for action). The flow moment can be sustained (often referred to as directed motivational currents) or repeated only if students continue to engage progressively with more complex activities, tasks, and challenges (Nakamura & Csikszentmihalyi, 2009). That is, to be actively engaged and motivated in a teaching and learning activity face-to-face (F2F) and/or online, students should experience (1) situational interest, which sets the foundation for continuing motivation and subsequent learning (Shernoff et al., 2014), (2) challenge in the activity or task, and (3) should perceive that they have the (acquired) skill or competence (s) to tackle the task.

Studies by Inkinen et al. (2020), Renninger et al. (2018), Goldin (2017), Shernoff et al. (2014), and Olitsky (2007) have shown, for instance, that discussing and/or solving a math problem individually, with a classmate or within a group can trigger situational interest and engagement. Results of a study by Choi et al. (2007) showed that a flow experience had direct and indirect positive consequences on the achievement of the learning outcomes. Additionally, Hong et al. (2017) argued that intrinsic motivation, self-efficacy, flow experience, and learning progress were positively correlated. As student engagement in learning is often intricate, the concept of flow has been investigated in several modalities (online, blended) and in various educational and geographical contexts (Pearce et al., 2005; Shin, 2006; Choi et al., 2007; Esteban-Millat et al., 2014; Hong et al., 2017) to identify similarities. Pearce et al. (2005) uncovered for instance a series of flow-paths and patterns related to the online interactions that occurred in the classroom. Several patterns of situational engagement were also identified by Upadaya et al. (2021) and Schnitzler et al. (2021) in F2F classes, which indicates that levels of engagement (and experience) within and between students in one classroom and with similar tasks can vary significantly (Martin et al., 2020; Pöysä et al., 2018).

Situational engagement and motivation in mathematics

While situation engagement has been studied extensively in the context of scientific learning (Lavonen et al., 2021; Pöysä et al., 2018; Upadaya et al., 2021), research related specifically to engagement in mathematics and statistics courses has been very limited. Situational engagement in solving math problems was investigated by Inkinen et al. (2020) as part of a wider inquiry into ten scientific practices at the high school level. It was found that solving math problems elicited an above-average level of situational engagement. A comparison of STEM project-based learning to traditional approaches showed greater positive affective mathematics engagement in terms of mathematical self-acknowledgement (Lee et al., 2019). Student engagement in linear algebra courses was shown to improve using the activity, discussion, and exercise cycle style of teaching, with cognitive engagement, affective engagement and behavioural engagement being particularly affected. A few studies examined mathematics situational engagement in various scenarios outside the traditional classroom setting (Bond, 2020; Lindstedt et al., 2020; Vainikainen et al., 2015). Similarly, several studies investigated the use of technology to improve situational engagement with the majority finding

a positive correlation (Attard et al., 2020; Gil-Doménech & Berbegal-Mirabent, 2019).

Student engagement in mathematics at the macro level has received greater attention. Several studies investigated the relationship between engagement and academic achievement. Wang et al. (2021), for instance, conducted two longitudinal studies seeking to understand the role of metacognition and motivation in predicting adolescents' engagement in math learning over time. Similarly, a longitudinal study of middle school students showed that students who were more alike in their engagement attained similar factor patterns regardless of their achievement level (Skilling et al., 2021). An investigation into the relationship between student engagement and mathematics achievement based on a survey of 295,416 high school students showed a positive correlation between engagement and higher levels of academic achievement, with cognitive engagement having the strongest association with achievement (Fung et al., 2018). Given the lack of studies that examine situational engagement specifically in mathematics and statistics courses in Higher Education, the present research fills an important gap in the literature.

Conceptual framework

Expectancy value theory is a psychological model that describes how individuals make decisions. The theory posits that people evaluate different options by considering the expected outcome (the average outcome if the option was chosen many times) and the value (or desirability) of that outcome. The overall evaluation of an option is the product of these two factors: the expectancy value. Expectancy-value theory (EVT, Eccles et al., 1983) is also a key theory on student motivation and achievement. Expectancy value theory can, therefore, be used to understand and predict a wide range of behaviours, including educational choices, career decisions, and health behaviours.

Additionally, it can help to explain why people may choose to engage in certain activities despite the potential costs or challenges involved. According to EVT, the expected value of an action is determined by two factors: the probability that a particular outcome will occur, and the value that the person places on that outcome. EVT posits that (1) expectancies students have about their success in a specific task ("Can I actually do this task?"), a positive answer would predict better performance and increased motivation to select more challenging tasks (Eccles & Wigfield, 2002, p. 111), and (2) reasons or task-related value beliefs ("Why should I do this task?") are critical to student engagement and motivation in the classroom. Recent research indicated, however, that (a) engagement is malleable (Upadyaya et al., 2021; Dietrich et al., 2019) and (b) motivation also often fluctuates during class periods. To reflect these latest findings, Eccles and Wigfield (2020) relabelled EVT as Situated Expectancy-Value Theory (SEVT) to give higher prominence to the fact that expectancy-value beliefs are "situationally sensitive and interact over short periods of time" (Beymer et al., 2022, p. 2).

Purpose of the study and research questions

The overall aim of the current study is to build on previous research by investigating situational engagement and motivation in the statistics classroom at the university level in the UAE. For the purposes of this study, the authors adopted Martin et al.'s (2017) definition of motivation "as the inclination, energy, emotion, and drive relevant to learning, working effectively, and achieving" (p. 152).

The present study seeks answers to the following three research questions:

- RQ1. To what degree are students in the statistics classroom situationally engaged and motivated?
- RQ2. Does the type of activity students were engaged in influence their level of engagement, effort, persistence, experience of flow, and anxiety?
- RQ3. Is there a correlation between the level of engagement across different dimensions of situational engagement?

Materials and methods

Participants and procedure

The study initially enrolled 100 students across two classes: 17 students in a 4th-semester Statistics II course and 83 students in a 2nd-semester Statistics I course. These were convenience and purposeful samples at Zayed University (ZU).

Different data collection points

Although 100 students were enrolled in the study, only 78 responded to the demographic survey. This reduction in sample size (from 100 to 78) can be attributed to non-response or incomplete participation in the initial demographic survey. In other words, 78 surveys were fully completed and considered for the statistics of the demographic variables - 17 students from the 4th-semester Statistics II course and 61 students from the 2nd-semester Statistics I course. The first sample comprised 17 students in a 4th semester Statistics Course (Statistics II), with a Mean age $M = 19$, $SD \pm 0.87$; range: 17-21 years. Demographics (17.6% male / 82.4% female). Overall, the first sample data comprised 38 survey responses (MMQ) and 108 ESM responses.

The second sample consisted of 61 students in a 2nd-semester Statistics Course (Statistics I), with a Mean age $M = 17.9$, $SD \pm 0.78$; range: 17-21 years. Demographics (9.8%, 90.2 % female). Overall, the second sample data consisted of 146 survey responses (MMQ) and 391 ESM responses. The class length was 90 minutes for both samples.

MMQ participation:

- **MMQ-Start (N=84):** At the start of the experiment, 84 students participated in the MMQ-start. This sample size is larger than the 78 who completed the demographic survey because not all students who participated in the MMQ completed the demographic survey, and vice versa.
- **MMQ-End (N=100):** By the end of the study, all 100 students had completed the MMQ. This increase in sample size reflects full participation in the MMQ at the conclusion of the study, even though some students may have missed the demographic survey earlier and the MMQ-start, they took part in the other stages of the study, i.e., the ESM.

ESM responses:

- The ESM was administered at two points during each class: 45 minutes into the class (N=277 responses) and at the end of the class (N=222 responses) for 3 weeks. These sample sizes reflect the number of ESM responses collected, not individual participants. Since each student provided multiple responses across the different time points and activities for 3 weeks, the response count exceeds the number of individual students. Therefore, the difference in sample sizes (277 vs. 222) is due to varying participation at different points in the class session, possibly influenced by factors such as class engagement and attendance.

Ethical clearance was sought and obtained on 27 November 2022. [Ethics Approval Number: ZU22_089_F]. A consent form was sent to all participating students for signature, before starting the experiment.

Fredricks and McColskey (2012) argued that “most current methods” did “not adequately capture the dynamic and interactive nature of engagement” (p. 779). Moreover, Rosenberg et al. (2020) stated that situational engagement was “often studied using single time-point surveys—which may not account for the dynamic nature of learners’ situational engagement” (p.4). Others, such as Morris et al. (2019), indicated that retrospective surveys were not as accurate as the Experience Sampling Method (ESM). as they often under-reported negative experiences and over-reported positive experiences (p. 4).

This study therefore used (1) the Mathematics Motivation Questionnaire or MMQ (Fiorella et al., 2021) and (2) the Experience Sampling Method (ESM) to collect, by means of self-report, actual, real-time data for three weeks.

- (1) **MMQ:** Originally designed to gauge secondary students’ motivation in mathematics classes, the 19-item validated MMQ was adapted by Fiorella et al. (2021) from the 25-item validated SMQ (Science Motivation Questionnaire) designed by Glynn et al. (2011). The nonlinear SEM reliability coefficients of the five MMQ constructs indicate

good to excellent values and range from .76 to .91. Cronbach’s α for the five constructs are Intrinsic value (3 items, .85); Self-regulation (4 items, .72); Self-efficacy (4 items, .86); Utility value (4 items, .89); Test anxiety (4 items, .78). Considering that results above 0.7 are deemed acceptable, a value close to .9 suggests that the consistency of the results obtained by the MMQ questionnaire was relatively high.

- (2) **ESM** was used to capture graduate students’ situational engagement and motivation in math classrooms, *in situ/online* and in the moment (s) they were occurring (Hektner et al., 2007) to minimise memory biases. Students were asked to specify whether they were [in the classroom] or [online].

Measures

- (1) **MMQ:** The 19 items of the MMQ are divided into five categories: (a) intrinsic value, described by Eccles and Wigfield (2020) as “anticipated enjoyment one expects to gain from doing the task or purposes of making choices and as the enjoyment one gets when doing the task” (p. 11); (b) self-regulation; (c) self-efficacy; (d) utility value, or “how well a particular task fits into an individual’s present or future plans” (Eccles & Wigfield, 2020, p. 12); and (e) test anxiety.

Example items were “I like math that challenges me” (intrinsic value), “I put enough effort into learning the math” (self-regulation), “I believe I can master the knowledge and skills in the math course” (self-efficacy), “I think about how learning math can help my career” (utility value), and “I am nervous about how I will do on the math tests” (test anxiety). A demographics section was added to the MMQ and collected information about participants’ gender, nationality (Emirati/non-Emirati), year of study, GPA, major, number and titles of mathematics courses currently taken, and most recent score at a math exam.

The MMQ was administered online on 30 January 2023 (=start of the experiment, *pre*) and a second time on 19 February 2023 (= three weeks later, *post*).

- (2) **ESM:** Interval contingent notification triggers (Van Berkel et al., 2017) - *experience* questions (one-to-five Likert scales) were simultaneously sent to all students (online and face-to-face) by email (Google forms) at 45 minutes (into the class, break time) for all samples and one question and four statement items were sent to all samples at the end of each class with a notification expiry time set at 5 minutes, to reduce participants’ burden and avoid interrupting students’ situational engagement. Research by Sahami Shirazi et al. (2014) on 200 million notifications from more than 40,000 users indicated that the

probability of a participant not clicking on a notification five minutes after receiving it was 17% (p. 3058).

Students were asked (1) to give thought to and reflect on the lecture and the activities of the past minutes and (2) to rate the items within five minutes. Then, they were asked similar questions at the end of the class. See Tables A and B in the Appendix.

Analytic plan

Statistical analysis

The collected data were coded, entered, and analysed using the statistical package SPSS version 28. Statistical tests with p-values < 0.05 were considered statistically significant. Descriptive statistics were employed to describe all items of the questionnaire. T-tests, paired t-test, or ANOVA were also used to examine the correlations between the different constructs measured by the Likert scale items.

For the MMQ, we computed the mean and standard deviation for each statement that was all positively worded, and then we constructed the below subscales:

1. Intrinsic Value (Items 1-3)
2. Self-Regulation (Items 4-7)
3. Self-Efficacy (Items 8-11)
4. Utility-Value (Items 12-15)
5. Test Anxiety (Items 16-19)

To score each subscale, the mean score (and standard deviation) of the statements that belong to each subscale was calculated, without the need to reverse-score any statement.

For the ESM scale, the average scores for the dimensions for both the ESM at 45 minutes and the ESM were computed at the end of class.

Results

Demographic characteristics

100 students enrolled in two classes were selected for the experiment. Out of the 100 students, 78 answered the demographic survey, leading a sample size of 78, with 88.5% being female and 11.5% male. Table 1 shows that most participants are in their first year of study (78.2%), while the rest are in their second year. Most participants are Emirati (96.2%), while only a small percentage are non-Emirati. In terms of high school type, most participants attended private schools (59%), followed by public schools (34.6%), and a small percentage attended both. Regarding majors, the most popular one is Computational Systems (56.4%), followed by Business Transformation (28.2%), Social

Innovation (11.5%), and Sustainability (3.8%). Lastly, in terms of courses, most participants were enrolled in Statistics I (78.2%), while 21.8% were enrolled in the Probability and Structure of Randomness course (Statistics II).

Table 1. Demographic characteristics of participants.

Variable	Labels	Total Participants	
		No.	%
Gender	Female	69	88.5
	Male	9	11.5
Study year	1 st year	61	78.2
	2 nd year	17	21.8
Nationality	Emirati	75	96.2
	Non-Emirati	3	3.8
Type of High School	Public	27	34.6
	Private	46	59.0
	Both Public and Private	5	6.4
Major	Public	27	34.6
	Computational Systems	44	56.4
	Business Transformation	22	28.2
	Social Innovation	9	11.5
Course	Sustainability	3	3.8
	Statistics I	61	78.2
	Statistics II	17	21.8

Table 2 provides additional information about the participants (age, experience with Math, GPA).

Table 2. Participants' characteristics.

Variable	No.	Minimum	Maximum	Mean	Std. Deviation
Age	78	17	21	18.15	.913
How many mathematics courses did you take in high school?	78	1	12	3.47	2.771
What was your score on the mathematics section of the EmSAT (The Emirates Standardised Test)?	69	580	2000	991.68	254.210
How many mathematics courses have you taken at ZU?	78	1	7	1.62	1.108
Current (semester) GPA	74	1	4	3.45	.610

MMQ

First, the descriptive statistics for the MMQ statements were calculated: Out of the 100 students enrolled in the study, 84 were present during the start of the experiment, while all of them were present during the last day of the experiment. This explains the difference in the total number of answers between MMQ-Start and MMQ-End, as shown in Table 3.

An analysis of the MMQ-Start data revealed that the students had moderately high levels of motivation for learning math. The mean scores for each item ranged from 2.94 to 4.01, with a standard deviation ranging from 1.02 to 1.52. Notably, the students reported the highest levels of motivation for "putting enough effort into learning math" (mean = 4.00) and the lowest levels of motivation for "being concerned that other students are better in math" (mean = 2.94).

Table 3. Comparison of MMQ scores between start and end of experiment: Student attitudes towards learning Math. (Fiorella et al., 2021).

MMQ Items	MMQ-Start (N=84)		MMQ-End (N=100)	
	Mean	Std. Deviation	Mean	Std. Deviation
1. I enjoy learning math	3.56	1.29	3.58	1.30
2. I find learning math interesting	3.56	1.27	3.68	1.24
3. I like math that challenges me	3.15	1.40	3.30	1.31
4. I put enough effort into learning the math	4.00	1.02	4.03	1.11
5. If I am having trouble learning the math, I try to figure out why	3.64	1.22	3.69	1.16
6. I use strategies that ensure I learn math well	3.76	1.05	3.81	1.05
7. I prepare well for math tests and quizzes	3.99	1.18	3.9	1.03
8. I am confident I will do well on math assignments and projects	3.63	1.04	3.71	1.10
9. I am confident I will do well on math tests	3.62	1.16	3.49	1.15
10. I believe I can master the knowledge and skills in the math course	3.76	1.13	3.76	1.14
11. I believe I can earn a grade of "A" in the math course	4.01	1.04	3.84	1.23
12. I think about how the math I learn will be helpful to me	3.59	1.20	3.58	1.27
13. I think about how I will use math I learn	3.42	1.22	3.51	1.27
14. I think about how learning math can help me get a good job	3.50	1.24	3.61	1.27
15. I think about how learning math can help my career	3.69	1.15	3.64	1.22
16. I become anxious when it is time to take a math test	3.63	1.26	3.33	1.30
17. I am nervous about how I will do on the math tests	3.58	1.25	3.29	1.27
18. I worry about failing math tests	3.29	1.52	2.83	1.41
19. I am concerned that the other students are better in math	2.94	1.43	2.67	1.30

Items 13, 14, and 15, which relate to how learners perceive the usefulness of math in their lives and career, have high mean scores, suggesting that respondents are motivated to learn math because they see its relevance to their future.

On the other hand, Items 17 and 18, which reflect anxiety and worry towards math tests and performance, have lower mean scores compared to other items, indicating that respondents are less anxious about math tests at MMQ-End than MMQ-Start.

Analysis of the MMQ-End data revealed a slight decrease in the students' motivation levels for learning math. The mean scores for each item ranged from 2.67 to 3.84, with a standard deviation ranging from 1.03 to 1.41. Notably, the students reported the highest levels of motivation for "preparing well for math tests and quizzes" (mean = 3.90) and the lowest levels of motivation for "being concerned about failing math tests" (mean = 2.83).

Overall, the results suggest that the students had moderately high levels of motivation for learning math at the beginning of the course, but that their motivation levels decreased slightly by the end of the three weeks. These findings may have implications for math educators and suggest the need for interventions to sustain students' motivation levels throughout the course.

Next, we calculated the descriptive statistics for the constructs, i.e., MMQ Dimensions, as shown in Table 4.

Table 4 shows that the mean scores for all five subscales slightly increased or remained stable from MMQ-Start to MMQ-End. The standard deviations for each subscale were relatively consistent across MMQ-Start and MMQ-End,

Table 4. Comparison of MMQ dimension scores at start and end of experiment.

MMQ Dimensions	MMQ-Start (N=84)		MMQ-End (N=100)		P-Value (Paired t-test)
	Mean	SD	Mean	SD	
Intrinsic Value	3.42	1.22	3.52	1.21	0.439
Self-Regulation	3.85	0.86	3.86	0.89	0.864
Self-Efficacy	3.76	0.96	3.69	1.06	0.783
Utility Value	3.55	1.03	3.58	1.13	0.815
Test Anxiety	3.36	1.13	3.03	1.12	0.033

indicating that the variability in responses did not change significantly over time. However, the Test Anxiety subscale showed a notable decrease in mean score from MMQ-Start to MMQ-End. These results suggest that the study had a positive impact on students' attitudes towards math learning and reduced their test anxiety levels.

- In terms of intrinsic value, there was a slight increase in mean scores from 3.42 to 3.52, indicating that students may have found math more enjoyable and interesting as they progressed through the study. This is a positive result, as intrinsic motivation is a key factor in learning and academic achievement.
- The self-regulation subscale showed no significant change, with mean scores remaining consistent at 3.85 and 3.86. This indicates that students maintained their level of effort and use of learning strategies throughout the study.
- The self-efficacy subscale showed a slight decrease in mean scores from 3.76 to 3.69. This could indicate that students may have become less confident in their ability to learn math as they progressed through the study. However, the difference in mean scores is not large enough to draw any definitive conclusions.
- The utility value subscale showed a small increase in mean scores from 3.55 to 3.58. This suggests that students may have become more aware of the usefulness of math in their lives and future careers as they progressed through the study.
- Finally, the test anxiety subscale showed a significant decrease in mean scores from 3.36 to 3.03. This is a positive result as it indicates that students may have become less anxious about math tests as they progressed through the study.

As it can be seen from Table 4, there is a significant difference between the means of MMQ-Start and MMQ-End for the Test Anxiety subscale ($p=0.033$). The mean score for Test Anxiety decreased from 3.36 ($SD=1.13$) at MMQ-Start to 3.03 ($SD=1.12$) at MMQ-End, indicating that students reported less anxiety towards math tests after completing the study.

For the other subscales (Intrinsic Value, Self-Regulation, Self-Efficacy, and Utility-Value), there is no significant difference between the means of MMQ-Start and MMQ-End. The mean scores for these subscales remained relatively stable over time, indicating that the intervention did not significantly affect students' motivation towards math in these areas.

The results suggest that the intervention was effective in reducing students' anxiety towards math tests but did not significantly impact their motivation towards other aspects of learning math.

To answer RQ1, MMQ scores were computed, which is the average of all items in the MMQ scale (MMQ-End). The mean score of 3.54 on the MMQ suggests that, on average, students have a moderate level of motivation and engagement in mathematics. The standard deviation of 0.71 indicates that there is some variability in the scores, with some students having higher levels of motivation and engagement than others.

A t-test to compare the mean scores on the MMQ across different groups of students was run, such as by semester of study and course enrolment. The t-test was 2.153 (p-value=0.031) indicating a statistically significant difference in the mean MMQ scores between students in their second or fourth semester of study. Therefore, based on these results, it can be concluded that students in their fourth semester of study, enrolled in Statistics II (mean of 3.80), have a significantly different level of situational engagement and motivation than students in their second semester of study enrolled in Statistics I (mean of 3.45).

T-tests were then used to compare the mean scores on the MMQ's five subscales across different groups of students; the two groups are by semester of study and by course level. The results are summarised in Table 5.

Table 5. Comparison of MMQ subscale mean scores across different groups of students.

	P-value	t	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Intrinsic Value	0.07	1.66	0.46	0.28	-0.09	1.01
Self-Regulation	0.05	0.97	0.20	0.21	-0.21	0.61
Self-Efficacy	<0.001	2.98	0.70	0.24	0.24	1.17
Utility-Value	0.40	2.14	0.55	0.26	0.04	1.06
Test Anxiety	0.23	-0.56	-0.14	0.26	-0.66	0.37

For the Intrinsic Value, Utility-Value, and Test Anxiety subscales, the t-tests were not significant at the 0.05 level (p-value of 0.07, 0.40, and 0.23, respectively). This suggests that there may be no statistically significant differences in mean scores between the two groups being compared by semester of study and by course as well.

For the Self-Regulation and Self-Efficacy subscales, t-tests were significant (p-value of 0.05 and p-value < 0.001, respectively), suggesting that there is a statistically significant difference in mean scores between the two groups (per semester of study and by course).

EMS: (EMS-45 minutes and EMS-End)

Table 6 presents the frequency and percentage of the types of activities that students reported engaging in during the last few minutes of the class at two different time points: 45 minutes into the class and at the end of the class.

At 45 minutes into the class, the most frequently reported activities were calculating and collaborating in small groups, each reported by 31.5% of students, followed by listening (24.1%). On the other hand, at the end of the class, the most frequently reported activity was listening (38.9%), followed by collaborating in small groups (27.8%) and writing (9.3%). These results suggest that the types of activities that students engage in change over the course of the class, with a shift towards more listening and less calculating as the class progresses.

Table 6. A comparison of student activities at 45 minutes and end of class.

Activity	ESM at 45 minutes (N=277)		ESM end of class (N=222)	
	Frequency	%	Frequency	%
Calculate	90	32.5	37	16.7
Write	22	7.9	29	13.1
Listen	60	21.7	55	24.8
Collaborate	51	18.4	63	28.4
Explain	2	.7	6	2.7
Interpret	45	16.2	26	11.7
Other (for instance asking questions, design scientific inquiry, etc.)	7	2.5	6	2.7

The differences in situational engagement based on the type of activity have been studied by several authors (Lavonen et al., 2021). However, it has not been done in the context of university mathematics/ statistics courses. To fill this gap in the literature, we measured situational level of interest, challenge, motivation, and importance in student studies and future goals with respect to several common classroom activities. The Experience Sampling Method was carried out twice during each lecture - once at the 45-minute mark and once at the end of the lecture. The summary of the results collected at the 45-minute mark is presented in Table 7.

As shown in Table 7, the mean level of interest, challenge, and motivation differs across activities. There is no single activity that dominates situational engagement across different dimensions. Listening was the highest-rated activity in terms of interest. Surprisingly, listening was also deemed as the most challenging activity followed closely by calculating. Calculating was also rated as the most motivating activity. Other activities were deemed the most important for students' studies and future goals.

The p-values of the one-way ANOVA test are shown in the last column of Table 7. Since all the p-values are above 0.05, the results show that there is no significant difference in the sample means of the activities. Concretely, the results suggest that all the activities hold the same level of interest, challenge, motivation, and importance in studies and goals.

The lack of difference between calculating and other activities is a somewhat surprising revelation, given that calculating is at the core of mathematics. Moreover, calculating is traditionally believed to be the most challenging activity in mathematics courses. However, this belief is not supported by our results, as other activities, such as listening and interpreting, are rated equally challenging by the students.

Table 7. Comparison of average levels of situational engagement across different classroom activities as measured at the 45-minute mark.

Activity	Calculate	Write	Listen	Collaborate	Interpret	Other	p-value
Frequency	90	22	60	51	45	7	
Interesting	3.62	3.36	3.88	3.53	3.42	3.14	0.193
Challenging	3.52	3.18	3.57	3.31	3.42	2.29	0.068
Motivating	3.33	2.73	2.97	3.12	3.20	3.00	0.195
Studies	4.14	3.95	4.23	4.12	4.00	4.71	0.454
Goals	3.46	3.36	3.57	3.14	3.40	3.86	0.403

The summary of the results collected at the end of the lecture is presented in Table 8. Students' situational engagement, effort, desire to continue the activity, and involvement are measured for various activities performed at the end of the lecture. As shown in Table 8, calculating, interpreting data, and other activities are rated as the most engaging while explaining is rated the lowest. Calculating is the highest-rated activity in terms of effort, followed by other activities and interpreting.

The results show that while calculating is often rated near the top of situational dimensions, there is no significant separation between calculating and the remaining activities. Since all the p-values are above 0.05, there is no statistically significant difference in sample means of the activities across different situational dimensions. Specifically, there is no evidence in our results to suggest that calculating required more effort than the other activities. As mentioned above, it is a surprising observation, given that calculating is traditionally considered the activity which requires the most effort. The results collected at the end of the lecture are in line with those collected at the 45-minute mark. This suggests that the differences in engagement scores were primarily due to individual differences rather than the activities themselves. The lack of significant differences between the activities indicates that engagement levels were consistent regardless of the activity in which participants were engaged in. The same applies to all other dimensions of the ESM.

Table 8. Comparison of average levels of situational engagement across different classroom activities as measured at the end of the class.

Activity	Calculate	Write	Listen	Collaborate	Explain	Interpret	Other	p-value
Frequency	37	29	55	63	6	26	6	
Engaged	4.00	3.90	3.82	4.08	3.67	4.08	4.00	0.657
Effort	4.24	3.90	3.93	3.92	3.17	4.04	4.17	0.098
Continue	3.76	3.31	3.27	3.63	3.50	3.42	3.83	0.322
Involved	3.54	3.28	3.09	3.54	3.00	3.23	4.17	0.108

Next, to answer RQ2, frequency and percentage of each response for each activity were computed from those who answered *true for me* and *very true for me* to the ESM-END,

as shown in Table 9.

Table 9. A comparison of student activities at 45 minutes and end of class.

Activity	I was engaged with the topic at hand	I put in a lot of effort	I wish we could still continue with the work for a while	I was so involved that I forgot everything around me
Calculate (37)	26(70.3%)	30 (81.1%)	23 (62.2%)	17 (45.9%)
Write (29)	17 (58.6%)	19 (65.5%)	13 (44.8%)	11 (37.9%)
Listen (55)	41 (74.5%)	38 (69.1%)	23 (41.8%)	18 (32.7%)
Collaborate (63)	47 (74.6%)	40 (63.5%)	34 (54.0%)	35 (55.6%)
Explain (6)	4 (66.7%)	1 (16.7%)	3 (50.0%)	1 (16.7%)
Interpret (26)	21 (80.8%)	20 (76.9%)	13 (50.0%)	9 (34.6%)
Other (6)	4 (66.7%)	4 (66.7%)	3 (50.0%)	4 (66.7%)

Table 9 indicates that for each of the activities, most participants who answered "true for me" or "very true for me" reported being engaged with the topic at hand. The activity that generated the highest percentage of such responses was collaborating in a small group (74.6%), while the lowest was explaining phenomena scientifically (66.7%). Additionally, for most activities, most participants who answered "true for me" or "very true for me" reported putting in a lot of effort, with the highest percentage being for calculating (81.1%). Regarding the desire to continue with the work, the activity with the highest percentage of positive responses was, again, collaborating in a small group (54%), while the lowest was interpreting data and evidence scientifically (50%). Finally, for the statement "I was so involved that I forgot everything around me," the activity that generated the highest percentage of affirmative responses was, once again, collaborating in a small group (55.6%).

Across all activities, the percentage of participants who reported being engaged with the topic at hand and putting in a lot of effort was generally high. This suggests that the activities were generally effective at capturing participants' attention and encouraging them to invest effort. Furthermore, the activities that involved more open-ended inquiry, such as interpreting data and evidence scientifically and asking questions and designing scientific inquiry, had slightly lower levels of engagement and effort compared to the activities that involved more straightforward tasks, such as calculating and writing.

ESM Dimensions were also examined, as indicated in Table 10, to gauge whether the types of activity students were engaged in influenced their level of engagement, interest, effort, motivation, persistence, experience of flow, being involved:

Table 10. Mean scores of EMS subscales at 45 minutes and end of class.

ESM at 45 minutes (N=277)			ESM End of Class (N=222)		
Dimension	Mean	SD	Mean	SD	Dimension
Interesting	3.59	1.12	3.96	0.86	Engaged
Challenging	3.42	1.13	3.97	0.83	Effort
Motivating	3.13	1.13	3.50	1.09	Continue (persistence)
Studies	4.13	0.90	3.36	1.10	Involved
Goals	3.41	1.16			

The mean scores for interest, engagement/challenge, effort/motivation, and continuation (persistence) were all higher at the end of the class compared to 45 minutes into the class. Specifically, the mean score for interest was 3.96 (SD=0.86) at the end of the class, compared to 3.59 (SD=1.12) at 45 minutes. The mean score for engagement/challenge was 3.97 (SD=0.83) at the end of the class, compared to 3.42 (SD=1.13) at 45 minutes. The mean score for effort/motivation was 3.50 (SD=1.09) at the end of the class, compared to 3.13 (SD=1.13) at 45 minutes. Finally, the mean score for persistence was 3.84 (SD=0.98) at the end of the class, compared to 3.47 (SD=1.12) at 45 minutes.

The standard deviations for each dimension are similar across the two-time points, which suggests that the variability in students’ responses did not change significantly over time. Again, a statistical analysis would be needed to confirm this. Overall, these findings suggest that participants may become more interested, engaged, motivated, and persistent as a class progresses, but the changes may be relatively small. It is also worth noting that these findings are based on self-reported data collected using the ESM, which may be subject to response biases or other limitations.

To obtain further insight regarding various dimensions of situational engagement and to attempt to answer RQ3, we considered their pairwise correlations. The results of the ESM at the 45-minute mark are shown in Table 11, where the values above the diagonal represent the Pearson correlation and the values below the diagonal represent the corresponding p-values. As shown in Table 11, all the correlations are relatively weak albeit in most cases statistically significant. The correlation between students’ assessment of the level of interest and the level of challenge is 0.00986. The corresponding p-value is 0.87 which indicates that there is no relation between student interest and challenge in the activities. While the lack of relation is expected in certain cases, it is surprising in others. For instance, the correlation between motivation and interest level is 0.16, which is very low. It is a surprising result, given that one would expect student motivation to be strongly correlated with interest in the activity.

Table 11. Pairwise correlations between different dimensions of situational engagement as measured at the 45-minute mark.

	Interesting	Challenging	Motivating	Studies	Goals
Interesting	1	0.010	0.163*	0.344*	0.352*
Challenging		1	-0.085	0.161*	0.157*
Motivating			1	0.142*	0.210*
Studies				1	0.376*
Goals					1

*p<0.05

Similarly, the pairwise correlations between various dimensions of situational engagement measured at the end of the lecture are presented in Table 12, to answer RQ3. The correlations between different aspects of situational engagement are stronger than in Table 11. In particular, the correlation between the level of engagement in activity and the amount of effort is 0.54. The correlation between the desire to continue an activity and the amount of involvement

is 0.58. The relatively strong correlations are expected in some cases while surprising in others. For instance, the correlation between engagement and effort is somewhat surprising given that activities that require a lot of effort may be expected to reduce students’ enthusiasm regarding the activity. On the other hand, a low correlation between effort and the desire to continue an activity is less surprising.

Table 12. Pairwise correlations between different dimensions of situational engagement as measured at the end of the class.

	Engaged	Effort	Continue	Involved
Engaged	1	0.53754*	0.33554*	0.44686*
Effort		1	0.21937*	0.42007*
Continue			1	0.56749*
Involved				1

*p<0.05

Comparison of different dimensions of situational engagement between the two courses is provided in Tables 13 and 14. As shown in Table 13, there is little difference in situational engagement between the Statistics I and Statistics II courses measured at the 45-minute mark. The mean values of the engagement levels are similar across all dimensions except *challenge*. The students on the Statistics II course (Year 2) found their activities to be on average significantly more challenging, which is normal as this is an advanced course (4th Semester, Year 2). Situational engagement in terms of interest, motivation, and importance for their future goals was on average the same for both courses.

Table 13. Comparison of ESM-45 minutes among students by course.

Courses	Statistics I	Statistics II	p-value
Frequency	222	53	
Interesting	3.58	3.68	0.549
Challenging	3.23	4.23	<0.000001
Motivating	3.13	3.15	0.906
Goals	3.41	3.43	0.892

The comparison of situational engagement between the two courses measured at the end of each lecture is presented in Table 14. As shown in Table 14, there is little difference in situational engagement between the two courses. In particular, the mean level of engagement, effort, desire to continue, and involvement is essentially the same for the two courses. The p-values indicate that any difference in values is not statistically significant.

Discussion

This exploratory study set out with the aim of investigating situational engagement and motivation in the statistics classroom at the university level in the UAE. The present study sought answers to three research questions: (1) To what degree are students in the statistics classroom situationally engaged and motivated? (2) Does the type of activity students were engaged in influence their level of

Table 14. Comparison of ESM-end among students by course.

Course	Statistics I	Statistics II	p-value
Frequency	168	54	
Engaged	4.00	3.85	0.269
Effort	3.98	3.94	0.773
Continue	3.47	3.59	0.473
Involved	3.34	3.43	0.616

engagement, effort, persistence, experience of flow, and anxiety?, and (3) Is there a correlation between the level of engagement across different dimensions of the situational engagement?

The Mathematics Motivation Questionnaire (MMQ) was administered to 84 students at the beginning of the study and to 100 students at the end of the study to measure changes in their motivation for mathematics. Pre- to post-course comparisons were done by descriptive statistics, T-tests, paired t-test, and/or ANOVA. Additionally, the Experience Sampling Method (ESM) was used in each class for three weeks to collect, by means of self-report, real-time data. ESM results' standard deviations and Pairwise correlations' coefficients were analysed to obtain further insight regarding various dimensions of situational engagement.

With respect to the first research question, a slight increase in mean scores for intrinsic value was found, indicating that students found math more enjoyable and interesting as they progressed through the course. The self-regulation subscale showed no significant change, indicating that students maintained their level of effort and use of learning strategies throughout the course. The self-efficacy subscale showed a slight decrease in mean scores, suggesting that students may have become less confident in their ability to learn math as they progressed through the course. The utility value subscale showed a small increase in mean scores, indicating that students may have become more aware of the usefulness of math in their lives and future careers (EVT's "Why should I do this task?"). Finally, the most obvious finding to emerge from the analysis is that the test anxiety subscale showed a significant decrease in mean scores, indicating that students became less anxious about math tests as they progressed through the study.

Overall, the results suggest that students' motivation for and engagement with math improved slightly over the course of the study, with increases in intrinsic value and utility value, and decreases in test anxiety. However, there were no significant changes in self-regulation and self-efficacy. These findings have important implications for educators and researchers in the field of mathematics education who seek to enhance students' motivation for mathematics, and more specifically statistics.

With respect to the second research question, consistent with literature (Olitsky, 2007; Shernoff et al., 2014; Calonge & Safiullin, 2015; Goldin, 2017; Inkinen et al., 2020; Hultberg et al, 2018; Renninger et al., 2018), and based on

the frequency and percentage of each response for each activity, this research found that participants' levels of (emotional) engagement and [effort] for the activities that involved more classroom interaction (e.g., small cooperative groupwork) were consistently higher. Conversely, activities that were more individually focused, such as explaining phenomena scientifically, seemed to generate slightly lower levels of engagement and effort.

Another trend that was observed is that participants' desire to continue with the work for a while after the end of the activity appears [persistence] to be lower overall, with only about half of the participants indicating a desire to continue for most activities. Additionally, for most activities, fewer participants reported being so involved [flow] that they forgot everything around them, suggesting that while participants were engaged with the class and the active learning activities, they were still aware of their surroundings to some extent.

With respect to the third research question, what stands out in the ESM dimensions results is that students may become more interested, engaged, motivated, and persistent as a statistics class progresses, which may be due to increased student-student and student-professor interactivity. However, the differences between the means for each dimension are relatively small, ranging from 0.37 to 0.84, which indicates that the changes in these dimensions over time may not be large or significant. Future research could use more rigorous statistical analyses to confirm these findings and explore potential moderators of the observed changes in students' experiences over time.

Practical implications

Situational engagement in the statistics classroom is undoubtedly multifaceted, contextual, and dynamic. Based on our results, we propose several implications for practice. First, stronger emotional engagement with statistics courses can be fostered by purposely designing classroom opportunities that create and maximise interaction between academics and students (e.g., active lecturing, teamwork with active guidance) or video-based learning using knowledge tracing (Shehata et al., 2023). Second, increasing the number of problem-solving formative assessments (problem-based teaching, e.g., *calculating*, and *interpreting data*, rated as the most motivating and engaging activities), providing, and discussing constructive feedback, in class and among students with the use of chatbots (Kamalov et al., 2023; Calonge et al., 2023; Rudolph et al., 2023a, 2023b) may help students comprehend and better synthesise content, may further decrease test anxiety, and thus improve the class experience, cognitive and behavioural engagement, satisfaction, self-efficacy, and motivation.

Third, as *listening* was rated very high in terms of interest but considered the most challenging activity, we recommend chunking every lecture with active learning strategies as advocated by Freeman et al. (2014) in a meta-analysis of 225 studies of undergraduate education across all the STEM areas, by for instance asking students to (a) apply statistics to authentic phenomena that may be of interest to them, such

as climate change, inflation, wealth distribution, healthcare, etc., (b) use Python tools such as Jupyter Notebook or SymPy (Kamalov et al., 2023; Calonge et al., 2023), (c) explain data visualisations, (d) practise statistical modelling, etc. Finally, as *explaining* was rated “most challenging” and “least engaging”, providing additional opportunities to present in pairs or teams with peer and instructor feedback may boost students’ confidence and improve their expectancies about their success in a specific task (EVT’s “Can I actually do this task?”).

Limitations

The scope of this study was limited in terms of institution ($n=1$), the number of participants, and course availability. With a small purposive sample size, caution must be applied, as the findings cannot be extrapolated to all contexts, all students in all statistics courses. Despite this limitation, statistics, a foundational STEM subject, is often perceived as challenging and abstract. Students across various cultures and educational systems face similar difficulties in understanding and applying statistical concepts. Moreover, the digital age has heightened the importance of data analysis and interpretation. A study from the UAE, a rapidly developing nation with a strong focus on technology and innovation, can provide valuable insights into global trends in data literacy education. In conclusion, a study on student engagement and motivation in statistics classrooms at a single UAE university, while focused on a specific context, can offer valuable insights with broad implications for higher education worldwide. Additionally, despite using ESM to help reduce general recall bias, as survey respondents participated of their own volition, there may be possible self-selection bias in the resulting data. A natural progression of this work would be to use multiple sources of data, such as behavioural observations or physiological measures, to assess students’ experiences more objectively in the classroom.

Conclusions

This exploratory study has identified significant factors that impact situational engagement and motivation in the statistics classroom, including instructor-student and student-student interactions, varied active learning strategies, tools and activities, and application of knowledge to real phenomena. Expectancy-Value Theory offers valuable insights into the dynamics of student engagement in the statistics classroom in higher education. By acknowledging the significance of students’ beliefs in their ability to succeed (expectancy) and the perceived importance of the subject matter (value), educators can better tailor their teaching strategies and course materials to enhance motivation and student engagement. Recognising that students are more likely to engage actively when they believe in their capabilities and see the relevance of statistics in their academic and future professional pursuits is pivotal. Moreover, the Expectancy-Value Theory reminds us that fostering a supportive, active, and encouraging learning environment is equally essential, as it can positively influence students’ perceptions of their own competence and the value of the subject.

Ultimately, integrating the principles of this theory into pedagogical practices can lead to more motivated and engaged statistics students, thereby enhancing the quality of education, and preparing them for success in their future careers. These actionable insights could be used to inform instructional design and classroom management in statistics courses to better align with student engagement and preferences. As educators and students adapted to the challenges of emergency remote teaching and learning during COVID (Calonge et al., 2022), they now need to consider AI as a powerful tool for engagement and motivation (Kamalov et al., 2023, Calonge et al., 2023). Students and educators can, for instance, use AI to create simulations and visualisations that bring statistical concepts to life. Students can also interact with chatbots (Kamalov et al., 2023, Calonge et al., 2023, Hultberg et al., 2024; Firat, 2023), question, explore, analyse and visualise real-world datasets in a more engaging way, fostering curiosity and a deeper understanding.

Chatbots, as virtual teaching assistants, can summarise and paraphrase key points and complex concepts (e.g. Bayesian statistics, Nonparametric statistics, etc.), provide immediate feedback and practice on assignments, upcoming exams and quizzes, allowing students to adjust their learning strategies on the go. This personalised feedback loop can boost motivation, learning, and highlight areas for revisions and improvement. However, universities need to proactively develop transparent and applicable policies and strategies to integrate AI into courses and programs effectively, as AI can fundamentally alter teaching methods, requiring a reimagining of curriculum design and delivery. This includes faculty and student training to avoid faculty resistance, and as students become more familiar with AI tools, they may demand their integration, pressuring universities to adapt quickly. Clear policies on the ethical uses of AI, quality assurance (of learning) and ongoing evaluation are also needed to ensure AI augments rather than hinders the learning experience (Van Wyk, 2024). Rudolph et al. (2024) summarised it as “the promise of unprecedented learning enhancements and the peril of crucially important ethical dilemmas” (p. 19).

By embracing AI thoughtfully and strategically, we can create a dynamic, motivating and engaging statistics classroom that fosters a deeper understanding and appreciation for this crucial subject. It is a new frontier, a somewhat still uncharted territory, and like any revolution or crisis, it requires us to be adaptable, agile, forward-thinking, and innovative.

Data availability statement: The datasets used/analysed during the current study are available from the corresponding author on reasonable request.

Ethical approval

The questionnaire and methodology for this study were approved by the Research Ethics committee of Zayed University (UAE) (Ethics approval number: ZU22_089_F).

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Appendices

Appendix A. Questions asked at 45 minutes (all samples)

Items				Multiple choice
1. Select the type of activity you were doing in the last few minutes				- Calculating - Writing - Listening - Collaborating in a small group - Explaining phenomena scientifically - Interpreting data and evidence scientifically - other
Question				Likert Scale
2. "Did you find the activity you were doing"	Interesting	Challenging	Motivating	1=not at all; 2=slightly; 3=moderately; 4=very; 5=extremely
3. "How important was this activity for your studies?"				1=not important; 2=slightly important; 3=moderately important; 4= important; 5= very important
4. "How important was this activity in relation to your future goals/plans?"				1=not at all; 2=slightly; 3=moderately; 4=very; 5=extremely

Appendix B. Questions asked at the end of each class (all samples)

Item	Select the type of activity you were doing in the last few minutes	- Calculating - Writing - Listening - Collaborating in a small group - Explaining phenomena scientifically - Interpreting data and evidence scientifically - other
Construct	Item	Likert Scale
1. engagement with the task at hand	"I was engaged with the topic at hand"	1=not true at all for me; 2=not true for me; 3=neutral; 4=true for me; 5=very true for me.
2. a. effort and persistence	"I put in a lot of effort"	
b. effort and persistence	"I wish we could still continue with the work for a while"	
3. experience of flow or having been totally absorbed by the activity	"I was so involved that I forgot everything around me"	



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Exploring an online metacognitive intervention on young and mature employees: A preliminary study

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Keywords

Adaptability;
career resilience;
critical thinking;
metacognitive intervention.

Abstract

With sufficient metacognitive knowledge and action, employees are better equipped in their time and work management, avoiding any unproductive behaviour. Metacognitive strategies thus equip them with the need to learn and develop their career resilience, especially the young and mature working adults. As there are limited intervention studies exploring the metacognition of both young and mature employees, the present study investigated a metacognitive intervention to promote adaptability and career resilience. It explored the metacognitive strategies that include planning, monitoring and evaluating and examined the differences of various outcome variables (e.g., adaptability, critical thinking and career resilience). A total of 71 participants were recruited, and they underwent an eight-week metacognitive intervention. Pre- and post-questionnaires were administered before and after the intervention. Key findings indicated that the group difference was insignificant, suggesting the importance of metacognitive strategies in supporting adaptability and career resilience for young and mature employees. Finally, limitations to the study were presented, and recommendations were made for future workplace research and practice.

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Introduction

The massive technological advances in today's world demand metacognitive strategies to upskill and upgrade (Drigas et al., 2023). Metacognitive strategies such as self-regulation and monitoring are essential skills for self-development and personal growth. With sufficient metacognitive knowledge and action, employees are better equipped in their time and work management, avoiding any unproductive behaviour. Metacognitive strategies also equip them with the need to learn and develop their career resilience. There are limited empirical studies investigating metacognitive interventions on young and mature employees. Specifically, the effectiveness of an online metacognitive intervention on young and mature employees is yet to be investigated.

Current employees may be more socially adaptable as they prefer not to stay at one job for long. Instead, they would rather move on to the next job if the current job does not meet their expectations (Ng & Kong, 2022). One key question is, are our young graduates more agile in their learning, such that they can venture into a new workplace easily? On the other hand, are our mature employees less agile and adaptable than young people in gaining employment and employability? These are concerns relating to lifelong employability whereby the means of securing one's job is not reliant on growing national and global policies but the processes of lifelong learning among individuals (Ng, 2022). Lifelong employability herein refers to learning agility and social adaptability in today's current context is necessary. To meet the demands of today's global economy, it is important to support individuals' continuous learning across working life and address their needs associated with work goals, so that they stay relevant and sustain their employability (Chung & Chapman, 2023; Le et al., 2023).

As there are limited studies in this field of research, it is important to examine any changes in employees' learning agility and social adaptability that may influence their career resilience. It is also meaningful to understand whether metacognitive strategies differ between the two groups of employees (i.e., young and mature) and any effect on skills development in the transition from education to employment. The findings of the study add value to both the educational and industry landscapes by equipping employees with metacognitive strategies that are of key relevance to the evolving workforce and global economy. Finally, the study provides some insights to mitigate the impact of potential job losses and nurture lifelong employability among young and mature employees.

Literature review

Metacognition

Metacognition refers to all aspects of cognitive self-regulation that can be cross-disciplinary and applied in the areas of industry and education (Bell, 2017). Metacognition can influence how learners allocate their effort, evaluate their progress toward desired objectives, and react to their goal progress. Metacognition is also about one's creativity in generating innovative and unique solutions to complex

problems (Hargrove & Nietfeld, 2015).

Due to technological globalisation and the evolving world economy, the workplace requires metacognitive skills for acquiring and applying knowledge (OECD, 2022). Metacognitive skills refer to the ability to think about thinking that includes monitoring and control processes (Flavell, 1979; Metcalfe & Shimamura, 1994). Monitoring refers to identifying the task, assessing and evaluating one's own progress. Control processes include decision-making such as allocating one's cognitive resources and intensity at which to work on a task and prioritising various tasks at hand (Schmidt & Ford, 2003). Metacognitive interventions aim to increase the effectiveness of more autonomous or self-directed learning in workplaces.

Learning agility, social adaptability, and career resilience

Learning agility refers to an individual's ability and willingness to learn from experience and apply the lessons of experience to improve future performance (DeRue et al., 2012; Lee & Song, 2022). Learning agility is also about coming up to speed quickly and thinking flexibly about current experience. As such, learning agility could contribute to social adaptability during job transitions or new roles in workplaces. It is likely that individuals who know themselves well, learn from experiences, and adapt to social situations are resilient under the pressures of change.

Social adaptability is defined as the proficiency in adapting one's actions to current social contexts (Baron & Tang, 2009). Social adaptability is also the ability to adjust one's behaviour to a wide range of rapidly changing situations (Baron & Markman, 2003). Only one study examined employees' occupational adaptability (i.e., creating and maintaining a positive relationship with their work environment) and social adaptability in a private organisation (Abdulshah et al., 2017), indicating a significant positive relationship between occupational adaptability with social adaptability. Social adaptability also relates to adjusting to the environment by being socially responsible. Adaptability, which may be perceived as context-dependent or the degree of flexibility to adjust within a given work context, shares similarities to creative thinking. Creative thinking is defined as "creating new knowledge or adapting to tasks in new ways and thus contributing novelty to the effective and efficient nature of routine expertise" (Gube & Lajoie, 2020, p. 8). Routine expertise refers to the regular tasks at the workplace. Hence, the social adaptability herein includes social responsibility, adaptability and creative thinking.

Career resilience is defined as the "capacity to continue making progress toward your current career goals with the resources and strategies" one has already developed (Pipe et al., 2012, p. 245). Career resilience is also the capacity to find and maintain a job, make proper job transitions, and lead a satisfied life (Tien & Wang, 2017). A recent study indicated that career resilience mediated the relationship between career competency (i.e., self-management of career goals and progression) and career success (Ahmad et al., 2019). There is increasing evidence of the importance of career resilience for the modern worker, with career competency

being a significant predictor of career resilience, which subsequently is a significant predictor of career success. Resilient workers can self-manage their careers, continue to learn, and adapt to unpleasant events (Ahmad et al., 2019). Together, the outcome measures of learning agility, social adaptability and career resilience would illustrate a holistic approach to employability in the 21st century among young and mature employees.

Existing metacognitive intervention and empirical studies

Skulmowski and Rey (2017) and Teng (2017) both examined the connection between task-induced engagement and vocabulary acquisition in adults. The purpose of developing this research is to investigate whether word learning can be enhanced by a significant level of task-induced workload, considering metacognitive knowledge and regulatory abilities. For example, the research sample comprised 77 undergraduates who were enrolled in the English major programme (Teng, 2017). The demographic composition consists of 18 males and 59 females, with a mean age of 19 years. Students who participated in the reading intervention had undergone two rounds of assessment to evaluate their vocabulary knowledge: the first time, to determine their prior knowledge, and the second time, to determine if they had made any progress in acquiring new words. Students who demonstrated a greater comprehension of the cognitive process and regulation of cognition achieved greater success in word learning, suggesting that metacognition serves as an indicator of higher educational performance (Teng, 2017).

In another study, critical thinking skills were taught using adult distance learning (ADL; Dwyer & Walsh, 2020). ADL refers to learning that involves an educational modality wherein employed adults who have lapsed since their initial education, re-engage in formal learning to finish their Training and Education Bachelor of Arts degree entirely via e-learning. Empirical research indicates that students who participate in e-learning demonstrate enhanced problem-solving and decision-making abilities, which are fundamental building blocks of critical thinking, in comparison to those who adhere to the conventional learning model of attending physical classes on a regular basis (Dwyer & Walsh, 2020). As a result, ADL students assumed greater accountability for their own conduct and developed a greater sense of agency. In turn, it encourages these students to persevere in their academic pursuits, which could foster enhanced critical thinking. Furthermore, critical thinking requires autonomy of thought processes and comprehension of these processes. The e-learning environment thus offers necessary opportunities to demonstrate independence and the cognitive control required to boost critical thinking (Dwyer & Walsh, 2020; Waring, 2024).

A recent study by Brinkhof et al. (2023) investigated whether a metacognitive self-help intervention could efficiently promote resilience by enhancing behavioural adaptability in the elderly, including those without mild mental health issues. Especially for the elderly, the capacity to exhibit resilience is an effective adjustment during adversity that

is frequently associated with successful ageing. By assisting them in establishing plans and goals that are realistic and attainable, developing a heightened awareness of their thoughts, emotions, and actions, and recognising obstacles that impede the attainment of those objectives, this metacognitive self-help intervention is a creative technique for motivating senior adults. It provides a novel and promising approach to promoting behavioural adaptability, a crucial component of resilience in old age, by facilitating the maintenance of autonomy and independent functioning. The aforementioned literature highlighted the importance of metacognitive intervention in enhancing educational performance, critical thinking, adaptability, and resilience. Nevertheless, there is no empirical study that investigates an online metacognitive intervention to promote adaptability and career resilience over eight weeks.

Purpose of the study

The present research aims to investigate the effectiveness of the eight-week online metacognitive intervention on young and mature employees.

- (1) What are the differences in the scores of learning agility, social adaptability and career resilience between young (21 – 30 years) and mature employees (50 years and above)?
- (2) What is the efficacy of metacognitive intervention on individual learning agility, social adaptability, and career resilience?

The hypotheses are:

- (1) There will be differences in the scores of learning agility, social adaptability, and career resilience between young and mature employees.
- (2) There will be significant changes in the scores of learning agility, social adaptability, and career resilience after the metacognitive intervention.

Method

Participants and procedure

Prior to data collection, ethical clearance was granted from the university's Institutional Research Board (IRB-2022-883). The present study recruited participants by using Telegram, a cloud-based mobile and desktop messaging application. A total of 79 participants (40 males, 39 females) were recruited for the study, over three waves of data collection. Written consent and confidentiality of all participants were assured. There were 21 participants in the first wave of data collection, 26 participants in the second wave, and 32 participants in the third wave. Due to the dropout of some participants, the final sample size comprised 71 participants (37 males, 34 females). Upon completing the 8-week intervention, each participant received an evaluation report on their pre- and post-questionnaire scores for self-perceived metacognitive

skills and other competencies.

Online metacognitive intervention

The online metacognitive workshop took place over four sessions, with a total of eight hours. The four two-hour online sessions were conducted over eight weeks and are described in detail in Table 1. The two-week period between each session is to allow participants to practise what they have learnt in each session and apply the strategies at work for the subsequent weeks. The rationale for an eight-week online intervention is that cognitive training is more effective when the duration is longer than seven weeks, with less frequency of training (Oh et al., 2018; Toril et al., 2014). Cognitive training that spans over one to six weeks is considered a short duration. A total of eight weeks of online metacognitive intervention was then used for this training.

Table 1. Details of online metacognitive intervention.

Week	Session	Description	Tasks
1	1	Pre-questionnaire of perceived metacognitive skills and competencies	Completion of pre-questionnaire
		Metacognition, planning, and goal setting (lectures, short videos)	Handout activity based on individual participant's work-related goals and reflection
3	2	Decision-making skills (lectures, short videos)	Handout activity based on decision-making case studies and reflection
5	3	Self-regulated learning and monitoring (lectures, short videos)	Handout activity based on Thinking Aloud strategies to provide rationale for each step of their work task and reflection
7	4	Evaluating and self-reflection (lectures, short videos)	KWL (What I Know, What I Want to Know, What I Learnt) Chart and reflection
		Post-questionnaire of perceived metacognitive skills and competencies	Completion of post-questionnaire

Outcome measures

The pre-and post-questionnaires contained all the following self-report measures. A 5-point Likert scale format, ranging from 1 (strongly disagree) to 5 (strongly agree), was used for all measures.

Metacognitive awareness inventory

The 20-item Metacognitive Awareness Inventory (MAI) was used to measure self-perceived metacognitive skill competencies (Harrison & Vallin, 2018). The competencies are planning, monitoring and evaluating. Examples of the items were "I think about what I really need to learn before I begin a task" for Planning, "I ask myself if I am meeting my goals from time to time" for Monitoring, and "I ask myself how well I have completed my goals" for Evaluating. Participants responded to the questionnaire in accordance with the degree to which they agreed with each item.

Learning agility scale

The 14-item learning agility scale (LAS) was adapted to measure self-perceived learning agility competencies (Bedford, 2011; SkillsFuture Singapore, 2019). Examples

of the items were "I am flexible and adjust my approach when something doesn't work" and "I collect information to monitor implementation of ideas, improvements or new solutions". Participants responded to the questionnaire in accordance with the degree to which they agreed with each item.

Social adaptability and career resilience scale

The 34-item social adaptability and career resilience scale (SACRS) was adapted to measure self-perceived social adaptability and career resilience skills (Khampirat, 2020; Kim, 2021; Ng et al., 2022; SkillsFuture Singapore, 2019), which consisted of two key constructs with seven sub-scales. The two key constructs are social adaptability and career resilience. The sub-scales of social adaptability include socially responsible (e.g., "I solve problems with my peers"), adaptability (e.g., "I monitor own work performance to enhance responses to changes"), and creative thinking (e.g., "I review current work processes and identify potential improvement areas"). The sub-scales of career resilience include coping with career crisis (e.g., "I solve career problems head-on without avoiding them"), coping with career stress (e.g., "I seek solutions to overcome career stress situations"), adjusting career goals (e.g., "I enjoy taking various perspectives while solving a career problem"), and career resilience (e.g., "I do not get discouraged easily after a career failure"). Participants responded to the questionnaire in accordance with the degree to which they agreed with each item.

Data analysis

Questionnaire data were uploaded to a statistical package for analysis. Descriptive statistics and Pearson correlations were conducted. Preliminary analyses were performed to examine any gender differences between the two groups. Repeated measures analyses were conducted to examine the effectiveness of intervention, in terms of changes in their perspectives (i.e., pre- and post-questionnaire scores of the outcome measures). Subsequently, multivariate analyses were performed to evaluate the relationships among learning agility, social adaptability, and career resilience among young and mature employees.

Results

The present study explored an online metacognitive intervention to develop young and mature employees' metacognitive skills, learning agility, social adaptability and career resilience. Descriptive statistics showed the mean scores for all variables. The mean of all variables is greater in post-intervention than in pre-intervention. The effect size of each variable is also presented. The effect size estimates of 0.10, 0.25 and 0.50 indicate small, medium and large, respectively (Richardson 2011). Table 2 presents the descriptive statistics and within-group effects of each variable.

Table 2. Descriptive statistics and effects table.

Variable	Pre-Intervention		Post-Intervention		Effect	
	Mean	SD	Mean	SD	F	η^2
Planning	3.76	0.52	3.95	0.45	12.048**	0.147
Monitoring	3.83	0.53	3.93	0.50	2.799	0.038
Evaluating	3.83	0.54	3.88	0.57	0.539	0.008
Learning agility	4.01	0.38	4.08	0.49	2.363	0.033
Socially responsible	4.01	0.54	4.12	0.51	2.879	0.040
Adaptability	3.93	0.50	4.08	0.57	10.307*	0.128
Creative thinking	3.90	0.55	4.07	0.63	8.178*	0.105
Coping with career crisis	3.64	0.70	3.80	0.69	7.200*	0.093
Coping with career stress	3.68	0.64	3.90	0.66	11.472**	0.141
Adjusting career goals	3.88	0.57	4.09	0.57	12.086**	0.147
Career resilience	3.61	0.70	3.88	0.74	13.630**	0.163

p < 0.01*; p < 0.001**

The reliability coefficients for the pre-intervention variables are very satisfactory. The Cronbach alpha for planning is 0.77; monitoring is 0.79; evaluating is 0.76; learning agility is 0.85; coping with career crisis is 0.87; coping with career stress is 0.78; adjusting career goals is 0.81; socially responsible is 0.82; resilience is 0.84; adaptability is 0.85, creative thinking is 0.82. Table 3 presents the Pearson correlations and Cronbach alpha of pre-intervention variables. Similarly, the reliability coefficients of the post-intervention measures are satisfactory. The Cronbach alpha for planning is 0.65; monitoring is 0.78; evaluating is 0.74; learning agility is 0.92; coping with career crisis is 0.88; coping with career stress is 0.83; adjusting career goals is 0.84; socially responsible is 0.80; resilience is 0.90; adaptability is 0.89; and creative thinking is 0.91. Correlational results showed positive significant relationships among all eleven variables both for pre-intervention and post-intervention. For example, among pre-intervention variables, planning and monitoring have the strongest positive correlation ($r = 0.760, p < .001$). Among post-intervention variables, learning agility and adaptability have the strongest positive correlation ($r = 0.852, p < 0.001$). Table 4 presents the Pearson correlations and Cronbach alpha of post-intervention variables.

Table 3. Correlations and Cronbach alpha of pre-intervention variables

Variables	α	1	2	3	4	5	6	7	8	9	10
1. Planning	0.77										
2. Monitoring	0.79	0.760**									
3. Evaluating	0.76	0.673**	0.592**								
4. Learning agility	0.85	0.562**	0.623**	0.670**							
5. Socially responsible	0.82	0.585**	0.502**	0.555**	0.581**						
6. Adaptability	0.85	0.559**	0.508**	0.492**	0.602**	0.665**					
7. Creative thinking	0.82	0.450**	0.543**	0.483**	0.590**	0.456**	0.737**				
8. Coping with career crisis	0.87	0.621**	0.622**	0.473**	0.632**	0.568**	0.724**	0.640**			
9. Coping with career stress	0.78	0.465**	0.523**	0.377**	0.462**	0.549**	0.664**	0.538**	0.684**		
10. Adjusting career goals	0.81	0.502**	0.502**	0.564**	0.520**	0.532**	0.764**	0.729**	0.652**	0.670**	
11. Career resilience	0.84	0.482**	0.531**	0.455**	0.469**	0.490**	0.563**	0.500**	0.736**	0.715**	0.649**

Note: p < 0.001**.

Repeated measures analysis with gender and age group as covariates were performed for planning, monitoring, evaluating, learning agility, social adaptability, and career resilience skills variables. It was hypothesised that there would be differences in the scores of learning agility, social adaptability, and career resilience skills between the young and mature groups. The results revealed no significant differences between the two groups in terms of age (Wilk's $\Lambda = 0.875, F(11, 58) = 0.752, p = 0.685$) and gender (Wilk's Λ

Table 4. Correlations and Cronbach alpha of post-intervention variables.

Variables	α	1	2	3	4	5	6	7	8	9	10
1. Planning	0.65										
2. Monitoring	0.78	0.721**									
3. Evaluating	0.74	0.765**	0.788**								
4. Learning agility	0.92	0.585**	0.632**	0.811**							
5. Socially responsible	0.80	0.495**	0.566**	0.761**	0.839**						
6. Adaptability	0.89	0.651**	0.664**	0.771**	0.852**	0.821**					
7. Creative thinking	0.91	0.639**	0.641**	0.764**	0.809**	0.767**	0.902**				
8. Coping with career crisis	0.88	0.616**	0.549**	0.701**	0.730**	0.700**	0.739**	0.730**			
9. Coping with career stress	0.83	0.569**	0.500**	0.694**	0.791**	0.707**	0.797**	0.784**	0.807**		
10. Adjusting career goals	0.84	0.528**	0.560**	0.680**	0.749**	0.755**	0.761**	0.711**	0.706**	0.736**	
11. Career resilience	0.90	0.587**	0.469**	0.689**	0.760**	0.708**	0.828**	0.802**	0.801**	0.833**	0.688**

Note: p < 0.001**.

= 0.792, $F(11, 58) = 1.385, p = 0.205$). Effect size analyses for partial eta-squared value (η^2) also indicated no significant differences in age ($\eta^2 = 0.125$) and gender ($\eta^2 = 0.208$).

One-way repeated-measures ANOVA was conducted to determine whether there were significant changes in planning, monitoring, evaluating, learning agility, social adaptability, and career resilience skills (SACRS) over time (see Table 2). The results revealed significant within-group effect (Wilk's $\Lambda = 0.662, F(11, 60) = 2.786, p = 0.005$) and the effect size is medium ($\eta^2 = 0.338$). It was hypothesised that learning agility, social adaptability, and career resilience skills would have significant changes from pre- to post-intervention. Subsequent univariate tests showed significant within-group effects for planning ($F(1, 71) = 12.048, p < 0.001$); adaptability ($F(1, 71) = 10.307, p = 0.002$); creative thinking ($F(1,71) = 8.178, p = 0.006$); coping with career crisis ($F(1, 71) = 7.200, p = 0.009$); coping with career stress ($F(1, 71) = 11.472, p = 0.001$); adjusting career goals ($F(1,71) = 12.086, p < 0.001$); and resilience ($F(1, 71) = 13.630, p < 0.001$). Effect size analyses also indicated significant change between pre- and post-intervention scores of each variable: planning ($\eta^2 = 0.147$); adaptability ($\eta^2 = 0.128$); creative thinking ($\eta^2 = 0.105$); coping with career crisis ($\eta^2 = 0.093$); coping with career stress ($\eta^2 = 0.141$); adjusting career goals ($\eta^2 = 0.147$); and resilience ($\eta^2 = 0.163$).

However, there was insignificant within-group effect for monitoring ($F(1, 71) = 2.799, p = 0.099$); evaluating ($F(1, 71) = 0.539, p = 0.465$); learning agility ($F(1, 71) = 2.363, p = 0.129$); and socially responsible ($F(1, 71) = 2.879, p = 0.094$). Effect size analyses also indicated no significant change between pre- and post-intervention scores of each variable: monitoring ($\eta^2 = 0.038$); evaluating ($\eta^2 = 0.008$); learning agility ($\eta^2 = 0.033$); and socially responsible ($\eta^2 = 0.040$). Overall, all variables increased from pre- to post-intervention, except for monitoring, evaluating, learning agility, and socially responsible.

Discussion

The purpose of the present study was to explore an online metacognitive intervention on young and mature working adults' adaptability and career resilience. It examined whether the intervention would encourage the utilisation of metacognitive strategies at the workplace and if there were any significant changes between the pre- and post-

intervention scores of all variables. For the first hypothesis, the metacognitive intervention showed no significant difference between the two groups (i.e., young and mature) of working adults, suggesting that metacognitive strategies are equally important in both groups. The subsequent univariate findings showed significant changes in the planning score, indicating that participants had improved planning skills after the metacognitive intervention. However, the increased scores for monitoring and evaluating are not significant. As for the second hypothesis, there were significant changes in the scores of adaptability, creative thinking and career resilience, but not learning agility.

Correlational results for all pre- and post-intervention scores are significant, indicating significant relationships among all 11 variables. The strongest relationship between learning agility and adaptability was demonstrated for the post-intervention scores. This finding is consistent with a recent conceptual paper that postulated that learning agility can increase an employee's adaptability (Lee & Song, 2022). When employees are faced with unfamiliar working conditions, they can adapt and perform effectively in changing job environments as they learn from experience with agility.

The efficacy of the metacognitive intervention was indicated by the significant increase in the scores for planning, adaptability, creative thinking, and career resilience. There are also significant increases in the career-related variables namely, coping with career crisis, coping with career stress and adjusting career goals, suggesting the positive efficacy of the metacognitive strategies. Applying metacognitive strategies at work is likely to enable individuals to align their career goals, manage the stress at work and stay resilient. As supported by a recent paper, the metacognitive approach is sustainable as it shapes an individual's physiological, behavioural and psychological response to stress by having a heightened awareness of their thinking process (Crum et al., 2023). Based on the effect sizes, it is significant that metacognitive strategies supported the improved scores on the individuals' adaptability, creative thinking, career resilience, and career-related variables.

First, metacognitive intervention has significant effects on the social adaptability variables namely adaptability and creative thinking, but not learning agility. This is an interesting finding, as the correlational results showed a very strong relationship between learning agility and adaptability. One possible explanation is that learning agility takes time to develop and the eight-week metacognitive intervention might not reveal the positive result. As stated by Lee and Song (2022), learning agility is defined as the ability to learn from experience. It takes time for individuals to learn from experience and develop the competency of learning agility. For instance, the amount of working experience accumulated over time and the skills developed over the lifespan of working are likely to promote learning agility. Furthermore, it is also dependent on the individual participants whether their working environment requires them to be agile learners when at work. It is likely that the working conditions might be routine, and they might not have the opportunity to develop and apply their learning agility skill.

Second, creative thinking is considered important in organisational research, especially in problem-solving, idea generation and idea evaluation (Pinkow, 2023). Amabile and Pratt (2016) stated that motivational factors are essential antecedents to creative thinking. Motivation drives individuals to learn and their ability to be involved in the co-creation of knowledge that is related to creative thinking (Gono & de Moraes, 2023). Hence, motivation stimulates engagement in creative thinking, and this is related to adaptability and career resilience.

Finally, the metacognitive intervention significantly affects career resilience variables, namely coping with career crisis, coping with career stress, adjusting career goals, and career resilience. This is an important finding as career resilience is an important construct in developing and achieving career goals and overcoming acute or chronic adversities during their years of working. Career resilience is about adjusting one's career goals in response to changes due to the organisational structure and strategy or evolving working environments (Coetzee et al., 2023). Aligned with the current correlational results, career resilience is also strongly associated with coping with career crisis and stress. Results in this study thereby suggest that using a metacognitive intervention supported young and mature employees' adaptability, creative thinking and career resilience.

Practical implications and limitations

The present study highlighted the importance of metacognitive strategies in the workplace by facilitating young and mature working adults' adaptability and career resilience. In today's evolving climate, equipping individuals with relevant skills could mitigate the impact of potential job losses and enhance lifelong employability among young and mature employees. Besides career resilience, it is necessary for individuals to build relationships and expand their knowledge for personal and professional growth (Pylväs et al., 2022). In particular, knowledge workers are considered mobile in today's context. As such, social adaptability is crucial for individuals to adjust their needs and perform their best at work (Kucharska & Kucharski, 2023).

The current findings offer two practical implications. First, the notion of utilising metacognitive skills is increasingly important with the changing nature of work. Metacognitive skills are linked to motivation and lifelong learning, which in turn results in career resilience and success (Ng et al., 2022). Second, the massive technological globalisation demands metacognitive strategies to learn and use generative artificial intelligence tools and big data analytics in today's world (Ng, 2022; Waring, 2024). Metacognitive skills are also important for individuals to regulate their cognition and control their decisions while at work. As such, it is essential to develop employees' metacognitive skills and enhance their adaptability and creative thinking skills which are strongly related to career resilience.

Although the hypotheses of the study were achieved, there are still some limitations to the study. The limitations are that this study did not have a control group to evaluate the impact of the metacognitive intervention and it did not

have a large sample size. As this is a preliminary study to test out the metacognitive intervention, future research will include the control group and a larger sample size for generalisation of the findings. In addition, there might be a lack of psychometric properties of the instrument that comprised the combined use of scales. As the current sample size was small, the confirmatory factor analysis was not performed. Finally, another limitation is that the activities for metacognitive intervention conformed to individual effort, with no social, collaborative involvement, resulting in no significant change in socially responsible scores. The contents of this metacognitive workshop could be improved for future intervention research.

Conclusion

This paper explored an online metacognitive intervention on young and mature employees' use of strategies that can inform policy and practice. The intent of this study is to contribute to both higher education and workplace learning by empowering our employees with metacognitive strategies. For instance, higher education institutes could consider applying metacognitive strategies to their training programmes (e.g., pre-employment training, continuing education and training) to support our working adults' employment and employability. Although this is a preliminary study, findings suggest that this online metacognitive workshop may be a promising intervention for increasing individuals' metacognitive skills. Future research should continue to examine metacognitive strategies in organisational and workplace research.

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Peer support in language learning: Mitigating anxiety, enhancing achievement, cultivating growth mindsets, and increasing enjoyment

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Keywords

Academic achievement;
academic enjoyment;
foreign language anxiety;
growth mindset;
peer support.

Abstract

This research focuses on Iranian undergraduate students and examines the impact of peer support on anxiety, success, growth mindsets, and enjoyment of learning English as a foreign language. This study employed a sequential exploratory mixed-methods approach to examine the impact of language learning interventions through peer-support on students' experiences and outcomes. The research involved 54 monolingual Persian-speaking participants aged 18 to 20, who were randomly assigned to either the experimental or control groups. In contrast to the control group, who participated in more conventional, teacher-led sessions without peer assistance, the experimental group could rely on classmates for help in and out of class. Methods for data collection included teacher-made assessments, observations, and semi-structured interviews. Quantitative data was analyzed using independent samples t-tests, while qualitative data was analyzed using thematic analysis. Results indicated that students in the experimental group experienced lower anxiety, better academic performance, cultivated growth mindsets, and enjoyed their language learning compared to the control group. The findings emphasize the significance of peer support in establishing conducive learning environments to enhance language learning outcomes and experiences.

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Introduction

In foreign language education, the significance of peer support cannot be overstated. Beyond the traditional roles as classmates, peers serve as invaluable sources of encouragement, understanding, and collaboration within the language learning process (Khan et al., 2023; Rababah, 2023; Rezai et al., 2024). This study explores the multifaceted effects of peer support on various crucial dimensions of foreign language acquisition. These dimensions include reducing language learning anxiety, enhancing language learning achievements, cultivating growth mindsets, and fostering academic enjoyment. By shedding light on these interconnected aspects, this research offers insights that enrich our understanding of peer dynamics in educational settings and offer practical implications for educators, curriculum developers, and learners. By exploring the nuanced interactions between peers and their impact on language learning outcomes, this study underscores the importance of cultivating supportive learning environments that go beyond traditional classroom companionship.

Peer support refers to collaborative teaching-learning processes where students assist each other in learning across various subjects (Huang, 2023; Newton & Ender, 2010). This approach involves active assistance among students of equal status and social standing, facilitating the transfer of experiences and knowledge from one peer to another (Solhi, 2024). Research underscores the benefits of integrating peer support into educational practices, including enhancing students' self-confidence and communication skills (Schleyer et al., 2005), improving reading performance (Sáenz et al., 2005), and cultivating positive social behaviors among students (Plumer & Stoner, 2005). Additionally, peer support promotes students' sense of learning responsibility and fosters a conducive learning environment (Baillie & Grimes, 1999; Wan et al., 2024). Learners have also reported that peer supporters uniquely understand their peers' needs, further highlighting the efficacy of peer support initiatives (Ten Cate et al., 2012).

Over the past four decades, extensive research has investigated foreign language (FL) learning anxiety. Studies consistently indicate that most language learners experience anxiety during the language acquisition process (Horwitz et al., 1986; Aida, 1994; MacIntyre & Gardner, 1986; Dewaele et al., 2023; Pan & Zhang, 2023; Zhou et al., 2023). The classroom environment significantly contributes to this anxiety, as students are expected to communicate in an unfamiliar language in front of their peers, often under public evaluation (Horwitz et al., 1986).

Dweck (1999) explored the reasons why some students embraced learning challenges despite their difficulty while others approached them with anxiety or reluctance. The theory of mindset has emerged illustrating a spectrum ranging from the fixed to the growth mindset across various domains of their lives. For example, a student may exhibit a fixed mindset regarding their academic abilities while embracing a growth mindset regarding their athletic prowess, such as playing baseball. In the fixed mindset framework, individuals perceive intelligence as immutable (Dweck, 1999; Dweck, 2006; Mueller & Dweck, 1998). Typically, those with

a fixed mindset view their academic or otherwise failures as indicative of their inherent intelligence. Moreover, the added distress arises when such individuals exert effort but still face failure, leaving them with no recourse other than attributing their shortcomings to a perceived deficiency in intelligence (Dweck, 2006).

Academic enjoyment refers to the enjoyment that students derive from studying a subject they favor (Boliver & Capsada-Munsech, 2021). As achievement emotions are domain-specific, exploring academic enjoyment necessitates examination within a specific domain (Goetz et al., 2010; Goetz et al., 2006). Thus, in this investigation, English as a foreign language (EFL) enjoyment refers to the pleasure students derive from learning English. Moreover, Pekrun (2006) elucidates that academic enjoyment can be characterized by valence, activation, and object focus. Specifically, EFL enjoyment manifests as a positive, activating, and task-oriented emotion. Prior research underscores the significance of academic enjoyment for adolescents, indicating that experiencing pleasure is crucial for attaining superior academic performance (Goetz et al., 2006; Lumby, 2011; Shernoff et al., 2003).

The pervasive influence of peer support on diverse facets of foreign language education prompts exploring its nuanced effects. This study addresses whether peer support impacts foreign language learning anxiety, language learning achievements, growth mindsets, and academic enjoyment among EFL learners. Despite recognizing the benefits of peer support across educational contexts, its specific implications within foreign language acquisition remain relatively underexplored. Existing literature emphasizes the prevalence of language learning anxiety among students, the crucial role of mindset orientations in shaping learning behaviors, and the significance of academic enjoyment in fostering sustained engagement and performance. However, there are still gaps in understanding how peer support interacts with these factors to influence the language learning experience. Through this investigation, the study seeks to provide empirical insights into how peer support shapes learners' experiences and outcomes in foreign language education, thereby contributing to the development of more effective pedagogical strategies and supportive learning environments.

This study holds significant theoretical and practical implications for language education, particularly in understanding the role of peer support in foreign language learning. From a theoretical perspective, it contributes to the growing body of research on how peer interactions influence key aspects of language learning, including anxiety reduction, academic achievement, growth mindsets, and overall academic enjoyment. By examining these dynamics, the study deepens our understanding of the psychological and social factors that shape language acquisition.

Practically, the findings can inform teachers, curriculum designers, and policymakers in several meaningful ways. For teachers, recognizing how peer support affects language learning outcomes can help refine instructional strategies that leverage peer collaboration to lower anxiety, enhance motivation, and foster a positive learning environment.

Curriculum designers can use these insights to create more effective, student-centered curricula that incorporate peer-based activities aimed at improving language skills, promoting growth mindsets, and increasing student engagement. For policymakers, this research highlights the importance of designing educational frameworks that support resilience, self-efficacy, and intrinsic motivation among learners, which can ultimately lead to more equitable and effective language programs. Moreover, the study's findings may help identify targeted interventions for students at higher risk of anxiety or negative attitudes toward language learning, ensuring that classrooms become more inclusive and supportive. By highlighting the multifaceted impact of peer support, this research can guide efforts to improve both the learning experience and academic outcomes for language learners on a global scale. To meet such significant implications, the present study aimed to answer the following research questions (RQs):

- RQ1. To what extent does peer support affect academic enjoyment?
- RQ2. To what extent does peer support affect foreign language anxiety?
- RQ3. To what extent does peer support affect EFL learners' mindsets?
- RQ4. To what extent does peer support affect EFL learners' academic achievement?

Literature review

Peer support

Peer support has its origins in the field of mental health, where individuals who have overcome mental illness provide assistance to those still struggling (Walker & Bryant, 2013). Despite a growing increase in psychology and education studies, a specific definition of peer support remains elusive (Rezai, 2023; Ulmanen et al., 2022; Xie & Guo, 2023). Researchers such as Barrera and Ainlay (1983) and Langford et al. (1997) have delved into the background and structure of social support. Clarifying social support helps in understanding the origins and structure of peer support, which is a fundamental part of social support (Wentzel et al., 2010).

Relationships with loved ones, close friends, and family are where social support begins (Zimet et al., 1988). According to Cutrona and Russell (1990), there are four main categories of social support: esteem, informational, social companionship, and instrumental. In a functional sense, social support includes various services, such as financial aid, behavioral advice, counseling, positive social engagements, feedback systems, and intimate contacts (Barrera & Ainlay, 1983). Support for students' academic and personal needs is fostered in the classroom via interactions between teachers and students (Ghaith, 2002). This study draws on previous research (Ghaith, 2002; Johnson & Johnson, 1983; Kim et al., 2018) to distinguish two main types of peer support. The first type is academic support, which encompasses academic assistance and guidance from peers who have similar

backgrounds and interact frequently. The second type is emotional support, which involves the provision of esteem, trust, care, and emotional connection from peers.

According to Vygotsky, learning occurs in a social and cultural context when students interact with others who are more knowledgeable, such as teachers, parents, or classmates (Vygotsky, 1978). Peer support is crucial for effective learning, particularly for foreign language students due to the wide array of tools available (Gardner, 1985; MacIntyre & Gregersen, 2012). Previous studies suggest that learning a new language may be a lot more enjoyable with the support of classmates and professors (Khajavy et al., 2018).

Enjoyment

Enjoyment is a powerful positive emotion characterized by a sense of fulfillment and satisfaction derived from engaging in activities (Ainley, 2017; Pavelescu & Petrić, 2018). In the context of positive psychology, enjoyment is specifically defined as the subjective sense of well-being experienced when undertaking challenging or novel tasks (Csikszentmihalyi & Csikszentmihalyi, 1990). Building on a decade of growing interest in positive emotions, particularly pleasure, MacIntyre and Gregersen (2012) were pioneers in introducing positive psychology into the field of second language acquisition (SLA) research (Dewaele & MacIntyre, 2014; Dewaele et al., 2018). Foreign Language Enjoyment (FLE), as a multifaceted emotion, arises from the balance between perceived competence and the difficulty of the task at hand, reflecting the innate human aspiration to overcome challenges and succeed (Dewaele & MacIntyre, 2016). To measure FLE, Dewaele and MacIntyre (2014) developed a 21-item Foreign Language Enjoyment Scale, which evaluates learners' positive emotions in relation to learning environments, peers, and teachers. Over time, this scale was refined to 14 items, revealing two distinct dimensions: FLE-social and FLE-private (Dewaele & MacIntyre, 2016).

Positive emotions, such as enjoyment, expand individual learners' horizons and foster resource construction, enhancing their ability to focus on L2 input (MacIntyre & Gregersen, 2012; Mackey, 2006). On the other hand, achievement emotions, based on the foundations of positive psychology, play a pivotal role in foreign language enjoyment (Fredrickson, 2001; Pekrun, 2006). Similarly, according to Pekrun's (2006) three-dimensional taxonomy of accomplishment emotions (Jin & Zhang, 2018), pleasure activates the system that guides promising academic endeavors. Studies have focused on the factors influencing first language acquisition, considering internal factors such as gender, age, emotions, motivation, and language proficiency, as well as external factors like instructors, classmates, and the classroom setting (Dewaele et al., 2018; Dewaele & Dewaele, 2017; Fang & Tang, 2021; Li et al., 2014; Wang, 2022).

According to research conducted by Shao et al. (2020), looking at FLE from the perspective of positive psychology acts as a motivator and enhances the desire to learn a foreign language. The findings of Saito et al. (2018) support

this idea, showing that students' FLE is positively correlated with their FLE, FLE frequency, and academic performance. Moreover, research by Jin and Zhang (2018) with 320 high school ESL students revealed a direct correlation between FLE and ESL proficiency, with the enjoyment of learning a foreign language (FLE) indirectly impacting language achievement via the joy of learning the language. According to a study conducted by Liu and Hong (2021) with 709 students from Chinese primary and secondary schools, students' perception of classroom pleasure played a role in encouraging them to pay attention, be active, and be open to learning English.

Anxiety

In EFL settings, students commonly encounter varying degrees of language anxiety, which can detrimentally impact their language acquisition endeavors (Chen & Chang, 2004). Earlier investigations on anxiety and language learning produced conflicting results, with some studies indicating a negative relationship (Papi & Khajavy, 2023), some suggesting a positive association (Zheng & Cheng, 2018), and a few reporting no significant link between anxiety and language learning outcomes (Wu, 2010). To attain more consistent results, subsequent research focused on this area more specifically. Pioneering works by Horwitz et al. (1986), Young (1991), and MacIntyre and Gardner (1986) shed light on the prevalence of foreign language anxiety among learners of English. However, inquiries consistently unveiled a moderate negative correlation between language anxiety and language learning achievement, particularly as elucidated by Horwitz (2001). A critical and interdisciplinary examination of language anxiety was undertaken in a study by De Costam (2015), further enriching the scholarly discourse in this domain.

Some scholars have categorized anxiety into two distinct types. Facilitative anxiety is regarded as beneficial, enhancing performance, while debilitating anxiety is viewed as detrimental, often leading to decreased performance. Anxious thoughts have been observed to disrupt cognitive control (Bellinger et al., 2018). According to Ando (1999), facilitative anxiety is linked to positive performance outcomes, while debilitating anxiety arises from negative expectations and tends to impair performance. When educators encounter anxious students, it is imperative to discern whether their anxiety is genuinely hindering their progress. This notion is supported in Backman's investigation (mentioned in Motallebzadeh et al., 2020), where individuals with varying levels of linguistic proficiency exhibited contrasting anxiety scores.

Additionally, Von Worde (1998) and Young (1990) propose that anxiety can either enhance or impair performance, termed *facilitating anxiety* and *debilitating anxiety*, respectively. Bailey (1983) suggests that facilitative anxiety may aid in the success of second language learners. On the other hand, the crippling consequences of worry are the primary focus of this research.

In a study examining the relationship between EFL students' test anxiety and variables including gender, academic achievement, and years of study within the Iranian educational context, Rezazadeh and Tavakoli (2009) found that students' levels of test anxiety were greater for female students. However, they found no correlation between the length of the study and students' levels of test anxiety (Rezazadeh & Tavakoli 2009). Furthermore, research by Dewaele and MacIntyre (2014) found that female students had higher anxiety levels while learning a foreign language.

Growth mindset

Dweck (1999) identifies a continuum of attitudes that impact students' reactions to learning difficulties, ranging from a fixed mindset to a development mindset. This spectrum illustrates that people's perspectives may vary in different parts of their lives. Take baseball as an example; a student could have a fixed mentality regarding their academic talents but a developed attitude regarding their athletic pursuits. According to the theory of the fixed mentality, by Dweck (1999), Dweck (2006), and Mueller and Dweck (1998), intelligence is considered permanently fixed. Individuals with a fixed mindset, regardless of their academic background, often interpret setbacks as reflections of their innate intellectual capabilities. Furthermore, when their endeavors do not yield the desired results, they may experience increased negative emotions and ascribe their failures to their inherent lack of intelligence (Dweck, 2006).

Students with a fixed attitude are more likely to see the achievements of their classmates as competition and less likely to listen to criticism (Saunders, 2013). Instead of taking responsibility for their mistakes, they blame other people or things, such as lousy instruction or missing information in their study materials. People with a fixed mentality tend to blame others or external factors for their failures rather than their own lack of talent or effort (Dweck, 2006).

In contrast, students with a growth mindset believe that intelligence was adaptable and subject to change, recognizing that failures were opportunities for learning and development. They attributed significance to the effort, viewing setbacks as catalysts for further growth and learning (Blackwell et al., 2007; Plaks & Stecher, 2007). Over time, their resilience and determination propelled them toward success (Dweck, 1999; Dweck, 2006). Additionally, those with a growth mindset actively sought and utilized constructive feedback to enhance their skills, drawing inspiration from the achievements of others (Saunders, 2013). Even in the face of negative feedback, Dweck (2006) observed improvements among growth mindset students, who refrained from externalizing blame for their failures and instead focused on strategies for improvement in subsequent endeavors. Notably, mere praise to bolster self-esteem did not necessarily translate into increased motivation or academic achievement. Instead, feedback from educators held the power to shape students' perceptions of themselves, their drive, and their academic performance (Dweck, 2006). Moreover, excessive praise could inadvertently signal to students that their teachers underestimated their potential (Dweck, 1999).

Hartmann (2013) suggested that students in special education programs often exhibited a more fixed mindset than their peers without special needs. Particularly, those receiving support for specific learning disabilities faced challenges in achieving academic success at the same level as their typically developing counterparts (Frederickson et al., 2007). These students frequently encounter academic setbacks, leading to familiarity with receiving substandard grades (Hartmann, 2013). This repeated exposure to failure contributes to a mindset where students perceive their worth as closely tied to their performance outcomes. Consequently, they prioritized their grades over acquiring knowledge (Hartmann, 2013).

Amidst the growing interest in the pedagogical and psychological dimensions of peer support, gaps persist in delineating its precise definition and elucidating its impact within educational settings. Despite being acknowledged as a fundamental aspect of social support, the conceptualization of peer support remains elusive, necessitating a more profound exploration to understand its origins, structure, and functional implications. Additionally, while existing literature highlights the manifold benefits of peer support, particularly in fostering academic and emotional support among students, its specific effects on foreign language learning anxiety, language learning achievements, growth mindsets, and academic enjoyment warrant further investigation. Therefore, this study aims to discover whether peer support affects foreign language achievement, anxiety, enjoyment, and growth mindset. By examining these interrelations, this study provides empirical evidence to further our understanding of the multifaceted role of peer support in EFL education and to provide practical insights for various stakeholders striving to create supportive learning environments conducive to EFL learners' achievement.

Method

Design

The present study employs a sequential exploratory mixed-methods approach to investigate the multifaceted effects of peer support on foreign language learning anxiety, language learning achievements, growth mindsets, and academic enjoyment among learners. The research design involves an initial qualitative phase to explore the subjective experiences and perceptions of peer support among language learners through in-depth interviews and observation. Subsequently, the quantitative phase utilizes teacher-made tests to assess the relationships between peer support and the variables mentioned above, thereby corroborating and extending the findings obtained from the qualitative phase. Through the integration of qualitative and quantitative methods, this sequential exploratory mixed-methods approach enables a comprehensive understanding of the complexities surrounding peer support in foreign language education, offering valuable insights for theory-building and informing educational practice.

Participants

The participants in this study comprised two intact classes, each consisting of 27 undergraduate students from a university in Iran. According to Riazi (2016), "intact classes" refer to pre-existing groups of students that are used as a whole in a study, rather than randomly assigning individual students to different groups. These students were randomly assigned to either an experimental or a control group to ensure the study's internal validity. The participants were recruited through announcements made in their respective classes, inviting students to voluntarily participate in the study. Inclusion criteria required participants to be monolingual Persian speakers, aged between 18 and 20 years old, and enrolled in the same academic program. Additionally, all participants had to be at an intermediate level of English proficiency, as determined by the Oxford Quick Placement Test (OQPT), to ensure homogeneity in language proficiency levels across both groups. Exclusion criteria included any prior experience with bilingualism or foreign travel, as these factors could influence language learning anxiety and achievement. Gender distribution was balanced, with half of the participants being male and the other half female, to avoid gender bias in the study's outcomes. These selection criteria aimed to establish a consistent baseline for language proficiency and demographic characteristics across both groups, facilitating meaningful comparisons of the effects of peer support on foreign language learning outcomes.

Instruments and data collection procedures

The instruments utilized in this study were chosen to comprehensively assess the effects of peer support on various dimensions of foreign language learning. To ensure that all participants' language proficiency levels were consistent, the Oxford Quick Placement Test (OQPT) was administered. This standardized test confirmed that all participants were intermediate learners, providing a reliable baseline for the study (Geranpayeh, 2003).

Semi-structured interviews regarding academic enjoyment and foreign language anxiety were conducted, adapted from previous research (Horwitz et al., 1986). These interviews allowed for a detailed exploration of learners' subjective experiences in these domains. The reliability of the interview data was enhanced through inter-rater reliability checks, where multiple researchers independently coded the data and reached a consensus on the themes.

Additionally, a semi-structured interview adapted from prior literature (Rammstedt et al., 2024) was employed to investigate the impact of peer support on mindsets. This tool enabled a nuanced understanding of learners' beliefs and attitudes towards language learning challenges. The validity of these interviews was ensured through pilot testing and expert review, which confirmed that the questions effectively captured the constructs of interest.

The textbook used throughout the semester was Touchstone 4 (McCarthy et al., 2014), providing a standardized curriculum for both the experimental and control groups. This consistency in instructional material helped control for

external variables that could influence the study's outcomes.

Furthermore, to measure the effect of peer support on academic achievement, two teacher-made tests were administered, one as a pretest and the other as a post-test. These tests were adapted from Ahmed Abdel-Al Ibrahim and Hashemifardnia (2024). Three Ph.D. holders in English Language Teaching corroborated the content validity of these tests, ensuring they accurately assessed the intended learning outcomes. The reliability of the instruments was established with Cronbach's alpha coefficients of .821 for the pretest and .834 for the post-test, indicating high internal consistency (Tavakol & Dennick, 2011).

It should be noted that written informed consent was obtained from all the participants prior to the commencement of the study, ensuring that they were fully aware of the research objectives and procedures. There were no ethical concerns or conflicts of interest associated with this research. Given the study's focus on evaluating educational methods or practices, rather than testing new medical interventions or substances, the potential risks to the participants were minimal or nonexistent. Consequently, formal approval from an ethics review board was not deemed necessary.

Interventions

The study's interventions were designed to evaluate the impact of peer support on EFL learners. In the experimental group, a structured peer support system was implemented, while the control group followed traditional teacher-centered instruction without any peer support component. To ensure effective peer interaction, the experimental group was divided into six smaller groups, each tasked with collaborative learning activities both during class sessions and outside of class for assignments and homework.

During class, the experimental group engaged in a variety of peer-supported activities. For instance, students worked in pairs or small groups to practice conversational skills through role-plays, debates, and group discussions on course-related topics. These tasks encouraged peer feedback and allowed students to help each other with language challenges, fostering a collaborative environment. The structured peer activities also aimed at clarifying concepts and sharing diverse perspectives, which helped to strengthen students' understanding and retention of the language material.

Beyond the classroom, the experimental group continued to work collaboratively on assignments and homework. They participated in group projects, peer-edited written work, and practiced oral language skills through virtual meetings or in-person study sessions. These out-of-class interactions were designed to further reinforce language acquisition, build confidence, and promote a sense of responsibility toward their peers. By sharing their knowledge and providing mutual support, students could take a more active role in their learning, benefiting from both individual and collective insights.

In contrast, the control group followed a more traditional, teacher-led instructional model. Lessons were structured around lectures, teacher-guided activities, and individual work. While students in the control group received feedback from the teacher, there were no formal opportunities for peer support or collaborative learning. The instructional environment emphasized teacher-directed learning, which limited peer interaction and focused primarily on individual student outcomes.

The peer support interventions in the experimental group were intended to foster a collaborative learning atmosphere, where students could engage deeply with the language through mutual assistance and shared learning experiences. By involving students in peer support activities both inside and outside the classroom, the intervention aimed to reduce language anxiety, improve academic enjoyment, and enhance language proficiency while cultivating growth mindsets and a sense of community among learners.

Data analysis procedures

This data analysis for this study involved both quantitative and qualitative analyses. For the qualitative component, a rigorous thematic analysis was employed to examine data from semi-structured interviews and observations (Flick, 2013). The process began with meticulous transcription of the interviews, ensuring accuracy and capturing nuanced details. To enhance reliability, inter-rater reliability was established by having multiple researchers independently code a subset of the data and then compare their coding to reach a consensus. The transcripts were thoroughly reviewed, and initial codes were assigned to segments of the data that revealed meaningful patterns or emerging themes, such as academic engagement, growth mindsets, concerns about learning a new language, and peer support. These codes were systematically refined through multiple iterations, ensuring consistency and relevance. The coded data were then organized into broader themes and subthemes, which enabled a comprehensive exploration of participants' experiences. This iterative process of coding, categorizing, and theme refinement allowed for a rich, in-depth understanding of the participants' diverse perspectives, providing a nuanced and holistic interpretation of the qualitative data.

For the quantitative part, independent samples t-tests were applied to compare the two groups' levels of peer support. This statistical analysis shed light on how well the peer support intervention worked by comparing the two groups' mean scores on essential factors. To further understand the role of peer support, the t-test compared the two groups to see whether there were any statistically significant changes in outcomes like academic satisfaction, worry about learning a new language, and growth mindsets.

It is worth noting that to deepen the understanding of the effects of peer support on learning a foreign language, this research employed triangulation by integrating qualitative thematic analysis with quantitative statistical analysis. Triangulation involves using multiple data sources, methods, or perspectives to validate and enrich the findings, ensuring

a more robust and well-rounded interpretation (Riazi, 2016). In this study, the qualitative data from interviews and observations were cross-referenced with the quantitative results from surveys and assessments, allowing for a comprehensive analysis. This mixed-methods approach enabled a nuanced understanding of the mechanisms and outcomes of peer support in language learning, as the convergence of different data points offered both depth and breadth to the findings, enhancing the credibility and reliability of the conclusions drawn.

Results

Effect of peer support on academic enjoyment

In the semi-structured interviews conducted with the participants from the experimental group, several themes emerged regarding their experiences of academic enjoyment in the context of peer support. Firstly, the majority of the participants expressed heightened enjoyment and engagement during collaborative learning activities facilitated by peer interactions. For example, one participant noted, *"Working with my peers made learning more fun and interesting. We could bounce ideas off each other and solve problems together, which made learning enjoyable."* This sentiment was echoed by several others, highlighting the positive impact of peer support on their overall learning experience.

Furthermore, the participants reported greater motivation and satisfaction when working collaboratively with their peers on assignments and homework tasks. They described how the opportunity to share ideas, receive feedback, and collaborate with classmates enhanced their understanding of course material and fostered a sense of accomplishment. One participant remarked, *"I felt more motivated to do my homework when I could discuss it with my peers. It made me feel like we were all in it together, and that camaraderie made learning more enjoyable."*

Additionally, the participants emphasized the importance of supportive relationships with their peers in contributing to their academic enjoyment. Many described feeling a sense of camaraderie and belonging within their peer groups, which positively influenced their attitude towards learning. They noted how encouragement and positive reinforcement from their peers helped alleviate feelings of stress and anxiety, making the learning process more enjoyable and rewarding. One participant shared, *"Knowing that my peers were there to support me and cheer me on gave me the confidence to take on challenges and enjoy the learning process."*

Conversely, the participants from the control group who did not have access to structured peer support interventions reported different experiences regarding academic enjoyment. The majority of the participants described feeling isolated and disconnected from their peers during class sessions, negatively impacting their learning enjoyment. One participant lamented, *"In our class, it was mostly just the teacher talking, and there wasn't much opportunity to interact with my classmates. It felt lonely, and I didn't enjoy it as much."*

Furthermore, the participants expressed a lack of motivation and engagement in their learning experiences, citing the absence of peer interaction and collaboration as contributing factors. They described how the passive nature of teacher-fronted instruction left them feeling disengaged and uninspired. One participant explained, *"Without peer support, I didn't feel as motivated to participate in class or do my homework. It felt like I was going through the motions without real enjoyment."*

Moreover, the participants highlighted the importance of social connections and supportive relationships in fostering academic enjoyment. Many desired opportunities to interact with peers and collaborate on assignments and projects. They noted how the absence of peer support limited their ability to learn from each other and share ideas, resulting in a less enjoyable learning experience overall. One participant said, *"I think learning would be more enjoyable if we had more chances to work together and support each other. It's hard to feel excited about learning when you're just listening to the teacher constantly."*

The observations conducted during class sessions provided valuable insights into the effect of peer support on academic enjoyment. In the experimental group, where peer support was encouraged, students were observed to be more actively engaged and enthusiastic about their learning tasks. They participated eagerly in group discussions, collaborated effectively with their peers, and exhibited a positive attitude toward their studies.

Moreover, the observations highlighted the supportive and inclusive nature of peer interactions within the experimental group. Students were observed encouraging and empathetic towards their classmates, offering assistance and feedback when needed. This camaraderie and mutual support contributed to a positive and enjoyable learning environment where students felt valued and respected by their peers.

In contrast, observations in the control group, where peer support was not implemented, revealed a less dynamic and interactive classroom atmosphere. Students were observed to be more passive and reliant on the teacher for guidance, with fewer opportunities for peer interaction and collaboration. As a result, the classroom environment appeared more formal and teacher-centered, lacking the sense of community and engagement observed in the experimental group.

In general, the results of the semi-structured interviews were corroborated by the observations, showing that the experimental group's students benefited greatly from peer support when it came to enjoying their academic work. Learners reported higher levels of motivation, engagement, and contentment due to the cooperative and encouraging atmosphere created by their classmates' interactions.

Several themes emerged for both groups based on the interviews and observation results.

Experimental Group:

1. **Enhanced Engagement:** The participants in the experimental group consistently expressed heightened engagement and enjoyment in their language learning experiences. They described feeling more motivated and enthusiastic about attending classes and participating in activities. Many attributed this increased enjoyment to the opportunities for peer interaction and collaboration provided by the intervention. For example, one participant remarked, *"Working with my peers made learning more fun and interesting. I looked forward to our group discussions and activities because they were engaging and interactive."*
2. **Positive Social Interaction:** Another prominent theme among participants in the experimental group was the positive impact of peer support on social interaction within the classroom. Many students noted that working with their peers facilitated their language learning and fostered a sense of camaraderie and community. They described enjoying the opportunity to exchange ideas, share experiences, and build relationships with classmates. One participant stated, *"I enjoyed the group work because it helped me connect with my classmates. We supported each other and learned from each other's perspectives, which made the learning process more enjoyable."*
3. **Sense of Achievement:** The participants in the experimental group also reported experiencing a heightened sense of achievement and satisfaction in their language learning progress. They described feeling proud of their accomplishments and motivated to continue improving. Many attributed this sense of achievement to the collaborative learning environment fostered by the intervention, where they could receive feedback and support from their peers. For instance, one participant mentioned, *"Working with my peers helped me feel more confident in my abilities. I could see my progress and felt a sense of accomplishment when I achieved my learning goals."*

Control Group:

1. **Limited Engagement:** In contrast to the experimental group, the participants in the control group reported experiencing less engagement and enjoyment in their language learning experiences. Many described feeling bored or disinterested during class sessions, remarkably when limited to teacher-fronted instruction. Some of the participants expressed frustration with the lack of opportunities for interaction and collaboration with their peers, which they perceived as hindering their motivation and enjoyment. One participant lamented, *"I didn't enjoy the classes as much because it felt like I was just listening to the teacher without actively participating. It was*

hard to stay engaged."

2. **Social Isolation:** Another prominent theme among the participants in the control group was a sense of social isolation within the classroom. Many students felt disconnected from their peers and lacked a sense of belonging in the learning environment. They described missing the sense of community and camaraderie they observed in the experimental group. Some of the participants mentioned feeling lonely or isolated during class sessions, negatively impacting their motivation and enjoyment. One participant reflected, *"I felt like I was learning alone most of the time. There wasn't much interaction with my classmates, so it was hard to enjoy the learning process."*
3. **Lack of Progress:** The participants in the control group also reported feeling frustrated with their perceived lack of progress in their language learning journey. They described struggling to stay motivated and engaged when they didn't see tangible improvements in their language skills. Many desired more peer support and feedback to help them overcome challenges and achieve their learning goals. One participant said, *"I felt stuck in my learning. Without the support of my peers, it was hard to stay motivated and make progress."*

Themes from observations on foreign language anxiety:

1. **Increased Engagement:** Observations revealed a noticeable increase in student engagement and participation during peer support activities. Students in the experimental group appeared more enthusiastic and motivated, actively contributing to discussions, group work, and collaborative tasks. They demonstrated greater enjoyment and satisfaction in their learning experiences, as evidenced by their animated interactions and positive demeanor.
2. **Positive Social Dynamics:** The observation also highlighted the positive social dynamics fostered by peer support within the experimental group. Students exhibited strong camaraderie and teamwork, supporting and encouraging each other throughout the learning process. They appeared comfortable and relaxed in each other's presence, fostering a supportive and inclusive learning environment where all voices were valued and respected.
3. **Sense of Achievement:** Additionally, observations indicated that peer support contributed to a heightened sense of achievement and confidence among students in the experimental group. As they worked collaboratively to tackle challenges and overcome obstacles, students demonstrated increased self-efficacy and belief

in their abilities. They celebrated their successes and milestones together, reinforcing a positive cycle of motivation and achievement that propelled their learning forward.

Overall, the observations underscored the transformative impact of peer support on academic enjoyment, highlighting its role in fostering engagement, social connection, and a sense of accomplishment among language learners.

Effect of peer support on foreign language anxiety

The participants in the experimental group articulated a notable reduction in their experiences of foreign language anxiety following their engagement in the peer support intervention. They expressed newfound ease and confidence when engaging in language-related tasks, mainly speaking activities. This shift was attributed to the supportive atmosphere cultivated by peer interactions, where the participants felt encouraged to express themselves without fear of judgment. The majority of the participants highlighted the significance of having peers to practice with, noting that the collaborative learning environment provided a sense of safety and camaraderie that helped alleviate their anxiety. Additionally, the participants emphasized the positive impact of receiving feedback from their peers, which helped them identify areas for improvement and boosted their confidence in their language abilities. By engaging in peer-supported activities, the participants felt more empowered to take risks and embrace challenges, ultimately decreasing their overall levels of language anxiety.

Conversely, the participants in the control group described persistent challenges with foreign language anxiety throughout the study. They articulated nervousness, apprehension, and self-doubt when faced with language-related tasks, mainly speaking in front of others. Despite their efforts to prepare and practice independently, the majority of the participants expressed a sense of helplessness in managing their anxiety. The absence of peer support was identified as a significant factor contributing to their heightened levels of anxiety, as the participants felt isolated and unsupported in their language learning journey. Without the reassurance and encouragement of peers, the participants struggled to overcome their negative self-talk and feelings of inadequacy, which further exacerbated their anxiety. Overall, the participants in the control group continued to grapple with the debilitating effects of language anxiety, highlighting the importance of peer support in fostering a supportive learning environment conducive to anxiety reduction.

Observations of the experimental group revealed a notable increase in academic enjoyment and engagement among the participants. Students demonstrated high enthusiasm and participation during peer-supported activities, actively contributing to discussions, group projects, and collaborative tasks. Positive social dynamics were evident, with the participants engaging in supportive interactions, exchanging ideas, and demonstrating mutual respect and encouragement. The cooperative learning environment fostered a sense of community and belonging, contributing

to the participants' overall satisfaction and fulfillment in their academic experiences. Additionally, the participants exhibited a sense of achievement and pride in their academic accomplishments, celebrating their successes and demonstrating confidence in their abilities to overcome challenges and achieve their goals.

In contrast, observations of the control group indicated lower levels of academic enjoyment and engagement among the participants. Students appeared less enthusiastic and involved during class activities, often displaying signs of disinterest or apathy. Social interaction was limited, with the participants engaging in minimal communication or collaboration with their peers. The absence of peer support and interaction contributed to isolation and disengagement within the classroom. The participants exhibited decreased satisfaction and motivation in their academic experiences, expressing frustration or dissatisfaction with their performance. Overall, the participants in the control group demonstrated a less positive attitude toward learning, characterized by a lack of enjoyment, fulfillment, and achievement.

Themes from semi-structured interviews on foreign language anxiety

1. **Peer Support as Anxiety Alleviator:** The participants across both the experimental and control groups highlighted the role of peer support in mitigating foreign language anxiety. Those in the experimental group emphasized the positive impact of collaborative learning environments facilitated by peer interactions, which provided reassurance, encouragement, and opportunities for shared experiences. In contrast, the participants in the control group expressed a desire for more incredible peer support and interaction to help manage their anxiety effectively.
2. **Negative Self-Talk and Self-Doubt:** A prevalent theme among the participants was the presence of negative self-talk and self-doubt as significant contributors to foreign language anxiety. The participants described experiencing intrusive thoughts, self-criticism, and feelings of inadequacy, which undermined their confidence and increased their anxiety levels. Many of the participants expressed a need for strategies to challenge and overcome negative self-talk to improve their language learning experiences.
3. **Fear of Judgement and Evaluation:** The participants articulated a fear of judgment and evaluation as a primary source of anxiety in language learning contexts. They expressed concerns about making mistakes, being perceived as incompetent, or facing criticism from peers and instructors. The pressure to perform well and meet academic expectations exacerbated their anxiety levels, leading to avoidance behaviors and decreased engagement in language-related tasks.

Themes from observations on foreign language anxiety

1. **Differential Engagement Levels:** Observations revealed differences in engagement levels between the experimental and control groups, with the participants in the experimental group demonstrating higher levels of active participation and involvement in language-related activities. The collaborative nature of peer-supported tasks facilitated increased the participants' engagement and interaction, contributing to a more positive and supportive learning environment.
2. **Social Interaction and Support:** The participants in the experimental group exhibited more significant social interaction and support than those in the control group. Peer interactions were characterized by mutual encouragement, assistance, and camaraderie, creating a sense of belonging and community within the classroom. In contrast, the participants in the control group appeared more reserved and isolated, lacking opportunities for social connection and peer support.
3. **Confidence and Self-Efficacy:** The participants in the experimental group demonstrated higher levels of confidence and self-efficacy in their language abilities than those in the control group. The positive feedback and encouragement from peers during collaborative tasks bolstered the participants' confidence and belief in their linguistic skills, increasing their willingness to take risks and participate actively in language learning activities. Conversely, the participants in the control group exhibited lower levels of confidence and self-assurance, struggling with self-doubt and apprehension in their language-learning endeavors.

Overall, the themes identified from the interviews and observations underscored the complex interplay between peer support, negative self-talk, fear of judgment, engagement levels, social interaction, confidence, and self-efficacy in shaping foreign language anxiety experiences among the participants.

Effect of peer support on mindsets

The participants in the experimental group provided insightful reflections on their attitudes toward learning and the concept of growth mindsets. The majority of the participants demonstrated a growth mindset perspective, emphasizing that intelligence and abilities are malleable and can be developed through effort, practice, and perseverance. They expressed a willingness to embrace challenges, view failures as opportunities for learning, and seek feedback to improve. The participants described instances where they actively sought new learning experiences, challenged themselves to expand their skills, and demonstrated resilience in the face of setbacks. Moreover, the participants

emphasized the importance of adopting a growth mindset in their language learning journey, recognizing its role in fostering motivation, resilience, and academic achievement. Overall, the participants in the experimental group exhibited a positive and adaptive approach to learning, characterized by a growth mindset orientation.

Conversely, the participants in the control group demonstrated a more fixed mindset perspective toward learning and academic challenges. Many of the participants believed that intelligence and abilities are fixed and inherent traits, leading to a fear of failure and a reluctance to take risks. The participants tended to avoid challenges, interpret setbacks as evidence of their limitations, and rely on external factors to determine their success. Additionally, the participants described feeling discouraged by negative feedback and perceived failures, leading to a sense of helplessness and self-doubt. The prevalence of a fixed mindset orientation hindered the participants' motivation, resilience, and willingness to engage in learning activities. Overall, the participants in the control group exhibited a less adaptive approach to learning, characterized by a fixed mindset orientation that impeded their growth and development.

Taken together, the participants in the experimental group demonstrated a growth mindset orientation characterized by a belief in the potential for growth and development through effort and perseverance. In contrast, the participants in the control group exhibited a fixed mindset orientation marked by a belief in innate abilities and a reluctance to embrace challenges. These findings highlight the importance of fostering a growth mindset perspective in promoting motivation, resilience, and academic achievement among language learners.

During observations of the experimental group, the participants exhibited behaviors indicative of a growth mindset orientation toward learning and academic challenges. Many of the participants were willing to embrace challenges and view failures as opportunities for growth and learning. They actively sought out new learning experiences, engaged in problem-solving tasks, and persisted in their efforts despite setbacks. The participants displayed resilience in the face of obstacles, demonstrating a positive attitude towards overcoming challenges and expanding their skills. Moreover, the participants exhibited a receptiveness to feedback and constructive criticism, using it as a means of self-improvement and skill development. Overall, the participants in the experimental group displayed adaptive behaviors consistent with a growth mindset orientation, characterized by a belief in the potential for growth and development through effort and perseverance.

In contrast, observations of the control group revealed behaviors indicative of a fixed mindset orientation towards learning and academic challenges. The participants were reluctant to embrace challenges and feared failure, often avoiding tasks or activities perceived as difficult or risky. They attributed their successes and failures to innate abilities rather than effort or perseverance. The participants were more likely to give up easily when faced with obstacles, showing a lack of resilience and persistence in their learning

endeavors. Additionally, the participants resisted feedback and constructive criticism, viewing it as a reflection of their abilities rather than an opportunity for growth. Overall, the participants in the control group displayed maladaptive behaviors consistent with a fixed mindset orientation, characterized by a belief in innate abilities and a reluctance to engage in challenging tasks.

Themes from interviews and observations on growth mindset

1. Growth Mindset Orientation:
 - The participants in the experimental group demonstrated a growth mindset orientation, characterized by a belief in the potential for growth and development through effort and perseverance.
 - They exhibited behaviors such as embracing challenges, viewing failures as opportunities for learning, and persisting in the face of obstacles.
 - The participants displayed resilience, receptiveness to feedback, and a willingness to seek new learning experiences.
2. Fixed Mindset Orientation:
 - The participants in the control group exhibited a fixed mindset orientation, marked by a belief in innate abilities and a reluctance to embrace challenges.
 - They demonstrated behaviors such as avoiding tasks perceived as complex, attributing success and failure to inherent traits, and giving up easily when faced with obstacles.
 - The participants resisted feedback and constructive criticism, viewing it as a reflection of their abilities rather than an opportunity for growth.
3. Effort and Persistence:
 - A prominent theme across both groups was the role of effort and persistence in shaping mindset orientations.
 - The participants in the experimental group emphasized the importance of effort and perseverance in achieving academic success and personal growth.
 - In contrast, the participants in the control group were more likely to attribute success and failure to fixed factors such as innate abilities, leading to a lack of motivation and resilience.

4. Response to Challenges:
 - Another notable theme was the participants' responses to challenges and setbacks.
 - Those with a growth mindset orientation demonstrated a positive attitude towards challenges, viewing them as opportunities for learning and growth.
 - In contrast, the participants with a fixed mindset orientation exhibited avoidance behaviors and a fear of failure, hindering their willingness to engage in challenging tasks.
5. Feedback and Learning:
 - The theme of feedback and its impact on learning emerged from interviews and observations.
 - The participants with a growth mindset orientation were receptive to feedback, using it as a tool for self-improvement and skill development.
 - Conversely, the participants with a fixed mindset orientation resisted feedback, viewing it as a threat to their self-image and abilities.

These themes highlight the importance of mindset orientations in shaping individuals' attitudes toward learning, effort, and resilience. They underscore the need for interventions to foster a growth mindset perspective to promote motivation, persistence, and academic achievement among language learners.

Effect of peer support on academic achievement

To investigate the impact of peer support on academic achievement, the authors conducted a series of statistical analyses. Initially, we performed a Kolmogorov-Smirnov test to assess the normality of data distribution. The results confirmed that both pre-test and post-test data were normally distributed ($p > .05$), satisfying the assumption for parametric testing. The authors then conducted independent samples t-tests to compare the EG and CG at both pre-test and post-test stages. Table 1 presents the results of the pre-test comparison.

Table 1. Results of the independent samples test on the pre-test.

	Group	N	Mean	Std. Deviation	Std. Error Mean	F	Sig.	t	df	Sig. (2-tailed)
Pretest	EG	27	2.88	1.31	.25	.00	.93	.72	52	.47
	CG	27	2.62	1.30	.25		1			

*Note. * EG = Experimental Group; CG = Control Group; M = Mean; SD = Standard Deviation; SE = Standard Error Mean.

The pre-test results revealed comparable performance between the experimental group ($n = 27$, $M = 2.88$, $SD = 1.31$) and the control group ($n = 27$, $M = 2.62$, $SD = 1.30$). The independent samples t-test indicated no significant difference between the two groups at the outset of the study, $t(52) = 0.72$, $p = .47$. This finding establishes that both groups started at a similar baseline level of academic achievement, ensuring a valid comparison of the intervention's effects. Following the intervention period, we conducted a post-test to assess the impact of peer support. Table 2 presents the results of this analysis.

Table 2. Results of the independent samples test on the post-test.

	Group	N	Mean	Std.	Std.	F	Sig.	t	df	Sig.
				Deviation	Error Mean					
Post-test	EG	27	13.11	3.00	.57	11.49	.00	15.77	52	.00
	CG	27	3.14	1.32	.25					

*Note. * EG = Experimental Group; CG = Control Group; M = Mean; SD = Standard Deviation; SE = Standard Error Mean.

The post-test results revealed a substantial improvement in the experimental group's performance ($n = 27$, $M = 13.11$, $SD = 3.00$) compared to the control group ($n = 27$, $M = 3.14$, $SD = 1.32$). The independent samples t-test demonstrated a statistically significant difference between the two groups, $t(52) = 15.77$, $p < .001$. The magnitude of this difference was further quantified by calculating the effect size, which was found to be large ($\eta^2 = 0.23$). These findings provide compelling evidence for the efficacy of peer support in enhancing academic achievement among EFL learners. The experimental group, which received peer support, demonstrated a remarkable improvement in their performance, with their mean score increasing from 2.88 in the pre-test to 13.11 in the post-test. In contrast, the control group showed only a marginal improvement, with their mean score increasing from 2.62 to 3.14.

The large effect size ($\eta^2 = 0.23$) underscores the practical significance of these results, indicating that peer support accounts for 23% of the variance in academic achievement between the two groups. This substantial effect suggests that peer support is not only statistically significant but also educationally meaningful in its impact on EFL learners' academic performance. These results align with previous research highlighting the benefits of collaborative learning environments in language acquisition (citation needed). The peer support intervention likely facilitated a more engaging and interactive learning experience, potentially enhancing motivation, providing opportunities for language practice, and fostering a supportive learning community.

Discussion

This research elucidates several essential aspects of second language acquisition, including language learning anxiety, academic success, growth mindsets, and academic enjoyment. According to the study's findings, peer support significantly reduced anxiety in language acquisition compared to the control group. This aligns with previous

studies indicating that supportive peers can help reduce anxiety and create a positive learning atmosphere. Students may experience a more pleasant learning environment when they have friends who provide emotional support, encouragement, and shared experiences, thereby reducing the anxiety associated with language learning activities. However, it is essential to consider alternative explanations, such as the possibility that students with lower anxiety levels are more likely to seek and receive peer support, rather than peer support being the direct cause of reduced anxiety.

Participants who received peer assistance also showed a significant increase in academic success, confirming findings from other studies that collaborative learning can enhance academic performance. The experimental group demonstrated improved learning outcomes due to increased information sharing, broader viewpoints, and mutual support fostered through in-class and extracurricular collaborative activities. Nonetheless, it is crucial to critically examine whether other factors, such as the students' initial motivation levels or the quality of peer interactions, might have contributed to these outcomes.

Additionally, there was a noticeable shift in mindset orientations between the control and experimental groups. Members of the experimental group exhibited a growth mindset, characterized by the belief that one can improve through effort and perseverance. In contrast, the control group displayed a fixed mindset, viewing intelligence and talents as static traits. These results underscore the importance of fostering a growth mindset to enhance motivation, resilience, and academic success among language learners. However, it is worth considering whether the observed mindset shift was influenced by other variables, such as the students' prior experiences or the specific instructional methods used in the study.

Furthermore, the study's findings demonstrated that peer support positively affects academic satisfaction. Participants in the test group were more invested, had more pleasant interactions with others, and felt more accomplished due to their education. In contrast, those in the control group were less invested and had less social contact, translating to less happiness and drive. These results highlight the importance of peer support in creating a welcoming and positive classroom environment. However, it is important to consider alternative explanations, such as the possibility that students who are naturally more sociable and motivated might be more inclined to engage in peer support activities, rather than peer support being the direct cause of increased academic satisfaction.

This study's results have important implications for understanding the literature on growth mindset, pleasure, anxiety, and peer support in the context of second language acquisition. According to the literature, students of foreign languages greatly benefit from the emotional and intellectual support they receive from their peers (Gardner, 1985; MacIntyre & Gregersen, 2012). Our results complement these findings by showing that students in the peer support group fared better academically than those in the control group and reported significantly less anxiety about learning the language. Peers foster a conducive learning environment

by providing emotional support, academic assistance, and guidance (Ghaith, 2002; Johnson & Johnson, 1983; Kim et al., 2018). However, it is crucial to critically examine whether other factors, such as the initial levels of anxiety or the quality of peer interactions, might have influenced these outcomes.

The research on enjoyable foreign language acquisition supports our findings, which show that positive emotions favor motivation and academic achievement (MacIntyre & Gregersen, 2012; Mackey, 2006). Members of the experimental group were more satisfied, engaged, and enjoyed their academic experiences more than the control group. To improve language learning outcomes, it is essential to create a welcoming and enjoyable learning atmosphere (Khajavy et al., 2018; Jin & Zhang, 2018). Nonetheless, it is worth considering whether the observed increase in academic enjoyment could be attributed to other variables, such as the novelty of the peer support intervention or the specific dynamics of the experimental group.

Concerning anxiety, our results align with other studies showing a modest negative connection between worry about learning a language and actual proficiency in that language (Horwitz, 2001). Language anxiety was reduced in the experimental group compared to the control group, indicating that having supportive peers may assist in reducing anxiety and making learning more enjoyable (Chen & Chang, 2004). However, it is important to consider alternative explanations, such as the possibility that students with inherently lower anxiety levels are more likely to engage in peer support activities, rather than peer support being the direct cause of reduced anxiety. Additionally, the role of other factors, such as the overall classroom environment or individual differences in coping mechanisms, should be examined to fully understand the relationship between peer support and language anxiety.

The present study also provides insights into the role of a growth mindset in foreign language learning, as discussed in the literature review. Participants in the experimental group demonstrated a growth mindset orientation characterized by resilience, perseverance, and a belief in the potential for growth and development (Dweck, 1999; Dweck, 2006). In contrast, participants in the control group exhibited a fixed mindset orientation, attributing success and failure to innate abilities rather than effort. These findings underscore the importance of fostering a growth mindset perspective to promote motivation, resilience, and academic achievement among language learners (Blackwell et al., 2007; Plaks & Stecher, 2007). However, it is worth considering whether the observed mindset shift was influenced by other variables, such as prior educational experiences or the specific instructional methods used in the study. Additionally, the potential impact of cultural factors on mindset orientations should be explored to provide a more comprehensive understanding of these findings.

Overall, this study contributes to the existing literature by providing empirical evidence of the beneficial effects of peer support on various dimensions crucial to foreign language acquisition. By creating supportive learning environments, alleviating anxiety, promoting enjoyment, and fostering growth mindsets, peer support initiatives can potentially

enhance the overall learning experience for language learners. Educators and policymakers should consider implementing peer support programs and collaborative learning activities to maximize student engagement, motivation, and success in foreign language learning. However, future research should continue to explore the complex interplay of factors influencing these outcomes to develop more targeted and effective interventions.

Pedagogical implications

For language teachers, the findings of this study carry significant implications for instructional practices. Incorporating peer support initiatives into language classrooms can provide teachers with additional tools to create supportive learning environments that foster student collaboration, engagement, and academic success. Teachers can encourage peer interaction, collaboration, and mutual support by implementing group activities, collaborative projects, and peer tutoring sessions. Moreover, language teachers can benefit from training and professional development opportunities focused on strategies for promoting peer support and creating inclusive learning environments. By leveraging the positive effects of peer support on reducing language learning anxiety, enhancing academic enjoyment, and fostering growth mindsets, language teachers can effectively support their student's diverse needs and learning preferences.

For language learners, the implications of this study underscore the importance of actively engaging with peers to enhance their language learning experience. Learners can leverage peer support networks to seek assistance, share resources, and collaborate on learning tasks. By working collaboratively with peers, learners can improve their language proficiency and develop necessary socio-emotional skills such as communication, empathy, and teamwork. Additionally, learners can cultivate a growth mindset orientation by embracing challenges, persisting in the face of setbacks, and seeking constructive feedback from peers. Language learners can benefit from peer support initiatives inside and outside the classroom, fostering a sense of belonging, motivation, and academic enjoyment in their language learning journey.

For materials developers and syllabus designers, the findings of this study highlight the importance of integrating peer support activities into language learning materials and curriculum design. Developers can create engaging and interactive resources that promote peer interaction and support by incorporating collaborative learning tasks, group projects, and peer feedback mechanisms into language learning materials. Additionally, syllabus designers can design language courses that prioritize peer-supported learning experiences, providing opportunities for students to work together, share ideas, and learn from one another. By aligning materials and syllabi with the principles of peer support, developers and designers can enhance the effectiveness and relevance of language learning resources for diverse learners.

For policymakers, this study underscores the importance of recognizing and supporting peer support initiatives in language education policies and programs. Policymakers can advocate for the inclusion of peer support strategies in language education policies, curriculum guidelines, and teacher training programs. By investing in peer support initiatives, policymakers can promote student-centered approaches to language education that prioritize collaboration, inclusivity, and learner autonomy. Additionally, policymakers can allocate resources and funding to support research and development efforts focused on peer-supported language learning interventions. By fostering a supportive policy environment that values peer support in language education, policymakers can create inclusive and effective language learning ecosystems that empower learners and promote academic success.

Conclusions

The results of this study provided valuable insights into the intricate ways peer support influenced several aspects of second language acquisition, including academic achievement, growth mindsets, enjoyment of learning, and anxiety reduction in EFL learners. Through a sequential exploratory mixed-methods approach, we gained a comprehensive understanding of the dynamic interactions between peer relationships and language learning outcomes. Our research highlighted the significance of peer support in creating safe, collaborative learning environments that promoted participation, cooperation, and academic success among language students. Learners reported reduced anxiety and increased enjoyment in their academic pursuits following participation in peer support programs. Furthermore, language instructors could cultivate inclusive classrooms that prioritized students' social-emotional well-being and academic performance by fostering opportunities for collaboration and mutual support. The study also demonstrated that peer support interventions fostered growth mindsets, enabling learners to persevere through setbacks and view challenges in language learning more positively. Overall, this research contributed to the existing literature on peer-supported language learning, emphasizing the need for inclusive learning spaces that extend beyond traditional classroom dynamics. Acknowledging the critical role of peer support in language education could lead to more empowering and successful learning ecosystems that enhance both personal and academic growth.

Though this study has provided valuable insights into the influence of peer support on language learning anxiety, academic achievement, growth mindsets, and enjoyment among EFL learners, several limitations must be acknowledged before generalizing the findings. The first limitation lies in the small sample size and the specific context, as the study focused solely on Iranian university students. Therefore, caution is advised when applying these results to broader populations or different educational settings. Additionally, the study employed a sequential exploratory mixed-methods design, which, while offering a comprehensive view, may introduce certain biases inherent in combining qualitative and quantitative data. While the study focused on critical factors such as language

learning anxiety, academic achievement, growth mindsets, and enjoyment, further research could explore additional variables that may affect the success of peer support interventions. For example, cultural differences, individual learner characteristics, and variations in classroom dynamics may all play a significant role in moderating the effects of peer support on language learning outcomes. Investigating these aspects could provide a more nuanced understanding of how peer support functions across different contexts. Another limitation involves the reliance on self-report measures, such as questionnaires and interviews, to assess learners' experiences and outcomes. Although these tools offer valuable insights into learners' subjective perceptions, they are prone to biases such as memory recall errors and social desirability. Future research could enhance the validity of findings by incorporating objective measures, such as standardized tests or observational methods, to better capture the impact of peer support on language learning. Finally, the study primarily focused on in-class peer support interventions, neglecting to account for the potential influence of peer interactions outside the classroom or through online platforms. Future studies could expand the scope by investigating how peer support functions in digital environments, including online forums, social media, and virtual learning spaces, where learners may engage in peer collaboration and support beyond traditional classroom settings. This would provide a more comprehensive understanding of the various dimensions of peer support in language acquisition.

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A study of Afghan university graduates' perspectives on the relevance of higher education

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Abstract

This study delves into the perspectives of graduates on higher education in Afghanistan. Utilizing a stratified sampling approach, 284 graduates from Samangan Higher Education Institute were surveyed. The sample size was determined using the Cochran method with a 5% error rate. Over three weeks in November 2023, responses from 121 graduates of the year 2021 and 163 graduates of the year 2022 were gathered, with males comprising 64.8% and females incorporating 35.2% of the respondents. The findings highlight that individual preferences were the primary influencers in selecting majors, followed by family and friends. Notable disparities in expectation levels emerged between male and female graduates, with only 30% of male graduates confirming that their expectations were met, compared to 60% of female graduates. Furthermore, an analysis of employment status among graduates, segmented by gender and faculty, revealed significant discrepancies. Around 60% of male graduates from agriculture and economics faculties are employed, whereas this figure stands at 11% for female graduates. Experience, foreign language skills, and connections are identified as crucial factors in securing employment. Over 60% of female graduates who are employed, work in the private sector. Moreover, 44% of female graduates from the economics faculty and 22% from the agriculture faculty are engaged in small businesses. We recommend implementing programs specifically designed to empower female graduates with entrepreneurship skills. These programs should provide training, mentorship, and resources to help them establish and sustain small businesses or ventures from homes or within their communities. Additionally, there should be efforts to create a supportive ecosystem that facilitates access to markets, finance, and networking opportunities for women entrepreneurs.

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Introduction

Following over four decades of conflict and war, the higher education system has faced significant disruption. The aftermath of the civil war and the Taliban era saw the system plunged into a state of devastation and decline. Numerous highly skilled faculty members had fled, been detained, or lost their lives. The majority of buildings lay damaged or in disrepair, equipment was either destroyed or absent, most laboratories lay dormant, and libraries were stripped of their resources (Babury & Hayward, 2013). However, in 2002, the Ministry of Higher Education (MoHE) undertook efforts to rebuild the system and enhance access and quality of higher education nationwide. This is evidenced by the significant increase in the number of students, rising from approximately 7,890 in 2001 (Babury & Hayward, 2013) to nearly 200,000 in public universities alone by 2021 (Table 1). Furthermore, as of 2021, Afghanistan was home to 133 private universities, with a combined enrollment of over 151,000 students (Table 2).

In addition to expansion, the MoHE prioritized quality assurance and increasing women's participation as key focus areas. The quality assurance and accreditation process commenced in 2012, and within one year, they reviewed 90 universities (Welch & Wahidyar, 2020). In 2001, there were only a few hundred female students in medical faculties (Hayward & Karim, 2019), while female enrollment in public universities alone reached nearly 60,000 by 2021 (Table 1). This figure indicates that three out of every ten students in public universities were female (Table 3). Despite significant progress, the MoHE faced numerous challenges, including limited budgetary resources (Babury & Hayward, 2013; MoHE, 2015a), inadequate dormitory facilities for female students (MoHE, 2015a), low quality of universities (Roof, 2015), a shortage of female academic staff (MoHE, 2015a; Table 3), conservative family beliefs (MOHE, 2015a), mismanagement, and corruption (Ali, 2014; 2015).

Following the Taliban's resurgence to power in August 2021, the higher education sector encountered a series of new challenges. Girls were banned from attending universities (BBC, 2022), leading to a significant setback in gender equality and access to education. Additionally, a considerable number of lecturers and educated individuals left the country (Hasht-e Subh Daily, 2023), resulting in a loss of expertise and capacity within academic institutions. Furthermore, financial issues and restrictions compelled several private universities to cease operations (Kawa, 2023), further exacerbating the already strained higher education landscape.

In the domain of research focusing on university graduates' perspectives on higher education and employment, a significant gap is evident. While some studies have explored students' views on education and career pathways in Afghanistan, there is a scarcity of research that specifically collects firsthand data from university graduates post-Taliban regime change. Furthermore, with the Taliban mandate banning female graduates from working in many organizations, there is an urgent need for research that focuses on understanding the perspectives of female graduates. Therefore, this research paper aims to bridge

these gaps by directly gathering data from university graduates in 2021 and 2022 and analyzing their viewpoints on higher education and employment status. To achieve this, the study will explore the following research questions:

1. What factors influenced your choice of major in university?
2. How satisfied are you with your education experience at Samangan Higher Education Institute?
3. What are the most important factors in securing a job?

Higher education landscape in Afghanistan (2010-2021)

Access to higher education

The Ministry of Higher Education (MoHE) has demonstrated a commendable commitment to expanding access to higher education throughout the country over the past decade (Welch & Wahidyar, 2020). The number of public universities has seen a significant surge, increasing from 20 in 2010 to 35 in 2015, and further reaching 39 in 2021. Moreover, both male and female academic employees have witnessed a considerable increase. In 2010, the male academic staff numbered around 2,570, with the female academic staff comprising 454. This positive trend continued in 2021, with the figures rising to 5,405 for male academic staff and 852 for female academic staff. The student demographic has also experienced significant growth, with the number of male students exceeding 51,000 and female students reaching 12,400 in 2010. Fast forward to 2021, and the numbers have surged to over 137,000 male students and approximately 60,000 female students. Despite significant development in Afghanistan, the gross enrollment rate in tertiary education remains one of the lowest globally, standing at 8.5%. Moreover, this rate is notably lower than those of neighboring countries: Kazakhstan at 50%, Kyrgyzstan at 44%, Tajikistan at 31%, and India at 27% (Sabzalieva, 2019).

Table 1: Public university growth, 2010-2021.

Year	Student (in thousands)		Academic staff		University
	Male	Female	Male	Female	
2010	51.3	12.4	2,569	454	20
2011	63.0	14.8	2,680	479	24
2012	82.1	19.2	3,033	522	26
2013	100.7	24.0	3,854	642	31
2014	122.8	30.4	4,375	726	31
2015	135.8	36.3	4,756	766	34
2016	141.3	41.0	4,700	774	36
2017	140.0	44.7	4,935	785	36
2018	153.3	54.2	5,058	811	38
2019	142.4	54.8	5,254	836	38
2020	142.7	62.7	5,326	853	38
2021	137.0	59.8	5,409	852	39

Source: NSIA, 2018; 2019; 2020; 2021; MoHE, 2018.

The private higher education sector in Afghanistan has experienced rapid growth, driven by a strong demand for higher education. This growth is evident in the remarkable increase in the number of private universities, which soared from 31 in 2010 to 133 in 2021. Furthermore, this expansion has had a significant impact on the academic workforce within private universities, with the number of

academic staff increasing tenfold from over 1,000 in 2010 to over 10,000 employees in 2021. Concurrently, the student population within private universities has seen a substantial surge, rising from 20,000 students in 2010 to an impressive 151,000 by 2021.

Table 2: Private university growth, 2010-2021.

Year	University	Academic staff	Student (in thousands)
2010	31	1,109	20.5
2011	59	1,757	35.3
2012	81	3,267	59.6
2013	88	4,546	80.5
2014	106	6,050	108
2015	124	8,022	128
2016	128	9,248	158
2017	130	11,508	181
2018	131	12,179	187
2019	132	12,819	227
2020	132	12,818	182
2021	133	10,285	151

Source: NSIA, 2018; 2019; 2020; 2021; MoHE, 2018.

The disparity in student-lecturer ratios between public and private universities has become more pronounced over the last decade. In public universities, this ratio has experienced an increase, rising from 21 students per lecturer in 2010 to 31 students per lecturer in 2021. Conversely, the student-lecturer ratio has declined in private universities over the same period. In 2010, private universities had a ratio of 18.5 students per lecturer; by 2021, this ratio had decreased to 15 students per lecturer. This reduction implies that private universities have successfully managed their student-lecturer ratios more efficiently, potentially providing students with more personalized attention and a lower lecturer workload.

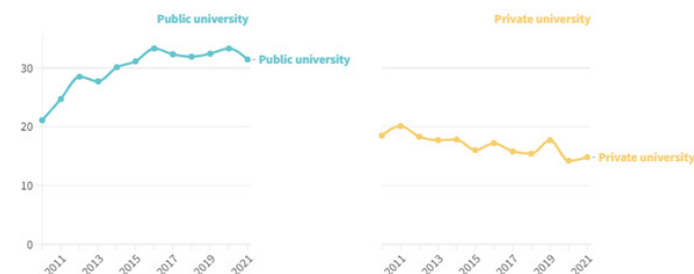


Figure 1: Student-lecturer ratio at public and private universities, 2010-22. Source: NSIA, 2018; 2019; 2020; 2021; MoHE, 2018.

Despite progress, universities face challenges in providing the quality and quantity of professionals needed for the labor market, particularly in management and technical fields where demand is critical (Roof, 2015). Additionally, insufficient dormitory space for women has been identified as a significant barrier to girls attending higher education institutions. Only 9.4% of girls have access to such facilities, which is significantly lower compared to boys, with access being three times higher (MoHE, 2015b). Families are reluctant to send their daughters to universities without access to safe and supervised accommodation (MoHE, 2015b; Roof, 2015). Moreover, mental health concerns pose a considerable challenge for young college students, with approximately 40% experiencing clinical levels of post-traumatic stress disorder, depression, or anxiety (Babury & Hayward, 2013). These mental health issues often result

in decreased academic performance and, in many cases, dropout.

The disparity in access to higher education is starkly evident across genders, regions, and wealth quintiles, primarily due to inequalities in primary and secondary education. This gender disparity is highlighted by a ratio of less than 2:1, indicating that more than two boys attend school for each girl, with close to 90% of girls out of school in some provinces (MoE et al., 2018). Additionally, the School Life Expectancy (SLE) reveals a significant gender gap, with boys expected to remain in education for 9.5 years, 1.7 times longer than girls (Pouras Consult, 2016). The completion rate for girls stands at 21%, nearly half of the rate for boys, which is at 40% (Pouras Consult, 2016).

Inequalities persist between rural and urban areas, highlighting geographical challenges that affect access to education. Children residing in rural communities are over twice as likely to be out of school compared to those in urban areas (MoE et al., 2018). Moreover, there is a substantial gap in primary school completion rates between rural and urban settings, with rural completion rates at 28% and urban completion rates at 42% (Pouras Consult, 2016). Additionally, inequalities based on wealth quintiles exacerbate disparities in educational opportunities. In the wealthiest quintile, primary school attendance rates are relatively high at 76%, contrasting starkly with the significantly lower rate of 25% in the poorest quintile (ARTF & UNICEF, 2023). Similarly, completion rates underscore this gap, with 77% of students completing school in the richest quintile compared to only 19% in the poorest quintile (ARTF & UNICEF, 2023).

Quality assurance and accreditation

In the aftermath of the Taliban's collapse in 2001, Afghanistan prioritized the expansion of private and public higher education institutions quantitatively, while neglecting to enhance educational quality (Welch & Wahidyar, 2020). However, improving the quality of university education has emerged as a critical challenge and focal point (World Bank, 2013). The MoHE, with the support of international organizations including the World Bank, have endorsed the establishment of quality assurance systems for higher education. These initiatives concentrate on various aspects, including aligning students' academic performance with international standards, ensuring the economic and social relevance of graduates, and evaluating the research contributions of academic staff through publications such as journal articles, books, and monographs (World Bank, 2013). The notion of quality assurance was a recent introduction in Afghanistan's higher educational landscape. It first emerged in 2009, prompting agencies to explore strategies for enhancing higher educational quality (Roof, 2015). Subsequently, in 2012, the MoHE established a Directorate on Quality Assurance and Accreditation, alongside the formulation of relevant rules and regulations. This development occurred in close consultation with higher education institutions (HEIs), leaders, non-governmental organizations (NGOs), and accreditation agencies from abroad (Welch & Wahidyar, 2020). A pilot project involving four universities was initiated, with the process officially

launched for public HEIs in mid-2012 and extended to private HEIs in 2013. Despite facing threats and intimidation, the review process encompassed 90 private HEIs by early 2013 (Welch & Wahidyar, 2020).

Part of the endeavor to enhance quality in higher education involves elevating the qualifications of faculty members, including their attainment of master's and PhD degrees. In an interview with Roof (2015), the Vice Chancellor of Kabul University highlighted that a considerable percentage of lecturers at the institution possess only bachelor's degrees, suggesting that faculty members should temporarily leave Afghanistan to pursue advanced degrees abroad. The World Bank estimates that around 500 faculty members were pursuing master's degrees overseas, with a smaller cohort working towards PhDs (World Bank, 2013). To facilitate this process, the MoHE has forged partnerships with several international universities worldwide. These collaborations enable faculty exchanges and grant Afghanistan access to valuable resources from partner institutions. About half of Afghanistan's universities have initiated partnerships with foreign educational institutions, aiming to bolster faculty development and enhance educational standards (Roof, 2015). In 2020, statistics on the qualifications of lecturers in public universities reveal that 50% possessed a master's degree, 45% attained a bachelor's degree, and 5% obtained a PhD (Ahmadi, 2022).

Despite advancements in quality assurance, the Strategic Plan for Quality Enhancement in Higher Education 2015-2020 outlined various challenges. These included the rapid growth of unplanned universities in the past decade, the streamlined process of granting permits to higher education institutions, resulting in unchecked expansion, and the insufficient budget allocated for implementing quality assurance programs (MoHE, 2015a). Another study compares the MoHE and the Ministry of Education (MoE), concluding that the MoHE is considerably smaller than its counterpart which is responsible for overseeing the broader education system. This discrepancy leads to ongoing challenges for the MoHE, including insufficient funds and personnel (Welch, 2011). These challenges are exacerbated by the highly centralized nature of the public higher education system in Afghanistan, which controls virtually every aspect of decision-making for individual campuses, while private institutions often fail to meet minimal standards for academic quality (Berger & Thomas, 2015). Thus, establishing a more autonomous public system and implementing stricter regulations for private institutions are crucial prerequisites for the further development of a high-quality higher education system (Berger & Thomas, 2015). Additionally, regularly reviewing the 12 standards and relevant guidelines for self-assessment is crucial. It is especially important to tailor them to the unique needs, circumstances, and available resources of each public institution (Taheryar, 2017).

Women's participation in higher education

The MoHE initiated efforts to reintegrate women into higher education, following the defeat of the Taliban at the end of 2001. Under Taliban rule, women were barred from all levels of education, except in the field of medicine,

where female doctors were permitted to treat women and daughters. Kabul Medical University saw the graduation of approximately 134 women MDs during this period, with an estimated 380 women enrolled in Kabul Medical School from 1996 to 2001 (Hayward & Karim, 2019). The issue of female illiteracy remained prevalent, with more than 90 percent of women in Afghanistan being unable to read in 2009 (Crane & Rerras, 2009). Additionally, child marriage persists as a significant challenge, further exacerbated by societal pressure that often leads employed women to resign after marriage (Crane & Rerras, 2009). Afghanistan continues to lag behind on the international Gender Parity Index, with a low score of 0.2, compared to an average of 0.6 for least-developed countries (World Bank, 2013).

Alongside other initiatives, the MoHE developed the Sexual Harassment Policy and the Higher Education Gender Strategy to address issues concerning women in higher education effectively. The sexual harassment policy, first instituted in 2009, underwent revisions and expansions in 2015. Moreover, the Higher Education Gender Strategy, with its final English version completed in May 2014, was formally released in July 2016. The gender strategy culminated in an action plan, prioritizing several key initiatives. These included enhancing access for women at both undergraduate and graduate levels, fostering a campus environment conducive to equal treatment and safety, aiming to increase the representation of women students to 25% and faculty members to 20% by 2020, expanding fellowship opportunities for women pursuing master's and PhD studies abroad, constructing an additional 4,000 dormitory spaces for women, and instituting a committee to monitor progress towards these objectives (Hayward & Karim, 2019).

The gender distribution among students in public universities has shown a positive trend over the past decade, with the number of female students increasing from 20 in 2010 to 30 in 2021 for every 100 students. Yet, female participation rates in higher education are strikingly low in Afghanistan compared to neighboring countries. In 2017, the participation rate was over 20% in Afghanistan, while it fell short of 40% in Tajikistan and nearly 55% in Kyrgyzstan and Kazakhstan, respectively (Sabzalieva, 2019). The MoHE underscores several factors hindering girls' access to higher education, including inadequate dormitory facilities, limited numbers of female graduates from primary and secondary levels, security concerns, economic challenges, societal norms, fear of harassment, and a lack of interest in pursuing higher education (MoHE, 2015b). The researcher identifies additional factors influencing the situation. According to Najam and Johnston (2023), the rigid score-based admission criteria of public universities contribute to the exacerbation of gender inequality, particularly in highly selective programs. This disparity in performance may be attributed to the systemic underinvestment and cultural barriers that Afghan women encounter when seeking access to post-secondary education. Roof (2015) discovered, through interviews, that while policies may appear adequate on paper, implementation often falls short. Ali (2014; 2015) reports instances of corruption and mismanagement within the MoHE, particularly in relation to the *Kankor* (university entrance exam).

Table 3: Gender distribution ratio for academic employees and students at public universities, 2010-21.

Year	Academic staff		Student	
	Male	Female	Male	Female
2010	84.9	15.1	80.5	19.5
2011	84.8	15.2	81.0	19.0
2012	85.3	14.7	81.0	19.0
2013	85.7	14.3	80.7	19.3
2014	85.8	14.2	80.1	19.9
2015	86.1	13.9	78.9	21.1
2016	85.9	14.1	77.5	22.5
2017	86.3	13.7	75.8	24.2
2018	86.2	13.8	73.9	26.1
2019	86.3	13.7	72.2	27.8
2020	86.2	13.8	69.5	30.5
2021	86.4	13.6	69.6	30.4

Conversely, the gender ratio among academic employees at public universities has seen a different trajectory. In 2010, there were 15 female academic employees for every 100 employees, and this ratio decreased slightly to 13.5 for every 100 employees by 2021. While the absolute numbers of male and female academic staff have increased, this reduction in the gender ratio suggests that there may be challenges or disparities in achieving a balanced gender representation among academic employees at public universities. This issue stems from two primary factors: Firstly, there is a limited number of girls with bachelor’s or higher education degrees. Secondly, entrenched conservative beliefs spread the notion that women should not pursue employment outside the home (MoHE, 2015b). Roof (2015) found in interviews with officials at the higher education ministry that most families do not permit females to pursue advanced degree programs overseas. Consequently, the ministry has suggested providing master’s programs within the country for female candidates unable to study abroad.

Higher education and employment under the Taliban rule

Higher education

Following the Taliban’s assumption of control in August 2021, numerous concerning developments have surfaced, marking a shift in policies. The implementation of restrictive measures has significantly curtailed personal freedoms and disrupted daily life. This has had a particularly severe impact on women and educated individuals, exacerbating barriers to education, employment, and participation in public life (UN Women et al., 2024; Safi et al., 2024). Based on a report from around 750 interviews with Afghan women across all provinces, more than half expressed feeling unsafe when leaving their homes without a Mahram (male guardian) (UN Women et al., 2024). Another evident outcome is the departure of professionals and intellectuals as they seek to leave the country amidst the changing political environment and related uncertainties. According to reports, 229 professors from Afghanistan’s leading universities, Kabul, Herat, and Balkh universities, have left (National Herald India, 2022). Similarly, a report reveals that over 400 professors have left Kabul University alone in the past two years (Hasht-e-Subh Daily, 2023). Moreover, educated youth and middle-class households also express a desire to leave the country due to concerns about personal safety, restrictions, limited

economic opportunities, and the potential for civil unrest (Rahimi & Joya, 2023; Barlas & Ammar, 2022). As skilled and educated individuals choose to seek better prospects abroad, their departure results in a notable loss of human capital within their home country (Docquier, 2014).

In their second month of power, the Taliban permitted the reopening of universities despite implementing strict mandates enforcing gender-segregated classes (Al Jazeera, 2022). Female university students encountered severe limitations, including the requirement to cover their faces not only in public areas of the university but also during classes, alongside the prohibition of male teachers from instructing female students (Easar et al., 2023). Subsequently, on December 20, 2022, the Taliban expanded these restrictions to include a ban on women pursuing university education entirely (BBC, 2022). These stringent measures have had a significant impact, resulting in the exclusion of over 100,000 female students from government and private higher education institutions (UNESCO, 2023). This exclusion has also been linked to an increase in mental health issues among students who are banned from attending education (The Washington Post, 2023; The Guardian, 2022; Neyazi et al., 2023). Additionally, according to the World Happiness Report for 2024, with a score of 1.72, Afghanistan is classified as the unhappiest country on earth (Wellbeing Research Centre, 2024).

Furthermore, these restrictions have had a profound impact on private universities. Enrollment numbers have declined significantly since the Taliban takeover, largely due to the ban on women attending universities and the fleeing of students from Afghanistan (SIGAR, 2023). Additionally, over 30 universities and private educational institutions were shut down due to financial difficulties. However, certain experts propose that the main factors contributing to the closure of private universities include the breakdown of ethical values and the absence of specialized subjects (Kawa, 2023).

The Taliban has also taken steps to Islamize higher education and implement changes in curricula. Prior to the Taliban’s rule, undergraduate programs typically included eight credits of Islamic studies, equivalent to one credit per semester. However, the Taliban has tripled this requirement, mandating that universities teach 24 credits of Islamic studies during undergraduate programs, with plans to increase this to 32 credits (Sharafat, 2024). Moreover, the MoHE under the Taliban rule, commenced the review of curricula in 2023, as they released a press statement highlighting their consideration of both religious and modern subjects in the higher education system (Tolo News, 2023; Sharafat, 2024). The MoHE decided to recognize religious studies conducted in madrasas as part of the formal education system. Following this decision, a qualifying exam was administered by the MoHE for 51,000 graduates of religious schools (MoHE, 2024). Upon successfully passing the exam, these graduates will be awarded a degree equivalent to a master’s level qualification (KabulNow, 2024). These degrees may potentially increase their chances of being hired as academic staff at universities.

These policies regarding higher education have played a significant role in undermining academic freedom. Academic freedom serves as a cornerstone, ensuring educators have the autonomy to utilize their expertise, engage in inquiry, and apply critical thinking, acknowledging their authority rooted in education and experience (Vélez & Curry, 2020). As outlined by the American Association of University Professors (AAUP), educators are entitled to freedom in various realms, including research and publications, classroom presentations and discussions, including textbook selection, and protection from institutional censorship when expressing opinions outside the institution through extramural speech (Vélez & Curry, 2020). The Academic Freedom Index (AFI) provides a unique framework for assessing academic freedom, examining five key indicators: freedom to research and teach, academic exchange and dissemination, institutional autonomy, campus integrity, and academic and cultural expression freedom (Kinzelbach et al., 2024). The AFI spans from 0 to 1 on a continuous scale, where higher values signify increased academic freedom (Lott, 2023). Afghanistan's position in this index has seen a significant decline, with a ranking below 0.1 in 2024, placing it in the bottom 10% (Kinzelbach et al., 2024). In contrast, Afghanistan, with a score above 0.5, was positioned within the bottom 30% - 40% in 2022 (Kinzelbach et al., 2022).

Employment

Since August 2021, there has been a marked deterioration in the employment landscape. According to a rapid assessment conducted by the International Labour Organization (ILO), job losses in the third quarter of 2021 exceeded half a million, escalating to 900,000 by mid-2022. The impact on female employment was particularly severe, with losses reaching 21 percent by mid-2022 (ILO, 2022). The Taliban systematically curtailed women's rights, imposing constraints that barred them from accessing public spaces, including employment opportunities. As part of this restriction, beauty salons were prohibited, leading to the closure of 12,000 businesses and the subsequent loss of jobs for over 60,000 women (Reuters, 2023). Additionally, on December 24, 2022, the Ministry of Economy issued a directive banning Afghan women from working with national and international NGOs. The authorities clarified that this ban would not affect women employed in hospitals, clinics, or other healthcare facilities (International Crisis Group, 2023). Before the ban, estimates indicated that around 30-40 percent of Afghan NGO workers in the country were women (International Crisis Group, 2023; UN Women, 2023).

These exclusive policies exacerbated the humanitarian and economic crises. Following the issuance of the directive, UN Women conducted consultations with 165 Afghan women who had previous experience working for national and international NGOs. They also surveyed 127 national NGOs. The results revealed that 94% of the surveyed organizations had either partially or fully ceased operations, with the ban affecting 70% of their activities (UN Women, 2023). These findings underscore the critical role of women humanitarian workers in facilitating aid for vulnerable populations, including women, across all provinces of Afghanistan. The surveyed organizations highlighted that over one million

women beneficiaries were impacted by this ban (UN Women, 2023). Moreover, the Norwegian Refugee Council (NRC) analyzed the restrictions on women's employment, estimating that the loss of many women from the Afghan workforce immediately reduced Afghanistan's economy by \$1 billion (NRC, 2023).

The political transition significantly undermined Afghanistan's private sector. Since August 2021, the World Bank has conducted three Private Sector Rapid Surveys (PSRS) to gain insight into the business environment in the country (World Bank, 2022a; World Bank, 2022b; World Bank, 2024a). The initial survey revealed that one in three businesses had temporarily halted operations, with surveyed firms laying off approximately three-fifths of their workforce. Smaller and women-owned businesses were disproportionately affected by these challenges (World Bank, 2022a). The most recent Private Sector Rapid Survey has revealed that employment levels in surveyed firms continue to lag behind those of August 2021. Key challenges cited include a lack of demand, issues within the banking system, uncertainty about the future, deficiencies in public services, and restrictions on women's activities (World Bank, 2024a). The unemployment rate among youth and women is alarmingly high (World Bank, 2023; ILO, 2023). The predominant form of women's participation in the labor market has shifted towards home-based self-employment (ILO, 2023). Furthermore, the Women, Business and Law Index analyzes countries based on indicators such as mobility, workplace conditions, pay equity, marriage and parenthood rights, entrepreneurship opportunities, asset ownership, and pension accessibility. Afghanistan's ranking in 2024 indicates a setback, with a score of 31.9, compared to 38.1 in 2020 (World Bank, 2024b; World Bank, 2020).

A decline in income was also observed at the national level as per capita income dropped from \$517 in 2020 to \$350 in 2021 (*Tolo News*, 2022). By 2022, approximately 97% of the Afghan population was living below the poverty line (UNDP, 2021). Moreover, around 24 million people are in urgent need of assistance to sustain their lives (OCHA, 2024). Economic crises, coupled with restrictions on female employment, have exacerbated the situation, leading to more children being pushed into labor and early marriage (Save the Children, 2022; Safi et al., 2024). Amidst this challenging economic context, a quarter of the children surveyed disclosed that they were asked to assist their families by engaging in work (Save the Children, 2022).

Assessments from global indices paint a concerning picture of Afghanistan's status. According to the 2023 Democracy Index, Afghanistan is ranked 167th, with a score of 0.26. This classification places Afghanistan's government system under the authoritarian category, indicating an absence of democratic governance (EIU, 2024). The Women, Peace, and Security (WPS) Index evaluates nations based on 13 indicators related to security, inclusion, and justice. In the 2023 ranking, Afghanistan received a score of 0.286, positioning it as the 177th country and identifying it as the most perilous nation for women (GIWPS & PRIO, 2023). Moreover, in the Human Development Report of 2023-2024 released by the United Nations Development Program (UNDP), a stark warning is issued regarding the impact of human development losses

in Afghanistan. The report underscores the alarming setback of Afghanistan's Human Development Index (HDI) by a staggering ten years (UNDP, 2024).

Literature review

Several studies have assessed the perspectives of students and graduates regarding higher education. Monib (2023) explored the perceptions of undergraduate students toward e-learning, specifically targeting those who were the primary beneficiaries of such methods. This quantitative study utilized a survey format, collecting data through questionnaires. A total of 140 randomly selected respondents participated in the survey. The study revealed that e-learning is generally perceived as beneficial in higher education. However, it also highlighted the challenges associated with electronic education, including its cost and the necessity for strong Information and Communication Technology skills. Furthermore, more than half of the participants expressed a preference for hybrid learning, which combines online and face-to-face learning methods. In contrast, Hashemi (2021) aimed to investigate the impact of COVID-19 on the academic performance of Afghan students and their satisfaction levels with online teaching. A total of 1231 respondents, comprising 867 males and 364 females from both public and private universities in Afghanistan, participated in the study. The findings revealed that COVID-19 had a detrimental effect on the academic performance of Afghan students, and they expressed high levels of dissatisfaction with online teaching during this challenging period.

Orfan (2022) conducted a study to investigate the faculty behaviors perceived as the most uncivil by students and the frequency of these experiences. Data were gathered from 948 undergraduate students through a questionnaire distributed across four public universities in Afghanistan. The findings revealed that students identified 30 faculty behaviors as uncivil to varying extents. Among these, the most frequently experienced behaviors were administering excessively difficult or tricky exams and grading students based on *Waset* (connection). Similarly, Orfan (2023) investigated behaviors exhibited by students that the lecturers deemed uncivil, as well as the causes and consequences of such behaviors. Data for the study were collected using a survey questionnaire and interview protocols with open-ended questions. The findings indicated that participants regarded threatening or harassing comments, belittling, engaging in *waset*, complaining about a lecturer, and cheating on exams as highly uncivil behaviors.

Studies have identified various factors that influence education and career choices. Noora and Wani (2021) examined students' approaches to career planning and their perceptions of Afghanistan's labor market. The study revealed that students with positive perceptions of the labor market tended to exhibit better control over their careers. Conversely, those with negative perceptions of the labor market were found to be influenced by other factors in their career decision-making process and struggled to plan their careers effectively, leading to their pessimistic view of the labor market.

Furthermore, as per Taneja (2005), children raised in an environment where parental guidance and lifestyle are congruent are more inclined to be influenced by them. Consequently, a child's career aspirations are likely to be shaped by their parents' occupations in such circumstances. Kazi and Akhlaq (2017) conducted a study to explore the factors influencing students' career choices, sampling 432 students from two public sector universities in Lahore city. The findings reveal that parental influence emerged as the most significant factor, followed by peer influence. Challenges emerge when parents are uninformed about the latest trends and advancements in the diverse range of professional options available (Noora & Wani, 2021).

Samangan Higher Education Institute profile

The Samangan Higher Education Institute (SHEI), initially established under the management of Balkh University in 2008, saw significant expansion over the years. The Ministry of Higher Education approved the addition of agriculture and economics faculties to the institute in 2012, officially recognizing it as a higher education institute (SHEI, 2023). Regarding departmental structure, the education faculty comprises nine departments, while the agriculture faculty consists of three departments and the economics faculty comprises two departments (Vice Chancellor, 2023). Furthermore, the Ministry of Higher Education recently approved the establishment of Islamic Sharia and Geology and Mining faculties at SHEI, although they have not yet commenced operations (Vice Chancellor, 2023).

Over the years, the distribution of academic staff has undergone significant changes across faculties. In the Education Faculty, the number of male lecturers increased from six in 2008 to 45 in 2021, with the inclusion of five female lecturers by the same year. The agriculture faculty, established in 2012 with male lecturers, saw an increase to 15 male lecturers by 2021, and while a female staff member joined in 2017, no further female recruitment occurred. The economics faculty experienced growth from four to ten male lecturers by 2021, yet it remains without any female academic staff. These trends underscore challenges in achieving gender diversity within faculties.

Table 4: Lecturer figures categorized by gender and faculty, 2008-22.

Year	Education faculty		Agriculture faculty		Economics faculty	
	Male	Female	Male	Female	Male	Female
2008	6	0	0	0	0	0
2009	6	0	0	0	0	0
2010	6	0	0	0	0	0
2011	8	0	0	0	0	0
2012	16	1	7	0	4	0
2013	28	2	9	0	4	0
2014	33	2	11	0	7	0
2015	33	2	11	0	7	0
2016	34	2	12	0	7	0
2017	38	5	12	1	9	0
2018	42	5	12	1	9	0
2019	45	5	13	1	10	0
2020	45	5	14	1	10	0
2021	45	5	15	1	10	0
2022	41	5	15	1	9	0

Source: This statistical information was derived from an interview with the Vice Chancellor (2023) and data obtained from the lecturers' department, 2023.

The distribution of students across faculties reveals varying patterns of female participation, with the education faculty exhibiting a higher female contribution compared to agriculture and economics. The agriculture faculty witnessed an increase in female students from 84 in 2019 to 132 in 2020, while the economics faculty saw a rise from 90 in 2019 to 116 in 2020. However, the landscape dramatically shifted after the Taliban takeover in 2021, leading to a significant decline in female student enrollment across all faculties. Considering the number of female students in 2021, it is apparent that over 950 girls were prevented from pursuing higher education at Samangan Higher Education Institute. It is necessary to highlight that this figure does not include new enrollments. The data further indicates a reduction in the number of male students, exemplified by the Education Faculty where the count dropped from close to 1,070 in 2021 to approximately 490 in 2023, less than half of the previous enrollment.

Table 5: Student distribution across faculties based on gender, 2019-23.

Year	Education faculty		Agriculture faculty		Economics faculty	
	Male	Female	Male	Female	Male	Female
2019	1,124	556	526	84	325	90
2020	963	648	472	132	347	116
2021	1,069	710	323	118	448	124
2022	603	554	247	86	302	77
2023	489	0	236	0	267	0

Source: This statistical information was derived from data obtained from the students' department, 2023.

The student-lecturer ratios exhibit variations among faculties, with a decrease observed from 2019 to 2021 in the agriculture faculty, an increase in the economics faculty, and fluctuations in the education faculty. However, a shift occurred when females were banned from pursuing higher education, leading to a decline in this ratio across all three faculties. In the education faculty, the ratio decreased from 36 students per lecturer in 2021 to 25 in 2022. Similarly, the Agriculture Faculty saw a decrease from 28 students per lecturer in 2021 to 21 in 2022, and the economics faculty experienced a reduction from 57 students per lecturer in 2021 to 42 in 2022. Comparing these figures with the student-lecturer ratio at public universities presented in Figure 1, it becomes evident that the Samangan institute faces a higher ratio. The faculties struggle with insufficient academic employees in their human resource structure (Vice Chancellor, 2023), exacerbating the challenges faced in maintaining optimal student-lecturer ratios. Another contributing factor could be that the Samangan Higher Education Institute is not authorized to independently process and hire its academic staff; instead, recruitment is handled through Balkh University. In most cases, it takes one to two years for a lecturer to be recruited at this institute, potentially leading to delays in addressing staffing needs and resulting in higher student-lecturer ratios. The first strategic plan of this institute also acknowledges the lack of sufficient staff, identifying the need to increase human resources as a key focus point (SHEI, 2023).

The number of graduates has steadily increased over time. In 2011, over 100 students graduated, comprising 82 males and 19 females. By 2019, this number had surged to 419 male graduates and 116 female graduates. The significant

Table 6: Student-lecturer ratio by faculties, 2019-22.

Year	Education	Agriculture	Economics	Overall
2019	34	44	41	40
2020	32	40	46	39
2021	36	28	57	40
2022	25	21	42	29

increase after 2015 and 2016 can be attributed to the addition of economics and agriculture faculties, which began graduating students during this period. Additionally, due to COVID-19 disruptions, 52 male students graduated from night shift classes in 2020. Table 7 further illustrates that approximately 200 female students graduated in 2022, representing the period before the Taliban implemented restrictions on girls attending universities.

Table 7: Number of graduates, 2011-22.

Year	Male	Female	Both
2011	82	19	101
2012	75	17	92
2013	23	10	33
2014	34	8	42
2015	320	115	435
2016	413	110	523
2017	430	118	548
2018	408	95	503
2019	419	116	535
2020	52	0	52
2021	366	162	528
2022	347	199	546

Source: This statistical information was derived from data obtained from the students' department, 2023.

Methodology

This study was based on a survey conducted among graduates of Samangan Higher Education Institute in 2021 and 2022. Additionally, a background interview with the Vice Chancellor of this institute was undertaken to provide an introduction and context about Samangan Higher Education Institute, given the limited available information.

Population and sampling strategy

The survey was focused on 284 graduates from Samangan Higher Education Institute, and a stratified sampling approach was chosen. This method was chosen to offer a structured framework for studying specific subpopulations within the graduate cohort. By doing so, it enhances the representativeness of the sample and elevates the quality of the data obtained (Arnab, 2017). The determination of the total number of graduates was crucial and was definitively established based on the information provided in Table 8, which categorized all graduates according to gender, faculty, and graduation year.

Table 8: Number of graduate students from Samangan Higher Education Institute in 2021-22.

Faculty	2021			2022		
	Male	Female	Both	Male	Female	Both
Education	193	114	307	183	163	346
Agriculture	100	25	35	90	17	107
Economics	73	23	96	74	19	93
Total	366	162	528	347	199	546

Source: This statistical information was derived from data obtained from the students' department, 2023.

The Cochran (1977) method with a 5% error rate was applied, to calculate the appropriate sample size. The Cochran formula facilitates the calculation of an optimal sample size

based on the desired level of precision, confidence level, and the estimated proportion of the attribute present in the population. This methodology, implemented in R, suggested a sample size of 298 observations for the survey. Following this recommendation, a list of participants for the survey was generated using the numbers proposed by R. The survey was conducted over the phone by five enumerators, consisting of three males and two females. These surveyors underwent training and worked with mock questionnaires before commencing the actual survey. A group chat was created for the enumerators and researchers, to facilitate communication and address challenges during data collection. This platform allowed them to share their experiences and difficulties. The research team took on the responsibility of responding to and handling these challenges. Approximately 20% of the initially selected participants were unreachable due to the unavailability of their active contact numbers. In response to this challenge, new participants were selected to replace the unreachable ones. This replacement process took into consideration their gender, faculty, and graduation year to maintain the initial stratified structure of the sampling.

The questionnaire was designed to be completed within 20-25 minutes. However, it took a longer time to arrange phone calls with respondents, and several challenges were observed in this process. Firstly, a significant percentage of female phone numbers belonged to their fathers or other household members, resulting in a prolonged effort to arrange a call with the graduate. Secondly, women typically responded to calls from numbers saved in their phones or numbers they recognized. Consequently, surveyors had to make multiple attempts to reach these respondents. Thirdly, in some cases, parents did not permit female respondents to complete our questionnaire.

The survey spanned three weeks in November 2023, during which the team successfully completed 284 questionnaires. These questionnaires comprised responses from 121 graduates of the year 2021 and 163 graduates of the year 2022. Both males and females participated in our survey, with 77 males and 44 females among the graduates of 2021, and 107 males and 56 females among the graduates of 2022. However, female participation from the education faculty is significantly higher compared to their counterparts in the agriculture and economics faculties. For instance, 49 female graduates from the education faculty in 2022 were surveyed, whereas the figures for female graduates of agriculture and economics were three and four, respectively. This issue arises from our graduate list, where most graduates come from the education faculty, which has more departments and students than the economics and agriculture faculties.

Table 9: Sample size based on faculty and gender.

Faculty	2021			2022		
	Male	Female	Both	Male	Female	Both
Education	33	33	66	57	49	106
Agriculture	22	6	28	20	3	23
Economics	22	5	27	30	4	34
Total	77	44	121	107	56	163

Research tool

The data were collected using a questionnaire comprising four major sections. Firstly, the family and demographic section addressed gender, age, province, and household information. Secondly, the higher education information section delved into details about the faculty, the Kankor exam, and reasons for major selection. Thirdly, the respondents' experience and opinions about Samangan Higher Education Institute were explored, covering aspects such as facilities, teaching quality, and department satisfaction. Lastly, the section on life after graduation dealt with employment status and the reasons behind job-seeking efforts. The questionnaire employed a diverse set of measurement units, including binary choices, scale measurements, and Likert scales, to ensure a comprehensive understanding of the participants' responses.

Interview

The interview, held on November 23, 2023, lasted over 90 minutes, delving into various aspects of Samangan Higher Education Institute. The interview covered a brief history of the institute, its current status, and future plans. Additionally, challenges and opportunities were explored, along with identifying key stakeholders. The valuable insights gathered during this interview played a pivotal role in shaping the profile of the institute.

Ethical considerations

During surveys with graduates, ethical considerations were prioritized to ensure the protection, well-being, and dignity of all participants. In essence, the data collection process adhered to the principle of 'do no harm' (Vibert, 2022). Verbal informed consent was obtained from all graduates participating in the study. Additionally, the researchers explained the following key points to participants:

- The purpose, nature, and potential risks and benefits of the survey were communicated in a language and format understandable to participants.
- The voluntary nature of participation and the right to withdraw without consequences were emphasized.
- Participants were assured that their responses would be kept confidential, and their identities would be protected.
- Contact information of a researcher was provided in case participants had further questions or concerns.

Findings

Demographic profile of graduates

The demographic characteristics of the respondents showcase notable diversity across gender, age, ethnicity, geographic location, and faculty affiliation. The gender distribution reveals that approximately 65% of the respondents identify themselves as male, while 35% identify themselves as female. Examining age categories, a majority fall within the 22-26 age range, with approximately 30% aged 22-24 and 47% aged 24-26, while a smaller percentage, around 2%, are in the 30-34 age bracket. In terms of ethnicity, the respondents comprise a varied mix, with the majority identifying as Tajik (56.2%), followed by Uzbek (22.2%), Pashtun (10.2%), Hazara (8.5%), Turkman (1.8%), and Arab (1.1%). The geographic distribution indicates that a significant proportion resides in urban areas, constituting 66.2%, while 33.8% come from rural areas. In the realm of academic disciplines, the respondents are distributed across faculties, with 60.6% affiliated with the Education Faculty, 18.0% in Agriculture, and 21.4% in Economics.

Table 10: Demographic characteristics of respondents.

Characteristics		Percentage
Gender	Male	64.8
	Female	35.2
Age	20-22	0.4
	22-24	28.9
	24-26	47.2
	26-28	16.2
	28-30	5.3
	30-32	1.0
	32-34	1.0
Ethnic	Tajik	56.2
	Pashtun	10.2
	Uzbek	22.2
	Hazara	8.5
	Turkman	1.8
	Arab	1.1
Area	Urban	66.2
	Rural	33.8
Faculty	Education	60.6
	Agriculture	18.0
	Economics	21.4

The data provides insights into the geographical distribution of respondents, indicating representation from 16 out of 34 provinces. Samangan province emerges with the highest share, constituting 67% of the respondents. Following are Balkh and Baghlan provinces, contributing 10% and 4.5%, respectively. Conversely, the Logar and Nangarhar provinces exhibit the lowest shares among the surveyed graduates.

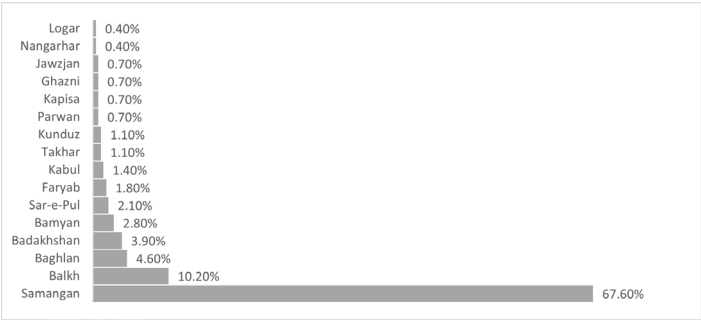


Figure 2: Distribution of respondents by province.

Expectations and education experience

Participation in Kankor preparation courses is integral for success in the Kankor national exam, significantly enhancing students' readiness and potentially improving their acceptance chances at public universities. There exists a discrepancy in participation rates between urban and rural areas within the surveyed sample. Approximately 64% of urban respondents acknowledged their participation in these preparatory courses. In contrast, the figure is lower in rural areas, with 52% of respondents confirming their engagement in Kankor preparation courses. Families predominantly enroll their male children in Kankor preparation centers, where courses typically cost around \$250 per person for several months. These programs have notably boosted admission success rates to approximately 80% for participants (Hayward & Karim, 2019). To address the gender disparity, the Ministry of Higher Education (MoHE) has initiated various efforts. These include urging NGOs to provide free or discounted preparatory courses for female students and recommending higher education institutions to offer complimentary pre-Kankor classes, particularly in rural regions. (Hayward & Karim, 2019).

A study focused on the Programe-e Erteqai Zarfiyat wa Amadagi Kankor dar Manatiq Mahroom (PEZAK), to assist high schoolers in underprivileged areas preparing for the national university entrance exam (Kankor). This initiative prioritized female inclusion as a requisite for participation. The findings demonstrate that the program positively impacted test scores, university enrollment in esteemed institutions and overall pass rates (Mobariz, 2022). Unlike male counterparts who can access preparation centers in provincial hubs and major cities, female students lack this advantage. Thus, programs like PEZAK play a vital role in facilitating female enrollment in higher educational programs (Mobariz, 2022). A shortage of qualified teachers, especially in science and mathematics, has hindered students' preparation for the Kankor exam. Kankor preparation courses offer additional support to students in grades 7-12, covering subjects like math, science and language, and providing exam-writing skills. As a result, more students are attempting and succeeding in the Kankor exam, paving the way for their higher education at universities (Roy, 2015). Reports also highlight significant challenges associated with the Kankor exam, including intense competition, corruption, interference from powerful individuals, and mismanagement (Ali, 2014; 2015).

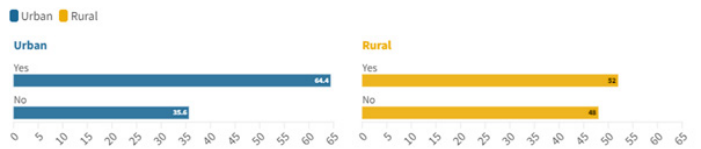


Figure 3: Participation rate in Kankor preparation courses by location.

The graduates provided insights into their motivation factors for selecting their majors, with considerations for both gender and geographical area. Individual preferences emerged as the most influential, suggesting that personal interest, passion, or individual aptitude heavily influenced major choices. Family and friends constituted another

significant motivator, reflecting the cultural and social context in Afghanistan where familial and peer influences play a pivotal role in decision-making. Students' educational and career decisions are significantly influenced by their environment, societal norms, and family (Popova, 2014). The emphasis on individual preferences and familial influences suggests that students might prioritize intrinsic motivations over external factors like job availability, potentially leading to a situation where graduates may be unprepared for the demands of the labor market.

Surprisingly, employment opportunities were ranked last among the motivating factors, indicating that graduates may prioritize personal fulfillment and societal expectations over immediate job prospects. However, studies show that enhanced perceived employability can result in heightened individual success within the labor market and foster more efficient recruitment, retention, and performance of new graduates (Jackson & Wilton, 2017). In the Afghanistan context, where economic conditions and job markets may be less predictable or well-defined (World Bank, 2024a), the impact of not knowing the employment market for a chosen major becomes particularly pronounced. This underscores the importance of improving career guidance services, fostering awareness about employment trends, and enhancing the alignment between educational offerings and market demands to better equip graduates for successful transitions into the workforce.

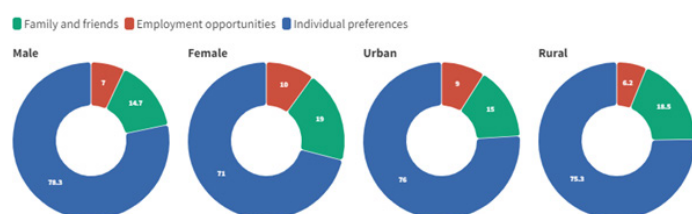


Figure 4: Motivation factor for selecting majors based on gender and area.

The data indicates that nearly half of the graduates engaged in short-term courses during their educational journey, with a comparable participation rate between male and female respondents. However, there is a slight variation in participation rates between rural and urban areas, with 50% for urban respondents and 59% for those from rural areas. In rural areas, access to educational resources and opportunities is limited in comparison to urban in Afghanistan (MoE et al., 2018; Pours Consult, 2016). Short-term courses could be perceived as valuable supplements to formal higher education, offering practical skills and knowledge that are often in high demand. Moreover, the slight variation may also be influenced by economic considerations. Graduates from rural areas might view short-term courses as a means to enhance their employability, bridging skills gaps and increasing their chances of securing livelihoods in environments where formal job markets are more limited or locally oriented.

The data reveals that a significant portion of graduates engaged in learning practical skills through various courses and training programs. For instance, 54% of respondents participated in computer skills courses. Digital skills are

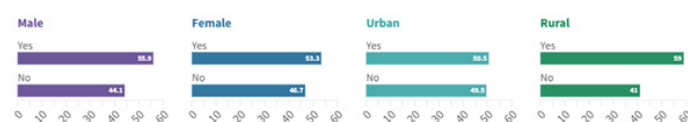


Figure 5: Participation rate in short-term courses by gender and area.

crucial in landing a job (Pirzada & Khan, 2014). A study examining the ICT market in Afghanistan revealed that many Afghans, including IT students, lack awareness of the potential opportunities within this sector. Furthermore, the workforce lacks the necessary skills and experience demanded by job openings in this field (ILO, 2017).

Language skills were also a priority, with 48% participating in language skills courses. Furthermore, 40% of graduates invested in their career development by participating in CV and job application training courses. However, the lower participation rate of 4% in research and academic writing courses suggests a lesser emphasis on academic and research-oriented skills among the surveyed graduates. These findings highlight the practical approach of graduates, emphasizing skills directly relevant to the job market. The participation rates in computer and language skills courses, coupled with career development training, indicate a keen awareness of the practical requirements of the professional landscape.



Figure 6: Participation rate in various types of short-term courses.

The respondents have conveyed their opinions on various aspects of Samangan Higher Education Institute, including facilities, lecturers, and departments, each examined through several sub-questions. In particular, when assessing the facilities, which encompassed the library, conference hall, classrooms, free internet, green campus, laboratories, sports facilities, and diploma issuance, graduates expressed dissatisfaction with certain amenities. Notably, sports facilities, free internet, and laboratories received low satisfaction ratings, with over 90% of graduates rating sports facilities as moderate, low, or very low. Providing internet services is a crucial component of the e-learning programs that this institute will prioritize in the next five years. Additionally, initiatives such as audio and video recording of lectures and establishing an e-library will be integral parts of these efforts (SHEI, 2023). In contrast, the majority of graduates expressed satisfaction with the institute's green campus, as over 70% rated it as high or very high.

Numerous questions were posed to the respondents regarding various aspects of the lecturers, covering factors such as education level, technical knowledge, quality of content, teaching methods, assessment and exams, utilization of technology, availability, communication skills, and respect and fairness. The feedback indicates a generally high level of satisfaction with the lecturers across these diverse dimensions. However, it is noteworthy that close to

half of the respondents expressed a moderate, low, or very low level of satisfaction specifically concerning the use of technology for teaching. This particular finding underscores an area that may benefit from increased attention and technological integration to enhance the overall teaching and learning experience at the institute. These issues are also addressed in the strategic plan, which proposes equipping classrooms with electronic devices and enhancing computer labs for practical modules (SHEI, 2023).

Table 11: Respondents’ opinion about Samangan Higher Education Institute.

Index	Rating (%)				
	Very low	Low	Moderate	High	Very high
Facilities					
Library	1.8	8.5	31.7	46.5	11.6
Conference hall	1.4	8.8	34.5	45.1	10.2
Classroom	2.5	12.7	40.1	33.1	11.6
Free internet	26.4	23.6	22.9	19.4	7.7
Green campus	2.8	8.8	16.9	39.4	32
Laboratories	18.7	15.1	39.1	23.9	3.2
Sports facilities	55.3	17.6	19.0	8.1	0.0
Diploma issuance	12.0	24.3	18.0	37.7	8.1
Lecturers					
Education level	0.0	1.1	16.2	46.5	36.3
Technical knowledge	0.0	0.0	17.6	47.2	35.2
Quality of contents	0.0	1.1	21.1	52.5	24.4
Teaching method	0.4	0.4	21.8	46.1	31.3
Assessment and exam	0.4	2.5	18.3	45.1	33.8
Using technology	3.5	7.7	37.3	31.3	20.1
Availability	1.1	3.9	16.5	49.3	29.2
Communication skills	0.0	2.8	31	40.1	26.1
Respect and fairness	0.4	0.7	16.2	45.1	37.7
Department and Dean					
Availability	1.1	2.8	16.9	43.0	36.3
Respect and fairness	0.0	2.5	13.4	50.7	33.5
Short-term programs	13.7	16.2	31.7	22.9	15.5
Attention to complaints	3.9	12.7	34.9	31.7	16.9
Considering students’ proposals	1.8	12.7	29.2	38.0	18.3
Orientation	14.4	19.7	22.5	26.1	17.3

The survey delved into various aspects related to the departments and dean at Samangan Higher Education Institute, including availability, respect and fairness, short-term programs, attention to complaints, considering students’ proposals, and orientation. The results indicate a high level of satisfaction among graduates with the availability and respect demonstrated by their departments and dean. Approximately 80% of respondents rated availability as high or very high, and a similar percentage expressed satisfaction with the respect and fairness exhibited within these academic entities. However, the findings also reveal areas that may require improvement. Graduates were notably dissatisfied with short-term programs and orientation, and attention to complaints, with close to 60% rated these aspects as moderate, low, or very low. These insights suggest that there is room for enhancing the effectiveness of short-term programs, improving the orientation process, and addressing concerns related to complaint resolution.

The survey findings indicate notable disparities in the expectation levels of male and female graduates. Only 30% of male graduates confirmed that their expectations were met, while this number doubled to 60% for female graduates. Additionally, around 40% of male graduates suggested the need for improvement, contrasting with only 16% of female graduates expressing a similar sentiment. Considering the Afghanistan context, potential explanations for higher

female satisfaction may include the limited historical and societal opportunities for women to pursue higher education (MoHE, 2015b; Roof, 2015). Female graduates may perceive their academic achievements as more significant due to potential gender-related barriers, leading to a higher level of contentment.

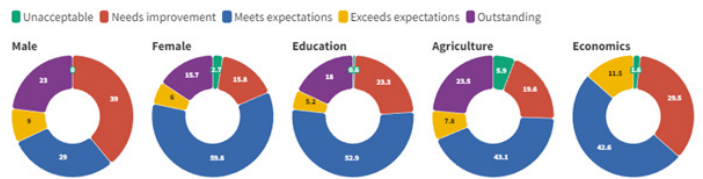


Figure 7: Distribution of expectations based on gender and faculty.

Furthermore, the study reveals variations in expectation levels across different faculties at Samangan Higher Education Institute. Specifically, four out of ten graduates from the economics and agriculture faculties confirmed that their expectations were met, while this figure slightly increased to five out of ten in the education faculty. Additionally, in terms of suggesting areas for improvement, three out of ten graduates in the economics faculty expressed this need, while it was slightly lower at two out of ten for the education and agriculture faculties. These findings suggest that graduates from the education faculty, on average, reported a slightly higher satisfaction level in terms of their expectations being met compared to their counterparts in the economics and agriculture faculties. One potential contributing factor to this difference could be the student-lecturer ratio, which plays a crucial role in the overall learning experience. Notably, the education faculty exhibited a smaller ratio of students to lecturers in 2019 and 2020 compared to the agriculture and economics faculties. This discrepancy in student-lecturer ratios could have positively influenced the quality of education, and better interaction between students and lecturers in the education faculty, potentially contributing to the higher satisfaction levels reported by graduates in that faculty.

The survey also included questions about the respondents’ experiences with continuing their education and participating in other degree programs. A significant majority, comprising 92% of respondents, indicated that they had not pursued further education beyond their current degree. In contrast, only a small minority, accounting for 8% of respondents, reported that they had participated in other education degree programs. The Taliban policy prohibiting girls from attending university could potentially serve as a primary reason for female graduates’ reluctance to participate in further education programs (UNESCO, 2023; Kawa, 2023). Additionally, economic hardship emerges as another significant factor contributing to graduates’ decision not to continue their higher education (SIGAR, 2023).

Employment

The analysis of employment status among graduates, segmented by gender and faculty, reveals significant disparities, taking into account three categories: employed, unemployed, and engaged in small livelihood activities.

For male graduates, the employment rate varies across faculties, with 66% employed from the education faculty, 63% from economics, and 57% from agriculture. In contrast, the employment rates for female graduates demonstrate a notable difference, with 40% employed from the education faculty, and significantly lower rates of 11% from agriculture and economics faculties. These findings highlight distinct patterns in employment outcomes for male and female graduates across different academic disciplines.

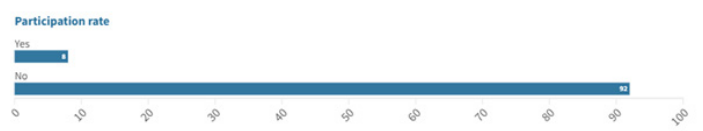


Figure 8: Participation rate for another education degree.

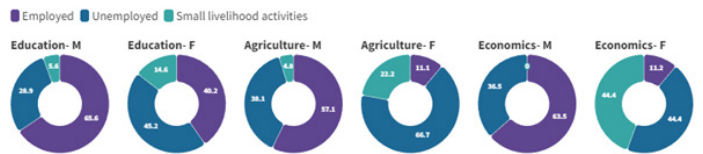


Figure 9: Employment status based on gender and faculty.

Further, the unemployment rates among male and female graduates from different faculties highlight distinct patterns. Among male graduates, four out of ten from the agriculture and economics faculties, and three out of ten from the education faculty are unemployed. In contrast, the unemployment figures for female graduates vary across faculties, with seven out of ten from agriculture, and four out of ten from both education and economics faculties being unemployed. These findings are consistent with assessments by the World Bank (2023) and the International Labour Organization (2023), which underscore an alarming unemployment rate among women. Restrictions imposed by the Taliban have limited women’s entry into the labor market (UN Women, 2023). In addition, conservative ideologies that discourage women from working outside the home may exacerbate this issue (MoHE, 2015b; Shekib, 2014).

The data further indicates that female graduates are more actively engaged in small businesses compared to their male counterparts, highlighting a potential avenue for economic participation. Moreover, the engagement in small businesses varies among female graduates across different faculties. For example, 44% of female graduates from the economics faculty are involved in small businesses, while this figure decreases to 22% for agriculture and 15% for education. This finding aligns with the observation that the primary mode of women’s participation in the labor market has transitioned towards home-based self-employment (ILO, 2023). Considering the Taliban restrictions on women’s employment, there emerges a notable opportunity for international organizations to play a pivotal role in empowering female graduates through entrepreneurship initiatives. By providing support, resources, and training in entrepreneurship, these organizations can contribute to fostering economic independence and creating sustainable livelihoods for women in Afghanistan.

The employed graduates provided insights into the sectors in which they work, categorizing their employment into the private sector, government, and NGOs. Among male graduates, half are employed in government organizations, 47% work in the private sector, and only 3% are employed by NGOs. In contrast, female graduates exhibit a different distribution, with over 60% working in the private sector, 20% in government, and 18% in NGOs. These findings shed light on the distinct employment patterns between male and female graduates, revealing a higher representation of males in government positions and a predominant presence of females in the private sector. Additionally, a notable proportion (18%) of female graduates are engaged in non-governmental organizations.



Figure 10: Gender-based employment distribution in various organizations.

The analysis of factors influencing job opportunities among all graduates, regardless of their employment status, reveals both similarities and differences. It is noteworthy that all graduates, both employed and unemployed, identified experience, foreign language skills, and connections as crucial factors in landing a job. For instance, over 60% of employed graduates and over half of unemployed graduates rated experience as high or very high in influencing job opportunities. Similarly, connections were deemed significant by over 50% of employed graduates and over 65% of unemployed graduates, indicating a shared recognition of the importance of professional networks in the job market.

Table 12: Influencing factors in landing a job categorized by employed and unemployed status.

Factor	Employed (%)					Unemployed (%)				
	Very low	Low	Moderate	High	Very high	Very low	Low	Moderate	High	Very high
Gender	30.0	12.5	13.8	22.5	21.2	40.6	9.4	12.5	11.5	26
Ethnic	52.0	16.7	18.0	9.1	4.2	47.0	8.2	12.5	18.8	13.5
Connection	16.0	10.5	18.5	33.3	21.6	11.3	9.3	14.4	25.8	39.2
National language skills	26.0	16.0	21.0	16.0	16.0	22.7	16.5	36.1	13.4	11.3
Major	14.6	20.2	14.0	25.6	25.6	37.1	21.6	16.5	13.4	11.3
Experience	6.1	8.6	22.7	32.5	30.1	15.5	9.3	22.7	28.9	23.7
Foreign language skills	12.3	21.5	25.8	25.8	14.7	8.2	22.7	28.9	24.7	15.5
Technical skills	4.3	11.1	27.2	35.2	22.2	20.2	24.5	34.0	17.0	4.3
Computer skills	14.1	19.6	23.3	27.0	16.0	10.3	21.6	32.0	21.6	14.4
Communication skills	2.5	5.6	17.4	47.2	27.3	8.6	24.7	38.7	20.4	7.5

Significant differences in opinion between employed and unemployed graduates emerge when considering the influence of the university major, technical skills, and communication skills in securing a job. Among employed graduates, five out of ten rated their major as a high or very high influential factor, whereas only one out of ten unemployed graduates shared this perspective. Similarly, technical skills were considered a high or very high influencing factor by six out of ten employed graduates, while only two out of ten unemployed graduates expressed a similar

sentiment. Further, seven out of ten rated communication skills as a high or very high influential factor in landing a job. In contrast, only three out of ten unemployed graduates expressed a similar perspective regarding the impact of communication skills.

Limitations

Two limitations could be observed in this study. Firstly, our sample was solely drawn from the Samangan Higher Education Institute, which may restrict the generalizability of our findings to all graduates across Afghanistan. Additionally, our study relied predominantly on survey data, which may have limited our ability to delve deeply into the context surrounding our research questions. Therefore, we recommend that future research endeavors consider employing a more representative sample size and utilize a combination of survey methods and interviews to gain a more comprehensive understanding of the opinions of graduates.

Conclusion

In conclusion, this study highlights several key findings regarding the factors influencing undergraduate students' choice of major and subsequent employment opportunities. Individual preferences play a significant role in choosing a major, underscoring the importance of personal interests and aspirations in educational decisions. Further, over half of the participants had access to short-term courses, including computer skills courses, which employed individuals confirmed as important factors in securing jobs. A study by the Asian Development Bank (2022) on digital jobs and digital skills in Global South countries found that individuals with intermediate or advanced digital skills are in high demand. These individuals have better opportunities, are more likely to change jobs frequently, and are less likely to face unemployment (Pichler & Stehler, 2021).

Recent educational policy changes by the Taliban in Afghanistan focus on implementing curricula with a stronger emphasis on religious subjects (Sharafat, 2024). However, we recommend that educational institutions ensure their curricula include subjects that align with labor market demands. Furthermore, universities should expand their short-term courses to include computer skills, foreign languages, and communication skills. These courses equip graduates with the necessary skills to enhance their employability and better meet the demands of the job market.

This study also reveals significant gender disparities in employment opportunities. Female graduates face more limited job prospects than their male counterparts, with a significant percentage of these women being unemployed or engaged in small businesses. This issue is primarily attributed to the Taliban's ban on women working at NGOs (International Crisis Group, 2023), which has led to a decline in the overall economy (NRC, 2023) and disrupted humanitarian aid distribution (UN Women, 2023).

These insights underscore the critical need for targeted interventions to support female graduates, who face unique challenges in the job market. To address these issues, we recommend implementing comprehensive programs designed to empower female graduates with essential entrepreneurship skills. These programs should provide practical training in business management, financial literacy, and marketing to equip women with the knowledge they need to start and run successful enterprises. Establishing mentorship networks where experienced entrepreneurs can offer guidance and advice will help female graduates navigate the complexities of building and sustaining a business. Additionally, providing access to essential resources, such as startup capital, business tools, and technology, will enable women to launch and grow their ventures. This program should facilitate women's access to markets, financing, and networking opportunities through partnerships with financial institutions, market access initiatives, and platforms for business development.

Lastly, the importance of connections and networks in securing employment cannot be overstated, as they play a major role in helping graduates land jobs. We acknowledge the importance of further research on the student perspective in higher education. It is crucial to delve deeper into understanding the experiences and viewpoints of graduates to inform future educational policies and practices effectively. Therefore, we recommend that future research endeavors prioritize employing a more representative sample size and utilize a combination of survey methods and interviews. This approach enables a more comprehensive exploration of graduates' opinions, providing deeper insights into the factors that influence their educational and employment outcomes. Such research efforts will be instrumental in identifying effective strategies to enhance the quality of higher education and support graduates in achieving their career aspirations.

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Exploring the efficacy of forum theatre and online high-fidelity simulation to challenge unconscious bias

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Keywords

Forum theatre;
high fidelity simulation;
intellectual disability;
nurse education;
unconscious bias.

Abstract

There is an ongoing commitment within nursing curricula to ensure that student nurses are fully prepared to support a person with an intellectual disability. In response to COVID-19 restrictions, universities rapidly adapted to digital technologies to continue the delivery of nurse education. The aim of this research study was to evaluate the effectiveness of an online educational initiative – Digital Community Health Awareness Training (DCHAT) – in comparison to attending the face-to-face version of CHAT. This research study adopted a two-phase qualitative approach using questionnaires to discern the knowledge of participants prior to and after attending a DCHAT workshop. The workshop was facilitated by actors with an intellectual disability using forum theatre. Open and closed questions were analysed using thematic analysis.

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The findings revealed that engaging in the online workshop increased participants' knowledge and skills. This was in aspects of supporting people with intellectual disabilities in health as well as an increased understanding of unconscious bias. Additionally, this research found that following the DCHAT workshop, relationships developed from passive learners to friends and compatriots. This study found that delivering DCHAT was effective and appropriate in preparing student nurses to support people with intellectual disabilities. The implications of the findings suggest that the DCHAT can be delivered by actors assuming the role of patients with intellectual disabilities to global audiences.

Background

Context

Supporting people with a learning disability/intellectual disability in a healthcare environment is not straightforward. This is because people with intellectual disabilities have diverse and sometimes complex needs, thus nurses need the skills to provide the right care. All Registered Nurses must be adequately prepared to do this; their skills must be person-centred and fit for purpose (Doyle et al., 2016). The use of the global definition of intellectual disability includes learning disability and learning difficulty and is now becoming more widely used (Cluley, 2018). Therefore, the term intellectual disability will be referred to throughout this paper. It is widely accepted that people with intellectual disabilities may need assistance with everyday living, particularly those with moderate or profound disabilities. As such, nurses must have appropriate skills, knowledge and attitudes to support a person who has an intellectual disability.

An expectation of nursing curricula in the UK is to prepare nursing students for anti-discriminatory practice including unconscious bias to marginalised groups (Nursing and Midwifery Council, 2018). This is achieved by using a variety of teaching and learning modalities, such as high-fidelity simulation. This is a valuable pedagogical approach adopted in nurse education and imitates reality in a safe and controlled learning space (Presado et al., 2018; Bøje et al., 2024) and has been noted to be a valuable educational resource (Billon et al., 2016) in nurse education and other fields such as medicine (Grafton et al., 2024). This approach can equip students with the relevant skills and support the development of positive attitudes towards people with intellectual disabilities. Forum theatre has been used in education as a catalyst for social change, where learners are active participants rather than passive observers (Thambu & Rahman, 2017). Additionally, this approach can support simulation activities and has been noted to challenge taken-for-granted views and promote conversations (Nordentoft & Olesen, 2023). That said, the role of the facilitator is crucial and needs to encourage reflexivity, otherwise the learner will revert to normative assumptions and misconceptions about people with intellectual disabilities (Olesen, 2021).

Between 2016 and 2020, it was estimated that there were 1.5 million people with an intellectual disability in England, equating to 2.16% of the adult population (Public Health England, 2016; Office for National Statistics, 2020). Historically, people with intellectual disabilities have been treated differently from the general population, often with negative consequences, as noted in *Death by Indifference* (Michael & Richardson, 2008). It is widely known that people with intellectual disabilities are more likely to die younger than the general population (Adam et al., 2020; National Health Service England, 2020), and lessons need to be learned to avoid overlooking this vulnerable group or causing any more unnecessary deaths. Additionally, people with intellectual disabilities are more vulnerable in a healthcare setting, experience disparities in healthcare and are more likely to die up to twenty years earlier than their peers without intellectual disabilities (Gulati et al., 2021; National Health Service England, 2020). They are often repeatedly

devalued and treated with indifference (Gates, 2019), with an added concern that people with intellectual disabilities would be adversely affected by the COVID-19 virus (Heslop et al., 2021). Therefore, it was a critical time, crucially to continue nurse education and to prepare nurses to be able to support patients with intellectual disabilities. While the general population grappled with a 'new normal' and social distancing measures, studies indicated that people with intellectual disabilities would be disproportionately affected by COVID-19, resulting in increased co-morbidity and death (Armitage & Nellums, 2020; National Health Service England, 2020). Unfortunately, this means that COVID-19 posed a further risk to people with intellectual disabilities, thus, presenting an even greater need for raising awareness, having an understanding, and possessing the knowledge and skills to be able to effectively support a marginalised group in a healthcare environment.

A partnership was created in 2009 between a UK university and The Lawnmowers Theatre Company – an independent company run by and for people with intellectual disabilities, identifying themselves as agents of social change (name identified at the request of the group). The aim of The Lawnmowers is to tackle social injustices, discrimination and stereotypical views held by those without intellectual disabilities. Workshops challenging Unconscious Bias (UCB) have been delivered by The Lawnmowers (The Lawnmowers Independent Theatre Company, 2024) to nursing students for over thirteen years, using forum theatre and high-fidelity simulation as the pedagogical approach. It was agreed to continue to deliver the workshops using an online platform and delivery during the pandemic and to explore the efficacy of delivering the forum theatre online.

Simulation

The Nursing and Midwifery Council (NMC) (2018) promotes the use of blended learning in nurse education by using different modalities, one of which is simulation-based learning (SBL). Simulation fidelity has three types: low, medium, and high. High-fidelity simulation is a complementary teaching strategy as it presents nursing students with opportunities for experiential learning in a safe environment, where learners can work through complex real-world clinical situations in an academic setting, supported through debriefing, reflection, feedback, and evaluation (Nursing and Midwifery Council, 2018; Labrague et al., 2019; Sedgewick et al., 2021; Hill et al., 2024).

One mode of high-fidelity simulation is forum theatre. Forum theatre, a form of applied drama, has the potential to connect the clinical and academic worlds as its purpose is to allow the exploration of difficult real-life situations, issues, or dilemmas by applying problem-solving techniques (Labrague et al., 2019; Tuxbury et al., 2012; Nordentoft & Olesen, 2023). Forum theatre stemmed out of Boal's 'Theatre of the Oppressed', which draws audience members into the performance, thus empowering them to co-create the characters' development within the real-life narrative depictions (Massó-Guijarro et al., 2021).

Any simulation-based activity relies on the active participation of students, and this is evident within forum theatre as the audience members are equal participants in the performance. As such, they are offered the opportunity to enter one of the roles to offer alternative solutions or practise a multitude of interactions in a safe environment with the support of the facilitators (Sevrain-Goideau et al., 2020; Tuxbury et al., 2012). Performance participation and discussion enable students to experience associated emotions and initiate understandings into complex interactions. It also elicits critical reflection by challenging one's feelings and biases, as confronting bias is often uncomfortable (Nordentoft & Olesen, 2023; Rizk et al., 2020; Sevrain-Goideau et al., 2020).

The collaboration developed the initiative 'Community Health Awareness Training' (CHAT). This is a two-hour workshop which incorporates a face-to-face forum theatre performance called 'Brian's Story'. The performance presents a sequence of events based on the real-life experiences of the actors in healthcare settings and depicts occurrences where mistakes were made. The forum of actors then engages with the audience (student nurses) to discuss what went wrong and why, then discuss what could have been done differently. Followed by several high-fidelity simulated case studies where the actors are 'in character' and the nursing students are tasked with carrying out a nursing skill, e.g., taking blood pressure. Subsequently, there is a reflexive discussion and debriefing based on the De-briefing with Good Judgement model (Rudolph et al., 2007).

Aims

The aims were:

1. To use simulation in an online teaching session as a safe space to challenge pre-existing stereotypes towards people with an intellectual disability in a healthcare environment.
2. To evaluate the pre and post-workshop knowledge of student nurses.
3. To evaluate the effectiveness of the online educational initiative – Digital Community Health Awareness Training (DCHAT) as an effective approach to preparing student nurses to support a person with an intellectual disability.

Method

Study design

This was a qualitative study designed with two phases. Phase 1 was a pilot run of DCHAT, attended by students and academics who had attended the face-to-face CHAT. In Phase 2, participants were asked to complete a questionnaire pre and post-session about their experience and confidence levels supporting a person with an intellectual disability, as well as their level of knowledge and understanding of unconscious bias.

Participants

Participants in Phase 1 involved convenience sampling to recruit participants easily accessible and available (Simkus, 2022) i.e., eligible participants were staff (n=2) and students (n=3) who had attended the in-person version of CHAT beforehand. Participants in Phase 2 (n=5) were final-year adult nursing students who were attending an online workshop on DCHAT as part of a nursing practice module.

The digital workshop involved watching a subtitled video of forum theatre called 'Brian's Story'. The film was based on real-life events and portrayed the main character, Brian, who has an intellectual disability, and his experiences of accessing healthcare. Students were placed into virtual breakout rooms for the high-fidelity simulated scenario, then invited to engage with the 'patient/actor' to elicit relevant information from a variety of simulated characters to complete the hospital passport. This is an effective tool for enhancing safety and person-centred care for people with intellectual disabilities when accessing acute healthcare (Northway et al., 2017). Facilitated by the theatre company's Creative Director and academic staff, the workshop ended with all students and actors returning to the main virtual room for a large group discussion and feedback.

The workshop enabled participants to reflect based on the 'Debriefing with Good Judgement model' (Rudolph et al., 2007), because this approach creates a safe space for careful feedback as well as authentic inquiry. Feedback included dialogue between participants and the actors, which centred around what they did well and what could be improved upon. The first phase involved a pilot of DCHAT with staff and students who had experienced in-person CHAT and to probe their views on its effectiveness, then to evaluate the digital version of DCHAT with a group of pre-registration nursing students and new module staff members.

The workshop lesson plan included time for debriefing, which was based on the 'De-briefing with Good judgment model' (Rudolph et al., 2007). This approach is often used for a debrief after a simulation (Murray, 2019) and provides the framework for a safe, open space for participants and actors to speak freely. In DCHAT, following a similar format to CHAT, participants watched a subtitled video of Brian's story. Following this, simulated scenarios, focusing on the completion of subsections of a hospital passport, occurred in Zoom's breakout rooms. Participants had to elicit relevant information from the actors, facilitated by the Lawnmowers Creative Director and academic staff. Phase 1 participants were invited to watch CHAT digitally (DCHAT) via Zoom. It followed a similar format to CHAT. However, the simulated scenarios occurred in breakout rooms and focused on the student practitioner eliciting relevant information required to complete the hospital passport for a variety of clients.

Data collection

Participants of Phase 1 were invited to answer three questions based on their experience of the face-to-face CHAT, their experience of the DCHAT session and finally, if the DCHAT session challenged unconscious bias in a similar manner to the face-to-face sessions. The participants completed a short questionnaire with open and closed

questions about their comparative experiences of CHAT and DCHAT. Additionally, whether the DCHAT still challenged unconscious bias to prepare healthcare professionals to effectively support people with intellectual disabilities. Finally, any recommendations for improvement to the DCHAT format were requested.

Table 1. Questions asked in Phases 1 and 2.

Phase 1 participants were staff/students who had attended the face-to-face CHAT workshop-the questions asked were;	Phase 2 participants were student nurses who attended the online DCHAT workshop-the questions asked were;
Please record below, your experience of face-to-face CHAT workshop, your level of knowledge and understanding of supporting people- prior to today's session	Do you have previous experience of supporting a person with a learning/intellectual disability?
Please write down your experience of DCHAT, including knowledge and understanding of supporting people with a Learning/Intellectual Disability in Health care environments at the end of today's session	Did you engage with the prior reading before attending this session?
Do you think the DCHAT challenges unconscious bias to adequately prepare a healthcare professional to support a person with an intellectual disability?	How would you rate your confidence in supporting a person with an intellectual disability in a health care environment prior to the workshop?
Do you think DCHAT can be improved?	Do you understand the term unconscious bias?
Please record anything else in the space below	Please record below, your level of knowledge and understanding of unconscious bias and supporting people with intellectual disabilities in Health care environments - prior to the start of today's session.

Participants were invited to comment on improvements in readiness for the Phase 2 delivery. These focused on pre-session preparation, delivery, and post-session discussion. Session practicalities included a pre-session instruction sheet on how Zoom works, such as how to raise one's hand and to bring note-taking material. Participants could elaborate on the written questionnaire.

Participants in Phase 2 were asked to report on their level of knowledge and understanding prior to and following the DCHAT workshop. In particular, the questions asked were about knowledge of unconscious bias and experience of supporting people with intellectual disabilities in a healthcare environment. Following their attendance at the DCHAT workshop, participants were asked to document their knowledge and skills on unconscious bias and confidence in supporting a person with an intellectual disability in healthcare.

Data analysis

Liamputtong (2013) explained that qualitative approaches offer the flexibility and fluidity required when the focus is on meaning and interpretation. Data from the open-ended pre and post-questions from both phases were analysed using qualitative inductive thematic analysis (Karavadra et al., 2020). Thematic analysis is used across a variety of frameworks and paradigms to provide rich accounts and deeper understanding (Clarke & Braun, 2017). Thematic analysis is useful for interpreting themes or patterns of meaning. Following Clark and Braun's (2017) steps,

familiarisation began by reading the participants' responses to identify and interpret key data; this led to initial code generation, which was further refined into broader themes with quotes, culminating in overarching themes (Clarke & Braun, 2017; Karavadra et al., 2020).

Ethics

Ethical approval was granted by the University Ethics Committee, project ID number 26503 for this study to proceed. All potential participants had access to the participant information leaflet and consent forms. Consent to participate was obtained on the day, and the consent forms, along with other data, were stored in accordance with General Data Protection Regulations, (Data Protection Act, 2018). The opportunity to withdraw was stated at the beginning of the workshop and then re-stated at the end. Confidentiality was maintained throughout the study and participants were allocated a numerical non-identifier.

Findings

Phase 1 findings

In relation to evaluating the effectiveness of the online delivery, pre-session suggestions were around Zoom functionality and how to navigate it, for example, how to raise one's hand and advising attending students to bring note-taking material. Proposals on session delivery focused on the comfort of the actors, the audience and the format. It was felt that more breaks were required as postures were adopted for lengthy periods of time. Suggested implementations were to divide the video into segments and invite audience discussion or suggestions for improvements such as alternative communication style. Another proposal was to have fewer simulated specific scenarios in the breakout rooms, due to the digital lag. This would free up time for more discussion and a debrief post-session.

One staff member and two adult nursing students who had experienced CHAT in a face-to-face classroom setting described how watching the film allowed them to explore unfamiliar situations with people with intellectual disabilities safely. This safety allowed for a depth of discussion and honesty of one's worries and/or biases when working with this clientele and provided an opportunity to make mistakes. The participants appreciated hearing from the actors' experiences as this aided them in breaking down certain stereotypes or barriers and realising the need for connection.

For all participants, there was a connection to the actors and skills required, as highlighted in the data:

"The importance of communication importance of adapting, positive body language, listening skills and clarification". [P1]

Using high-fidelity simulation, such as forum theatre, followed by students engaging with professional actors in simulated scenarios, enabled a distinct split between observation

Table 2. Themes after attending the CHAT face-to-face workshop.

Overarching theme	Sub-theme
Connectivity	Importance of communication Reinforces communication skills and consequences
Stereotypes	Breaking barriers Confidence
Self-growth	Self-confidence Self-honesty Extended learning opportunity
Challenging unconscious bias	A safe space to do so Raises the same issues online or face to face, but some might be more comfortable online Safe to make mistakes
Improvements for delivery	Student accessibility

and simulation (the ‘doing’). By enabling the ‘doing’, the participants felt the students were able to gain practical skills; thereby, a perceived growth in their self-confidence was noted as the CHAT session progressed. Following the student and staff exposure to CHAT, the participants were positive in their appreciation of such a learning opportunity within a nursing programme and predominantly expressed similar themes as they had done in the face-to-face delivery.

By participating in this extended learning opportunity, participants became aware of alternative sources of information as the simulated task was to elicit the likes and dislikes of the character when filling in the hospital passport. The staff participant felt the audience should be encouraged to take notes due to the complex and multiplicity of issues occurring within the storyline. Yet, this observation was not mentioned for the face-to-face delivery. The digital delivery reinforced the need for advanced communication skills as it is the client who bears the consequences, as highlighted in P3’s quote below:

“it [DCHAT]displayed how a lack of understanding and skills such as communication can be decremental to individuals with learning/intellectual disability which can put this individual at high risk of unintentional neglect.”

Participants said DCHAT was successful in challenging unconscious bias, as a safe environment was enabled. This provided an immediate reflection on the scenarios and was perhaps more successful as some students were comfortable in the virtual environment.

Phase 2 findings

Phase 2 was an evaluation of learning from the online DCHAT workshop. Participants were halfway through an eighteen-month programme, with no previous exposure to CHAT. Additionally, these participants had no academic content about supporting patients with intellectual disabilities or on the subject of unconscious bias in their programme to date.

Pre-workshop themes

At the beginning of Phase 2, participants were asked to comment on their level of knowledge and understanding of unconscious bias, and about supporting people with intellectual disabilities, one participant (P12) said they had no previous experience. Prior to the workshop, participants said they had some knowledge of people with an intellectual disability and an awareness of unconscious bias; there were varying levels of increased understanding of supporting people in health care with intellectual disabilities. The themes at this stage were Recognition and Terminology.

Recognition

Participants recognised that supporting people with intellectual disabilities required a different approach, although no depth was provided as to what the different approach would be.

“Dealing with the patients in different ways supporting their needs...”. [P5]

Similarly, participants stated that they recognised unconscious bias and gave examples of how communication and respect were important. This was linked to awareness and understanding of unconscious bias, as well as equality and person-centredness.

“unconscious bias is making assumptions about patients based on generalisations or your own prejudices that affect the way you treat them” [P7]

One participant’s definition incorporated other constructs such as stereotyping and behaving differently towards people with intellectual disabilities, “looking at people with preconceived perception of that person and acting differently towards them” [P12].

Participants acknowledged candidly the limited knowledge they had in supporting a person with an intellectual disability.

“I lack knowledge ...unless I am signposted by colleagues...still learning and not ashamed to say” [P6]

Terminology

Participants frequently homogenised and created group[s] or cohort[s], “supporting **their** needs...supporting **them** through **their** stay ...” [P5]. “...escorting **them**... what is important to **them**...in **their** own words” [P7]. Using third-person pronouns creates a concept of unconscious bias whilst paradoxically commenting on how “dealing with

patients in different ways...treating each person with respect" [P5]

Post-workshop themes

Participants were asked to comment on their level of knowledge and understanding of unconscious bias and supporting people with an intellectual disability. The thematically analysed data produced overarching themes and sub-themes as shown in Table 3.

Table 3. Themes after attending the Digital CHAT workshop.

Overarching theme	Sub-theme
Cultural Competence	Cultural intelligence
	Reasonable adjustments/Adaptability
	Unconscious bias
Pedagogy	Enhanced understanding
	Learning from simulation
Power paradox	Professional actors
	Getting the language right

Cultural competence

Cultural competence is an active, ongoing process with three dimensions: awareness, knowledge and skills (Sue et al., 2022). A culturally competent workforce is crucial in nursing (Douglas et al., 2014), more importantly so when supporting people with an intellectual disability (van Herwaarden et al., 2021).

Cultural intelligence

Themes from the post-workshop data indicated an increased level of knowledge, skills and understanding. Moreover, participants gave examples of how clinical practice can be adjusted to meet the needs of those with an intellectual disability.

Data demonstrated there was increased knowledge and understanding across a range of cultures, and the importance of a culturally competent workforce.

"Understanding different cultures, and addressing concerns" [P5]

Reasonable adjustments

Participants were candid in expressing the limited knowledge they had, although this was clarified in the sense of progressing through their programme of study and gaining confidence in the journey. *"Getting better as I go through my training and gain confidence"* [P5] and to *"Quite good but there is always more to learn from patient's own experiences"* [P7]. This highlights the insight into understanding service user perspective, and being able to accommodate and make adjustments, *"...understanding the patients have different needs and adjust your care..."* [P5]. The analysed data revealed that students were able to give examples of precisely what that may mean for practice. Demonstrating

they were able to bridge the theory to practice gap.

Participants commented on adaptability and the need for reasonable adjustments, identifying the individual, needs-led personalised approach.

"... using alternative methods to engage patients who struggle with verbal communication, such as pictures or hand signals by discussion discussing patience likes and dislikes it helps to engage them in the conversation and open up put them at ease and help you discover more about them as a person..." [P12]

Unconscious bias

Participants' definition and description of unconscious bias, demonstrated in-depth knowledge and insight as to how this can be addressed in healthcare;

"...displaying attitudes and stereotypes that people unconsciously attribute to another person or group of people, that affect how they understand and engage with that person or group...in a healthcare setting people are sometimes scared to ask questions that may or may not appear sensitive or uncomfortable for people with a learning disability , and therefore do not find out important information about how best to care for them." [P12]

Pedagogy

Enhanced understanding

Appreciation of high-fidelity simulation as a pedagogical approach was shown through enhanced understanding,

"...it's a good way to practise our communication skills and how to adapt to the different situations before doing it for real in practise... loved the use of the subtitles on the video... learned more about the passport and how to apply to practise and the importance of this passport especially the likes and dislikes of that individual..." [P6]

Learning from virtual simulation

Participants' feedback demonstrates the aims of the workshop were met,

"...I think the DCHAT worked well the play was impactful through the screen..." [P13]

Additionally, the use of simulation was successful,

"...especially simulations helped me to understand more to supporting people with learning disabilities..." [P12]

However, suggested refinements in the format were given, *"Good use of the video although it may be beneficial to break up the video and tough discussions around every situation where we felt could be improved in this scenario..."* [P6].

The participant's quote below captures the appreciation of forum theatre as an immersive approach of High-Fidelity Simulation; it highlights the enhanced understanding and expansion of knowledge achieved through peer learning, an integral feature of high-fidelity simulation.

"This has been a knowledgeable session...I enjoyed the teamwork and support from the students in each area." [P6]

DCHAT demonstrated how simulation supports the development of practical skills in exploring patient needs as depicted in the following quote.

"...simulations helped to understand more to supporting people with learning disabilities." [P13]

This participant quote displays the need for simulation in pre-registration nursing programmes.

"In a health care setting, people are sometimes scared to ask questions that may or may not appear sensitive or uncomfortable for people with a learning disability and therefore do not find out important information about how to best care for them." [P12]

Power paradox

In the post-workshop de-brief, participants were candid in expressing their gratitude to the actors, to a level of servitude and ingratiation. Paradoxically, the power tends to lie with the professional when supporting people with intellectual disabilities healthcare. The participants acknowledged the actor's professionalism and expertise, as well as expressing gratitude.

"Thank you for your time, patience and knowledge..." [P6]

Getting the language right

Terminology emerged in the pre and post-workshop data. During the workshops, the term learning disability was used interchangeably with learning difficulty. The actors preferred the term learning difficulty, and post-workshop data demonstrated an increased level of confidence accepting and using the term learning disability. There seems to be a dissonance of terminology use between participants and actors, yet the actors gave license to use such terms. However, in the complexity of the narrative, an argument can be made that using the term learning 'disabilities' creates an atmosphere to increase unconscious bias as it does not focus on abilities.

Participants reported on having an increased ability to communicate, "...better engage with patients with a learning disability such as not using jargon or overly technical terms to confuse patients" [P7].

Furthermore, participants demonstrated the ability to use terms themselves, and using acceptable and preferred words, confidently articulated.

"...people with learning disability..." [P13]

Additionally, participants described that by attending the workshop they had a better understanding of communication, accessible language and how to overcome the barriers to communication.

"After today's session I have learned several communication techniques to better engage with patients with a learning disability" [P7]

"...the importance of communication..." [P5]

Discussion

This study sought to evaluate the efficacy of a digital version of forum theatre (Brian's story), set to challenge pre-registration nurses' pre-existing stereotypes of people with intellectual disability in healthcare environments. Using forum theatre to challenge preconceptions is not new, however its delivery over a digital platform is innovative for both learners and educators. This supports the conclusions from McGrath et al. (2022) that presenting real-life situations (high fidelity simulation) and using forum theatre created an opportunity to manage difficult yet authentic scenarios in a safe space. This offers a unique simulated learning opportunity to challenge current thinking and break down barriers to enhance future practice. Thus, to evolve from providing standardised reasonable adjustments to individualised person-centred care.

It is accepted that simulation is an immersive platform for experiential learning (Erlam et al., 2017). Building on McGrath et al. (2022), participants experienced a sense of realism created through the interactivity of the simulation sessions and in the intimacy of the breakout rooms, were able to reflect on their own attitudes, practice, and communication skills. It is also known that simulation events provide a safe environment for making mistakes (Turner & Harder, 2018) and the professional actors guided students through some common pitfalls. The true power paradox in the data was the irony that the actors were consummate, experienced, well-rehearsed professionals leading the learners to learn, whereas the participants were passive vessels to drink the information provided. However, the active engagement/learning from the participants during the workshop demonstrated that by the end, they could articulate the travesty in the healthcare needs of people with intellectual disabilities, provide details on what unconscious bias was and how to spot it. More importantly, the workshop had facilitated relationships that would never have happened. Participants expressed various levels of confidence when communicating with the actors and felt that following the workshop, their levels of knowledge relating to unconscious bias had increased somewhat.

By having smaller groups, this enabled greater participation for each participant to engage in this learning opportunity and develop their critical thinking, thus impacting more on their professional practice (Hao et al., 2022). DCHAT was effective for students to gain practice in assisting people with intellectual disabilities and to identify situations where reasonable adjustments can be operationalised, thus improving the person's healthcare experience.

This research study found that virtual high-fidelity simulation is an appropriate teaching and learning strategy to challenge and help student nurses' understanding of unconscious bias. The workshop facilitated over Zoom, was an appropriate and effective medium to prepare student nurses to support a patient with an intellectual disability in a healthcare environment. By using digital technology allowed for inclusive and developing pedagogy (Crawford et al., 2020), thus providing an alternative way to prepare student nurses, which may have otherwise been hindered.

Similarly, this workshop provided an opportunity for participants to hear experiences and challenges faced by people with intellectual disabilities when accessing healthcare, and to foster an understanding of what their role is to address the difficulties. An unintended consequence of the simulated activity (filling in the hospital passport) was the engagement of both learners and actors in virtual communication, as this would lend itself to future practice post-COVID in an ever-increasing use of telehealth. This approach would challenge health inequalities, traditional or virtual consultations using reasonable adjustments, adopt appropriate communication strategies, learn the importance of teamwork and foster reflexivity (Rudolph et al., 2007).

Limitations

The limitations of this research study were the fact that this was a small study within one university in the Northeast of England with fourteen participants. Additionally, it introduces the students to an unfamiliar digital platform (in this case, Zoom) and acknowledges digital poverty amongst the students (Barker et al., 2024). This research opens opportunities for further exploration of virtual forum theatre high-fidelity simulation to prepare and equip healthcare professionals to support people with an intellectual disability. For example, expand the use of forum theatre for use with people with intellectual disabilities and student nurses in telehealth consultations.

Conclusion

In response to the global pandemic, most higher education institutions (HEIs) moved content delivery to virtual platforms such as Blackboard, Moodle, Teams or Zoom, and it is important to learn from our own lessons for future pedagogical developments. Just as forum theatre has proved successful in supporting the development and improvement of nursing students' knowledge and communication skills with people with intellectual disabilities, an argument could be made that it is a useful portal to assist with the de-colonisation of nursing curricula for other marginalised groups.

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Graphic assemblages for storytelling: A posthuman perspective from an English language classroom

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Abstract

The post-anthropocentric concept of posthumanism decentralizes human experiences and dismantles absolute human agency. This is done by endorsing the importance of relationality between various human, non-human, material and abstract elements in constituting/composing experiences, events or matters. In education, posthumanist philosophy envisages an inclusive, interdisciplinary perspective that endorses the human and non-human agencies dynamically engaging in material and abstract relations, inside as well as outside the classroom, to reconstruct traditional pedagogies that focus on texts, teachers and the lack of learner agency. Conceived in the qualitative paradigm, the present study attempts to examine the role of learner agency, motivation, and the affect of assemblages in developing the speaking proficiency of tertiary-level learners in an English for Specific Purposes (ESP) classroom in India.

As part of the intervention, learners created wordless graphic assemblages (in groups) with arbitrary images using an online digital comic builder platform to create stories. Their post-task activities, such as discussions, hypothetical questioning, and Socratic seminars oriented towards the development of their speaking proficiency, were analysed. The findings of the study show that graphic assemblages can be used as an affective posthuman pedagogical tool to enhance learners' speaking skills and operationalize their higher-order thinking skills. It also augments agency, facilitates affect, and increases motivation among learners. The results of the study suggest that the graphic assemblages fulfil different teaching and learning objectives. It also provides scope for educators to formulate strategies involving creative practices in a language classroom using a posthuman educational perspective.

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Introduction

Stories as a pedagogical tool have been effectively used in language classrooms for varied purposes such as language and skill development (Bayram & Tongur, 2020), enabling a secure and stress-free learning environment (Porras, 2010) and fostering cultural sensitivity (Alkhaleefah, 2017). Graphic narratives are relatively new forms of stories that have gained significance in language learning. Eisner (1985) defined graphic narratives as “sequential art, the arrangement of pictures or images and words to narrate a story or dramatize an idea” (p. 5)—for example, graphic novels such as *V for Vendetta* by Moore et al. (2005). Numerous studies assert the potential of graphic narratives that substantially contribute to language teaching and learning (Aldahash & Altalhab, 2020; Manning-Lewis, 2019). However, using graphic narratives as a pedagogical tool is not practiced widely probably owing to their unfamiliarity among teachers (Carter, 2007).

The COVID-19 pandemic has changed education’s ambit, necessitating educators to upgrade their practices that cater to the current needs of learners by involving technology as a chief aspect (Sam, 2022; Bala & Mitchell, 2024). Additionally, the present exclusive and hierarchical nature of education essentializes new modes of teaching that disrupt humanistic ideologies and create new knowledge with interdisciplinary perspectives such as posthumanism (Blaikie et al., 2020). For instance, the COVID-19 pandemic enabled online and hybrid classes that disrupted the idea of classroom space and enabled new modes of teaching and learning. This allowed the interactions and transactions between the teachers, learners, materials, environment and methods to evolve which challenged the conventional humanistic ideology of teacher-learner hierarchies. The entanglement of concrete and abstract, living and non-living elements both inside and outside the classroom interacts with the processes of learning and teaching, making the educational space dynamic and constantly evolving (Karthika, 2024). When technology mediates learning and we perceive education in a posthuman context, acknowledging differences, dismantling the notion of agency, and fostering the idea of connectivity between similar or dissimilar material or abstract ‘things’ or ‘events’ become important. For instance, the material elements such as chalk, blackboards, benches, windows and lights impact the physical interaction occurring in the classroom. Likewise, PowerPoint slides facilitate sharing information with ease and at the same time, mediate intellectual transactions by helping to convey complex ideas and creating an emotional, social and intellectual impact, which helps in knowledge production in the learning process.

It is important to understand that posthumanism is a post-anthropocentric philosophic strand that decentralizes the experiences of humans and demonstrates them as a part of totality by establishing that ‘things’ come into being through/in relations and their attributes do not pre-exist in isolation (Barad, 2007). For instance, a technological gadget such as a mobile phone comes into being and is put to use only when it comes into contact with a human who operates it. Similarly, a human defines her/his/their being in relation to other humans, materials and others. The notion of posthumanism is more inclusive, considering

humans, nature, animals, technology, the environment, and other non-human or material objects in terms of relationality (Dolphijn, 2020). Situated in a relational ontology, posthumanism emphasizes how everything is already entangled with humans, non-humans, technologies and discourses in non-hierarchical relationships (Kuby, 2019; Karthika, 2024). Thereby it extends subjectivity and agency to non-human actors in an entanglement (Herbrechter, 2016). The concept also questions the notion of binaries such as nature/culture, body/mind, human/nonhuman and theory/practice. It attempts to establish an ‘intra-action’, which is the relational encounter between/among the elements (Barad, 2007; Taylor, 2016; Murris, 2020; Malone, 2016) and produce multiple and heterogeneous perspectives that add to the nuanced knowledge production concerning such faulty binaries (Taylor, 2016). Thus, posthumanism is a navigational tool to understand the current conditions undergoing massive change, such as the post-pandemic hybrid classrooms and climate crisis and to rethink literacy. Deriving elements from the posthuman theory, the theory of assemblages, and the idea of graphic narratives, this study formulates the model of graphic assemblage as a posthuman pedagogic tool in English classrooms. Assemblages can be defined as the grouping of various elements that involve human, non-human, social, material and technological aspects that collaboratively work in a context to produce an affect (Deleuze & Guattari, 1987; Bennett, 2010; Strom, 2017). The role and agency of these elements become relational as they possess a non-hierarchical relationship with each other in the assemblage (Lenters & McDermott, 2020). The study explores the graphic assemblage model as a posthuman mediation in the learning process that involves the coming together of learners, teachers, technology, art, graphic narratives, classroom spaces, and many others that interact and work collectively in the learning assemblage to produce an affect. Therefore, the present study explores the posthuman possibilities and the role of post-Anthropocene thinking in an English for Specific Purposes (ESP) classroom through the implementation of graphic assemblages as a posthuman pedagogic tool. It aims to examine the enabling of agency, motivation and affect in the learning process from a posthuman theoretical perspective and outlines some possibilities for the teachers to incorporate creative classroom practices/activities in their language teaching. The study also documents the impact of the intervention on the speaking proficiency of second language (L2) learners.

Graphic narratives in language learning

Graphic narratives can be used as pedagogical tools in language classrooms for diverse purposes to enhance the overall language learning of the learners. Studies suggest that graphic narratives can contribute substantially to teaching and learning a foreign or second language (Aldahash & Altalhab, 2020; Manning-Lewis, 2019) as they foster better learning by amalgamating graphics and words more than texts with absolute words (Mayer, 2009). They are also used to enhance the learners’ language skills, such as vocabulary (Castillo-Cuesta & Quinonez-Beltran, 2022), reading (Aldahash & Altalhab, 2020; Thompson, 2023), writing (Manning-Lewis, 2019) and speaking (Gultom et al., 2022). Graphic narratives improve and sharpen visual literacy

(Kwon, 2020), contribute to the four components of intrinsic motivation, which are curiosity, competence, internalized motivation, and autonomy (Thompson, 2023) and motivate reluctant learners (Matuk et al., 2021). It also develops higher-order thinking skills (Gultom et al., 2022). Studies also claim that graphic narratives improve the affective and cognitive faculties and facilitate the learners' Intercultural Communicative Competence (Savic, 2022). In this study, graphic narratives in an English language classroom are explored to examine their role in the learning assemblage and account for the rich, heterogeneous classroom spaces and the multiple affects they can have on the learner's English language proficiency. In the 21st century, where learners have a considerable degree of expertise in the use of technology, such explorations facilitate greater learner engagement and sustained learner motivation assisting them to assume more agency in the teaching-learning process. Rather than being mere witnesses/participants in the learning process, the graphic assemblages equip learners to create their own learning assemblages by using technology for co-constructing knowledge which is an important aspect of posthuman education.

Posthumanist education

The humanistic view of education operates based on binaries and hierarchies. This view accounts for the exploitation of disadvantaged humans, nonhumans and the environment responsible for the manifold crises we face such as exclusivity and climate crisis (Braidotti, 2013, 2019; MacCormack, 2020). Therefore, the current conditions require new modes of teaching that disrupt humanistic ideologies and create new knowledge with interdisciplinary perspectives. Posthumanism as a theoretical framework enables educators to achieve this requirement (Blaikie et al., 2020). Posthuman education places all creatures (human and non-human) in a nonhierarchical web (Morris, 2014). This enables us to examine all the actors and their agencies in a learning environment that extends beyond texts and incorporates many other dimensions that shape classroom learning which might not have been thoroughly accounted for in literacy research (Nichols & Campano, 2017). In other words, all the material objects involved, the environment of the class and the emotional bearings of the students and the teachers are some of the aspects that are left unexplored. Therefore, posthumanist encounters enable heterogeneity and multiplicity in learning not just in terms of subjectivities but also with regard to classroom practices and methodologies (Taylor, 2016). Discontinuity and nonlinearity are the characteristics of posthuman educational practices that deregulate the learning process, position the learner in discomfort, and enable the learner to deal with the unfamiliar to learn, unlearn and relearn (Semetsky, 2014; MacDonald et al., 2020).

Posthumanist theory of assemblages

According to Deleuze and Guattari (1987), assemblages 'have elements (or multiplicities) of several kinds: human, social, and technical machines' (p. 36). Assemblages are also described as 'ad hoc groupings of diverse elements,

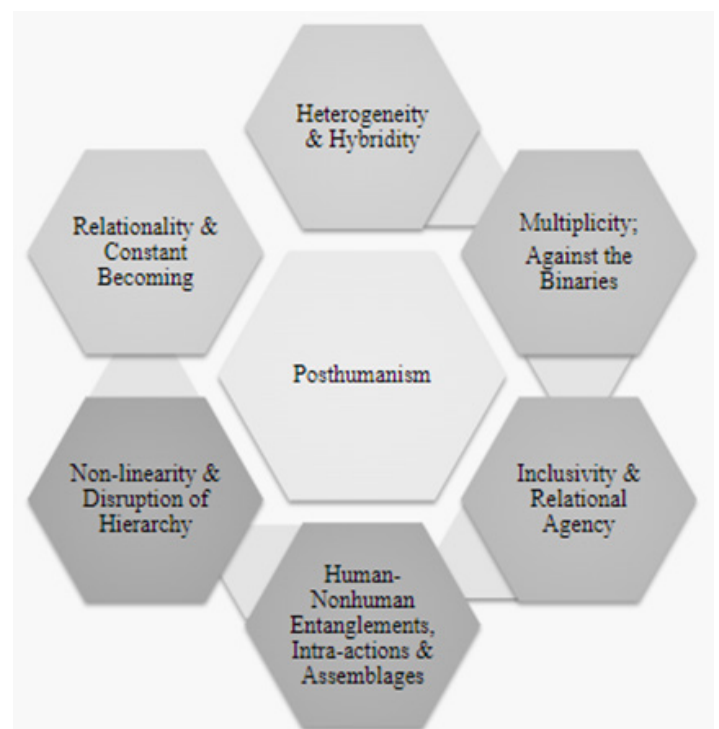


Figure 1. Aspects of posthumanism.

of vibrant materials of all sorts' (Bennett, 2010, p. 23) that function collectively in a context to produce something (Strom, 2017). For instance, a classroom can be considered an assemblage of learners, teachers, texts and material objects which are a mix of bodies, things, ideas, senses, memories, words and much more, deconstructing the subject/object binary (Haraway, 1987). Every element of an assemblage is conceived as a participant and its relationship with every other element is non-hierarchical (Lenters & McDermott, 2020). The assemblages are subject to change as they are always in the process of 'becoming' (Deleuze & Guattari, 1987) which involves 'coming together' (reterritorializing) of diverse elements as/in an assemblage and 'moving apart' (deterritorializing) from it (Deleuze & Guattari, 1987; Wise, 2005). Owing to the constant 'becoming,' the assemblages are always fluid and do not arrive at a final point where it is complete with stable elements and boundaries (Wee, 2021). For instance, a classroom assemblage is never fixed with any constant elements. Instead, the elements keep changing, coming in and moving out. The hybrid classroom as an assemblage is distinct from the traditional classroom and academic discussions occurring outside classroom spaces in themselves are assemblages with varied, untraditional elements contributing to their formulation. This also implies that the constituting elements forming assemblages are independent entities that can be detached and attached and interact differently in different assemblages (DeLanda, 2019; Wee, 2021). Barad (2007) also affirms that all human and non-human things are in a continual state of exchange due to relationality and interdependency while being a part of an assemblage. As a result of this relationality, the outcomes and effects of an assemblage are always emergent and 'becoming' and cannot be reduced to the totality of each element's potential (Bennett, 2010).

The theory of assemblages shares many cognate concerns with theories such as Latour's Actor-network theory (ANT) and Cultural-historical activity theory (CHAT) drawn from the ideas of Vygotsky. Similar to the notion of assemblages, ANT is a relational concept that situates all human and non-human entities equally. ANT also accounts for the multiple and simultaneous trajectories in a network (which is similar to assemblage in this context) that explain the complexities of its workings (Muller, 2015). CHAT, on the other hand, is an advanced version of the Socio-cultural theory (also known as Cultural activity theory) which assumes that human interactions and transactions are always mediated by objects and tools and cannot be isolated from the social context in which the activity is carried out. CHAT also takes into account the relationality between the individual and the community, culture, history and context which is dynamic (Batiibwe, 2019).

While both ANT and CHAT focus on exploring the role and contribution of object-oriented activities on learning and human development, they have differences with regard to posthumanism and the theory of assemblages. For instance, if the social context is not found to be a strong influence to become a concrete network, ANT rejects it. ANT also suggests that agency is a mediated achievement and hence, the components in a network do not have intrinsic qualities or agencies (Muller, 2015). Contrarily, the theory of assemblages does not reject any aspect that could be affecting an assemblage. It is more inclusive and argues that every participant has intrinsic qualities and agencies outside its participation in an assemblage (Bennett, 2010; Deleuze & Guattari, 1987). Therefore, while all three theories share similarities, ANT and CHAT are comparatively rigid and concrete; posthumanism and assemblages are fluid and accommodate multiplicity.

Learning design: The graphic assemblage model

The term *graphic assemblage* is creatively used in this context to elucidate the entanglements of all the multiple elements in the classroom acting together to create something. The term combines graphic narratives and the posthuman idea of assemblages to illustrate how creating distinct graphic panels with the intervention of learners, teachers, and technology can act as a pedagogical tool in an English language classroom that challenges absolute agency and hierarchy in terms of knowledge or power.

Graphic assemblages, in the context of classroom activity, are the arbitrary groupings of various wordless graphic panels created by the learners using a freely available comic builder website called *storyboardthat.com*. Each participant in the group creates one panel and all the panels are grouped arbitrarily as an assemblage. These graphic assemblages created by the learners in groups are used to construct stories by all the learners individually by making meaningful connections between the graphic panels present in the assemblage. Each of such panels is an assemblage while the clubbing of such several panels creates further assemblages. Ideas, perspectives, pictures, technology, training (to narrate a story), and the physical presence of collaborators, and gadgets interact and intra-act to create several abstract as

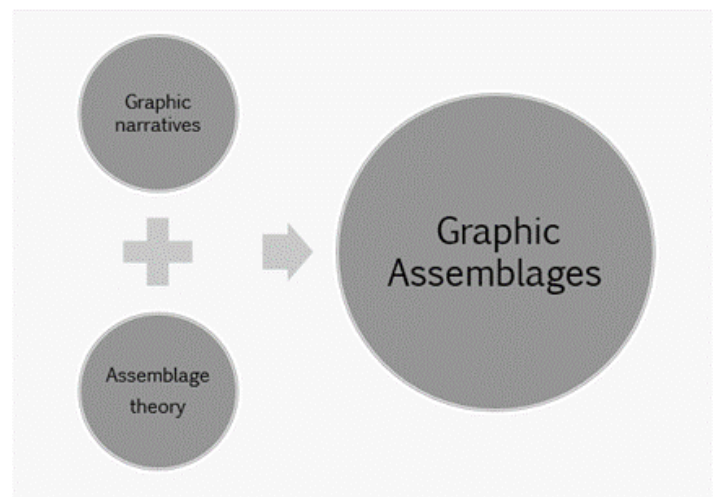


Figure 2. Demonstrating the formulation of graphic assemblages as a pedagogical tool.

well as concrete assemblages.



Figure 3. Participants creating graphic panels.



Figure 4. Arbitrary groupings of graphic panels to form an assemblage.

These pedagogical tools from the posthuman perspective explain the human-nonhuman entanglements, technology inclusion, and new forms of materialism (Herbrechter, 2016). Graphic assemblages are the result of learners, technology,

materiality, visual images/objects, and graphic panels coming together and intra-acting in the classroom assemblage that disrupt the subject/object binaries (Haraway, 1987). As non-human agents such as computers and other material objects are involved in language learning in this context through non-hierarchical relationality, the output is always multifold (Barad, 2007; Bennett, 2010; Taylor, 2016), which is discussed further in the results below. It enables posthuman classroom practices as learning and knowledge production in this context is achieved through creativity, relationality and experimentation (Wee, 2021).

Graphic assemblages in a posthuman English classroom

Design

As the participants' reflections, perceptions and experiences form the core of this exploratory study, it adopts a qualitative case study methodology to analyse the various assemblages that emerge in the classroom and the effectiveness of them as posthuman pedagogical tools in facilitating English speaking proficiency. Case study as a research method enables the researchers to analyse the data at the micro level (Zainal, 2007). It also allows a holistic conceptualization of the phenomenon to derive important insights (Merriam & Tisdell, 2015). To avoid researcher bias and ensure objectivity while analysing the data, which is pivotal in case study research (Yin, 2004; Priya, 2021), the study was conducted in two batches independently, with 8 participants in each batch and their results were compared to affirm the derived conclusions.

Participants

The study was ethically approved by the host university - the National Institute of Technology, Tiruchirappalli, which is a premier science and technology institute in south India. Twelve first-year students from the Department of Metallurgical and Material Engineering and ten first-year students from the Department of Civil Engineering volunteered to participate in this study and sixteen students, eight from each department, were considered. All of them were aged between 17-20 and are referred to as S1, S2, etc. A purposive sampling method was used in selecting the participants for the study to enhance the credibility and relevance of the data (Bock & Sergeant, 2002), as one of the core objectives of purposive sampling is to ensure that all relevant people are included in the sample. Therefore, preference was given to those whose English-speaking proficiency levels were between basic to intermediate levels, allowing scope for improvement.

Data collection and procedures

The study was conducted in December 2022 and January 2023 for six weeks. The intervention was not completely predetermined as it was also subject to 'knowing-in-being', which developed in the very act of carrying out the research (Taylor, 2016). The intervention entailed creating

graphic assemblages in groups, creating stories out of them individually, narrating them, self-evaluating them, and having Socratic seminars. These happened twice, first as a preliminary task and then as the final task. The learners were introduced to storytelling by holding discussions on the elements of the story and speaking proficiency and formulating rubrics for evaluating the stories based on discussions. All the stories were audio recorded with consent for further analysis. After every class, a reflective questionnaire was circulated, and the participants' inputs were obtained through their response sheets and semi-structured interviews. The questions for the interview were open-ended (See Appendix) and they prompted the participants to share their experiences and takeaways from the study. The stories narrated by the participants and their interviews were transcribed. Those transcriptions were closely read and further explicated for the analysis of the study. Additionally, a researcher's diary was maintained to note important intervention episodes.

Instruments

This study used the following instruments for data collection.

Instruments	Coded as
Questionnaire	QS
Reflection Report	RR
Semi-Structured Interviews	SSI
Researcher's Diary	RD
Researcher's Observation	RO

Figure 5. Instruments used for data collection and their codes.

Data analysis and findings

The data collected were qualitatively examined. The analysis aimed to identify and explore various assemblages in the English language classroom to give an account of how agency, motivation, and affect of the learners are relational and non-hierarchical. In addition to exploring the posthuman perspectives, the analysis documents the pedagogical implications of employing such creative interventions.

Agency

Agency is the ability of anything to be a part of an assemblage and act in a particular way when it comes to other things to produce an outcome. This is one of the significant aspects discussed in relation to posthumanism. The agency is not limited to humans but other non-humans and material objects as well. The agency is relational, distributive and always dependent 'on the collaboration, cooperation or interactive interference of many bodies and forces' (Bennett, 2010). Through "agential realism," Barad (2007) also affirms that agency exists through intra-action and not as an influence of a pre-existing element that blurs the subject/

object dichotomy. Bennett’s ‘thing-power’ establishes the role of nonhuman things as actors in an assemblage that augments the overall agency during the intra-action of the humans with those nonhuman actors. This is reflected in the study as 13 out of 16 participants from both batches together performed better which is further discussed in the next section. This is because the material for the activity in this context was not predetermined; instead, the participants were the creators of the materials (graphic assemblages) by intra-acting with the classroom assemblage of technology, digital comic builder platform, material objects, other learners and the researcher (the first author of this paper). This led to their maximum involvement in the activity owing to their learner-centeredness.

Batch	Transcript
Batch 1	<i>While choosing the image, we choose something which already exists..but when we make our own panel, we make it from scratch. That's why I like it more than choosing a picture. (SSI, S3)</i>
	<i>..Because these were randomly selected images that were earlier selected.. But this one was our panel that we made by ourselves and according to our convenience.. (SSI, S7)</i>
Batch 2	<i>Yeah exactly, it was more in-depth and we were able to say a lot because.. that was because.. we created this panel. We added all the elements we want. In stories with personalized graphic panels, we can create our own and execute stories. It gives satisfaction.. (SSI, S12)</i>

Figure 6. Learners sharing their experiences concerning agency.

Formulating the rubric through classroom discussion enabled the learners to self-evaluate their recorded stories. The ten criteria of the rubric involved fluency, vocabulary, grammar, task completion, interaction, body language, accuracy, voice and intonation, the interconnectedness of events (panels), and pragmatic knowledge. The self-evaluation involved three steps - clear explanation of each criterion of the rubric to the learners by the researcher, self-evaluation of the recorded stories by the learners, and engaging in introspection by reflecting on their performance. Self-evaluation was a pivotal part of the study. It fostered learners’ autonomy in learning and promoted reflective practices and motivation among learners, thereby augmenting their agency. Through interviews, it was found that the rubric was a helpful tool that facilitated the learners to self-evaluate their stories efficiently.

Batch	Transcript
Batch 1	<i>..it was very useful because it gave me an idea that.. on what basis I have to evaluate the story.. and I also got to know some new components of speaking. (RR, S2)</i>
Batch 2	<i>It was very useful in the way that there were 10 components given.. and we had to evaluate each of them in our story.. and.. evaluate it by noticing it carefully. This way we could easily find our mistakes in story narrating.. and.. where and in which aspect we have to improve. (RR, S9)</i>
	<i>It's very effective for self-analysis, it saves reviewing and analysis from other people or someone pointing out our mistakes. Recordings helps us to do it ourselves. (RR, S15)</i>

Figure 7. Learners commenting on the usefulness of the rubric.

All the learners who shared specific details about their observations of their recordings during the self-evaluation rectified their mistakes and improved their story narration, such as correcting the use of wrong pronouns and reducing the number of fillers during speaking.

Batch	Transcript
Batch 1	<i>..through self-evaluation... I felt that I could have done better and I need to improve in some of the elements of speaking.. like.. fluency and interaction. (SSI, S1)</i>
	<i>It was good to evaluate our stories by ourselves. I feel.. this way we can precisely get to know about our mistakes and how to improve them. Our way of talking and clarity of speaking is also known to us. That way we can improve.. accordingly. (SSI, S5)</i>
Batch 2	<i>In previous.. when I.. I made many mistakes like using she instead of that.. I used he.. that one. I made many mistake in second one. I clarify.. I rectify that finally. (SSI, S11)</i>
	<i>Of course yes. Well before this activity I was using.. I would say while speaking much, I was stopping.. stopping like even though now I'm stopping, but I'm not using any fillers. (SSI, S16)</i>

Figure 8. Learners sharing their experiences of self-evaluation.

Motivation

Multiplicity and creativity

Through data explication, it was found that several factors motivated the learners in the process of learning through graphic assemblages. Firstly, the very nature of the task of creating and narrating stories through assemblages individually is open-ended, creative and manifold, with multiple possibilities for the story to develop. These are the tenets of posthumanism where the learning process is constituted by the interplay of diverse human and non-human factors such as the infrastructure of the class, the technological resources that facilitate creativity and learner engagement when intra-acting with the learners, and the emotional bearings of the learners that get reflected through their creation of panels which have not been thoroughly account for in educational research (Nichols & Campano, 2017). The results of the workings of the classroom as various assemblages have motivated the learners to actively participate as they could listen to diverse stories that differed in narration style, genre, and theme narrated by their team members from the same assemblages.

Technology

Studies recommend that teachers find creative ways of engaging learners in learning the language that is fun and exciting and, at the same time, not very difficult for the learners to carry out (Lile, 2002; Hussin et al., 2001). Generating graphic panels is a creative act that requires technological engagement. The interface of *storyboardthat.com*, which was used to create graphic panels is remarkably user-friendly, allowing the learners to engage with the task without hindrances. The website also offered various options for learners to craft their panels. For instance, the

Batch	Transcript
Batch 1	<i>We were able to hear different versions of stories from the same assemblages. (RR, S6)</i>
	<i>That we have to create a story by connecting some random pictures in a sequence which actually has no connection with each other. (SSI, S1)</i>
Batch 2	<i>We heard our friends.. Like how they have made a different story out of the same images.. That was very interesting for me.. I enjoyed listening to all of them. (SSI, S15)</i>
	<i>the third task is very interesting. And also creative because I have to create a panel by my own and then I have to create this story. (RR, S9)</i>

Figure 9. Learners sharing their views on the storytelling activity.

options included a variety of facial expressions, bodily positions that involved sitting, standing, moving, hand gestures, and a range of objects, images and backgrounds. This facilitated interest among the learners to engage in the activity. Therefore, access to technology and online tools, and intra-acting with them in a classroom assemblage where the agency of the learners gets augmented due to their interplay with the agency of the technological tools can be a significant source of motivation for English language learners. The theory of posthumanism enables educators to view teaching/learning practices with a new perspective that accounts for the human-nonhuman entanglement in creating graphic assemblages in an already existing classroom assemblage

Batch	Transcript
Batch 1	<i>That was very very interesting because.. I was doing.. while creating the panel, I was creating a theatre setup.. and I didn't know how to add people. I was planning to add single.. single people in each seat, but that will be much difficult. But then the.. the website had an option for the crowd on and crowd off, and light on light off. it was.. we can add expressions too. That's.. that's very good I guess. (SSI, S5)</i>
Batch 2	<i>Yeah, actually a website is very interesting and familiar. It is easy to use. It's not so difficult for me to operate this website. in panels.. I have the story with panels because there are many elements.. so it's easy to create those panels also.. It was very interesting.. Like a puzzle game. (SSI, S11)</i>

Figure 10. Learners sharing their experience of using the website for creating graphic panels.

Researcher’s mediation

Some studies have found that creating a secure environment and understanding the learners’ needs and difficulties is crucial for meaningful engagements (Alison & Halliwell, 2002; Dornyei & Ushioda, 2011; White, 2007). Therefore, throughout the study, the researcher made sure to establish mutual trust and respect for one another by interacting with them, understanding their needs and personal challenges, showing enthusiasm about the classroom activity and creating a safe classroom environment for the learners to narrate their stories with confidence and express themselves. This explains the role of a teacher in a classroom assemblage and how the agency of the researcher in this context is relational to the agency of the learners in the learning process. The

well-being and emotional bearing of the teacher, and the excitement and safe space that the researcher creates have a direct impact on learner engagement. Posthumanism enables us to record these elements that foster motivation among the learners. The learners expressed during their interviews that they were motivated by the researcher to perform better.

Batch	Transcript
Batch 1	Researcher: <i>So, what motivated you to speak like that?</i>
	Learner: <i>Actually.. You also motivated me.. and.. and.. helped me</i>
	Researcher: <i>Why did you say that I motivated you?</i>
	Learner: <i>You. Actually... actually you teach me that.. how I can be good at public speaking.. You also encouraged me.. (SSI, S6)</i>
Batch 2	<i>Like you, you said one day that it's your story. You have to express. so.. that gave me confidence. (SSI, S11)</i>

Figure 11. Learners sharing their source of motivation.

Learners’ self-evaluation

Self-evaluation is a useful exercise that has been asserted as beneficial in teaching and learning practices (Andrade et al., 2010; Jamrus & Razali, 2019). In this study, self-evaluation facilitated autonomy among learners, enabled them to reflect on their mistakes while evaluating their stories, and motivated them to rectify the errors and perform better in the final task.

Batch	Transcript
Batch 1	<i>..through self-evaluation.. I felt that I could have done better and I need to improve in some of the elements of speaking.. like.. fluency and interaction. (SSI, S2)</i>
Batch 2	<i>Evaluating our story on our own was a good idea.. through it, we came to know about our speaking skills and difficulties.. and how to improve.. (SSI, S13)</i>

Figure 12. Learners commenting on their experience of self-evaluation.

Affect

Affect is a “visceral, pre-conscious response of the body” that “precedes the articulations of language and thought” (Lenters & McDermott, 2020, p. 20). It is a form of knowing that begins as unconscious and then informs our immediate actions (Semetsky, 2014). Accounting affect in pedagogical practices is imperative as affect has been less discussed in comparison to the significance given to utility and knowledge gain concerning language learning (Garrett & Young, 2009). There is a need for learners to reveal how they affect and are affected by the classroom assemblage (Massumi, 2015) by being agents of human-nonhuman entanglements for socially just pedagogical practices to take place (Bozalek & Zembylas, 2016). This is an essential aspect of posthumanism as it attempts to break the mind/body duality. The mind is given superiority in comparison to the body. Affect also gives significance to bodily responses that precede the

mind and establish a connection between them, thereby disrupting the binary. The learners spontaneously created the panels, resulting from the bodily senses. Therefore, this study examined the use of graphic assemblages in eliciting affect where the learners expressed affect through intra-acting with the assemblages.

The learners articulated their spontaneous act of creating the graphic panels and, later, connected it with their emotions, revealing how they were unconsciously affected by it while simultaneously affecting the graphic assemblage. This enables the teacher to move beyond objectivity and facilitate affective pedagogical practices in a classroom space.

Batch	Transcript
Batch 1	Researcher: Why did you create a basket ball court with supernatural people playing it? Learner: After coming to NIT, I playing basketball with full passion, so I'm loving this. The first time I'm playing basketball and I'm kind of good at it. Just two months if I see so. It was kind of automatic that. Saw a court and imagine something and I built near basket. It was, you know, something without resistance. You could just kind of continuous flow.. it automatically. I didn't use that much of my.. Like that will scale up brain.. like it just came.. just automatically kind of thing. (SSI, S4)
Batch 2	Researcher: Why did you create a spaceship in your panel? Learner: I really like some astronomy. Yeah, actually like. I like to some doing like doing some sorry. I like the. OK, oh, so I want to do some degrees in astrophysics, so I tried some ISER exams, also selected in that. But it is in Punjab Mohali, so my parents didn't allow me. So that created. (SSI, S10)

Figure 13. Learners realizing the affect while creating the panels by reflecting on it.

Impact of the intervention on the speaking proficiency of the learners

Beyond exploring the posthuman tenets in an English language classroom, the intervention also led to a significant improvement in the learner's speaking proficiency which is discussed further.

Improvement in speaking proficiency

To evaluate the learners' speaking proficiency through the stories created and narrated from the graphic assemblages, a tailor-made rubric was developed through classroom discussions for them to self-evaluate their audio recordings of the story. The results of the self-evaluation were compared with the researcher's evaluation and observation to infer a rigorous analysis of the results and outcomes.

Most learners showed considerable improvement concerning interaction, body language, voice and intonation, interconnectedness, pragmatic knowledge and task completion. This was majorly influenced by self-evaluation and other motivational factors discussed above. The learners included dialogues in their stories and prompted interaction by asking the other team members questions while narrating the story, thereby involving other learners as active participants. They were able to stress a few words and change their intonation and voice to draw attention and emphasize significant events of the story. The learners who

hesitated to speak in front of others with stiffened bodies and less or no eye contact were able to stand at ease with confidence, make hand gestures when necessary and make eye contact with everyone, which is imperative for effective communication and transfer of knowledge (Gregersen, 2007; Basnet et al., 2022; Shumin, 2002). The learners also shared that the self-evaluation and classroom discussions led to the cognizance of each criterion of the rubric and enabled them to practice speaking with better body language and interaction. Despite the difficulties with using advanced vocabulary and syntactically correct sentences, all the learners were able to convey the meaning by using familiar expressions and explaining concepts in simple sentences, which exhibited their pragmatic knowledge.

Batch	Transcript
Batch 1	After self-evaluation.. I felt that I could have done better and I need to improve in some of the elements of speaking like fluency and interaction. I didn't know.. story telling can be interactive.. So I added many questions in the final task.. I asked my friends few questions.. It was good. (Interaction-SSI, S8) Many students performed better. They interacted with other participants while narrating the story, they made eye contact and hand gestures.. Many of them used appropriate sounds and intonations whenever required... Overall, they were more confident with their narrative. (Body language- RD, RO). My voice is very soft.. And usually I talk very low voice.. But after I came to know that sound and saying words correctly is important.. I tried to increase my pitch when I have to stress (Sound and intonation- SSI, S3)
Batch 2	I didn't mug up the story, I just came.. and I want to say my views. So I explained what was there in my mind to my friends.. (Pragmatic knowledge-SSI, S12) Almost all learners were able to make meaningful connections among the panels and the events of the story created through those panels were coherent. All the learners completed the task of creating stories by incorporating the elements of story, such as having a beginning, middle and end, surprise elements, climax and a moral. (Interconnected and task response- RD, RO)

Figure 14. Excerpts from the semi-structured interview transcripts and researcher's diary supporting the improvement in the learners' speaking proficiency.

Duration of speech and sentence structures

They spoke with ease for a longer time with confidence due to increased motivation, active engagement in creating the text for the task, and increased agency as an outcome of their intra-action with technology, material objects, team members, researcher and classroom space. The learners expressed that they were not conscious of the time taken to narrate the story as they were more involved in the final task.

A few learners struggling to make sentences with appropriate vocabulary could make more prolonged and complex sentences with basic vocabulary as they focused on conveying the story and meaning. This was also aided by other measures such as pragmatic knowledge, body language, voice and intonation and involving the participation of the team members through interaction.

Batch	Transcript
Batch 1	<i>I made the panel so I.. I.. said that I already know the elements of my panel. But during the storytelling I feel that I have to tell what in my mind to create the.. all the story.. I tell everything, but I don't know how it take long. (SSI, S4)</i>
Batch 2	<i>I didn't mug up the story, I just came and I want to say my views. So I explained what was there in my mind to my friends. (QS, S10)</i>

Figure 15. Excerpts from the semi-structured interview transcripts and questionnaire explaining the duration of the learners’ speech.

Batch	Transcript
Batch 1	<i>I went away from my school. In my... in my school there is a... there is a ground. So I'm walking in middle of the group. Two, the two boys. They are driving the bike. So they tried to hit me. (shorter sentences in the preliminary task- S7)</i> <i>So actually the next day is Christmas, and she's missing her brother because the previous time they two celebrated Christmas.. but this time her brother had work... (longer sentence in the final task- S7)</i>
Batch 2	<i>He is also a scholar of geography. He is doing research on the planet Earth and Sun. So he used to notice every day the sunrise. Timing and sunset. So when he once one day when he.. he is taking the reading of the sunrise. (shorter sentences in the preliminary task- S12)</i> <i>So they just planned that every weekend you both came here and play a match with us and after that they leave him to the main door of the mansion and after that they both came out from the mansion and with happily. (longer sentence in the final task- S12)</i>

Figure 16. Excerpts from the audio transcripts of the stories narrated by the learners.

It was also noted that a few learners attempted to reduce the use of fillers in the final task. Instead of fillers, they paused, formulated thoughts, and then resumed. This practice made the learners unflustered and enabled them to narrate the story with clarity. The learners also expressed that self-evaluation enabled them to work towards reducing fillers while speaking, through conscious practice.

Of course yes. Well before this activity I was using... I would say while speaking much, I was speaking for a long time... I was stopping ... like even though now I’m stopping, but I’m not using any fillers. (Batch-1, SSI, S4)

Higher-order thinking skills

Making graphic assemblages and creating stories through them enabled the learners to operationalize their higher-order thinking skills. The learners were able to analyse all the panels of the assemblage by closely reading them and identifying all the elements of the panels. They were able to evaluate the numerous ways in which they could make meaningful connections between the panels and the varied directions in which the story could be taken forward. Through this process, they could create an original story using graphic assemblages (Phakiti, 2018; Wilks, 1995; Dillon, 2002; Zohar & Dori, 2003).

Batch	Transcript
Batch 1	<i>Yes, I love history very much, so I like to learn.. I learn about history so... and I love to watch movies. So I.. I.. combined both of them- people watching movie about history. (SSI, S5)</i>
Batch 2	<i>There's a process.. very simple.. The first.. I know much about my panel than the other.. other panels, right? So I created. I started writing the story based on my panel. So my panel was theatre where people are watching some movie OK. My plot was depending on a director and his friend because there are two people in the screen which I created. So it's like my director, which is depending on the movie so... its a friend and his friend. So I started writing the story on that and when it comes to places.. when it comes to.. where they're meeting.. all that, I took the other images and I was able to do that. I was.. I just added that other images and my.. my the main plot was depending on my panel. (SSI, S9)</i>

Figure 17. Learners explaining the process of creating stories through graphic assemblages.

Discussion

The study of the graphic assemblage model as a storytelling posthuman pedagogical tool has exposed the learners’ perceptions, reflections and experiences that facilitated an understanding of the nature of the model and the classroom assemblage, the role of various classroom actors in carrying out the task, the process of their learning and their achievements. The model positively impacted the motivation level of the learners similar to the studies that dealt with graphic narratives (Thompson, 2023; Matuk et al., 2021). Studies have focused on enhancing learner agency through graphic narratives (Saltzman, 2021; Kinoshita, 2022). However, a one-size-fits-all approach, where using an existing definite text in a classroom for varying purposes can limit the learners’ agency and design capabilities (Reid et al., 2021). On the contrary, this study documents numerous possibilities of a classroom intervention and many elements working together in an entanglement. Therefore, creative practices such as these, formulated through posthuman perspectives that include multiplicity, heterogeneity and non-linearity as its chief aspects, enable multitudinous possibilities in a classroom space that nullify the factors limiting the learner agency. The study affirms that learner agency is affected by various factors such as self-evaluation, peer learning, and intervention of the teachers, technology, and environment.

This study also essentializes the affect in the learning process. While other related studies illustrate the significance of graphic narratives in affecting learning strategies and outcomes (Castillo-Cuesta & Quinonez-Beltran, 2022; Gultom et al., 2022), the present study explores how the learners affect and are affected by the learning process (Massumi, 2015). This is carried out by emphasizing the pre-conscious response of bodily movements and unconscious knowing (Lenters & McDermott, 2020; Semetsky, 2014). These perspectives enable the teachers to build convivial relationships with the learners (Alison & Halliwell, 2002) and facilitate socially just pedagogical practices (Bozalek & Zembylas, 2016). Similarly, concerning language learning, the study confirms the improvement in English speaking proficiency of the learners and the development of higher-order thinking skills. The findings show that learners with basic level speaking proficiency in English significantly improved their interaction, body language, voice and

intonation, interconnectedness, pragmatic knowledge and task completion. Fluency, vocabulary, grammar and accuracy can also be majorly improved if aided with parallel classroom sessions focusing on these subskills.

The interview data highlighted that storytelling as a pedagogical tool has been underused in language classrooms. This can be due to factors such as a large number of students in a classroom, time constraints and the extreme energy consumption of teachers (Kalia, 2017). To tackle these conditions, it is important to realize the affect that the agency and autonomy of a learner can have on the learning process with the informed nature of possible classroom assemblages and, therefore, facilitate them to engage in creative classroom activities that foster language proficiency. Additionally, the intervention enabled the learners to perform better in their class presentations of other subjects and engage in their daily social life.

Batch	Transcript
Batch 1	<i>Yes, before this activity I.. I sometimes.. I get.. got nervous while talking to new person. But by this activity, during the Pongal days I went to the Rockfort Temple and some French foreigner is also there. So sometime.. for two or three minutes, I talked to them. but earlier from this activity I.. I don't talk some new persons. Yes. that was achievement for me. (SSI, S3)</i>
Batch 2	<i>Yes ma'am. This activity helped me a lot in improving my speaking ability because we had presentation of our other class and I had not done any presentation earlier before. But I had done that story telling in front of that eight.. eight students. So I had I had knowledge of my ability that I can do so, it helped me a lot to improve my speaking ability in this stage also. And I get to know about my weak weak points. Also that I have to.. I have to take less gaps and stop using in the fillers. (SSI, S15)</i>

Figure 18. Learners sharing their experiences post-study.

Analysis of the gathered data revealed that storytelling through learner-created graphic assemblages enhanced agency, affect and motivation in them in addition to attaining linguistic goals, promoting language proficiency levels and enabling the learners to operationalize their higher-order thinking skills. The findings also affirm that storytelling as a pedagogical tool, and technological resources can be used efficiently in language classrooms as they are underused and have more potential to enhance language learning.

Limitations and further research

Despite the detailed reports, the results of this study cannot be extended to generalizations concerning English language proficiency as the study has been conducted with a limited number of participants for six weeks. Most of the learners were comfortable with technology and using computers; all the learners were able to use the comic builder platform efficiently and create their panels successfully. This can also be a limitation in learning environments where technology and good infrastructure are not a part of the learning assemblage. Similarly, the agency of the learners and teachers can be limited if they are not digitally equipped/literate enough to utilize the resources which will have a consequence on the overall engagement in the classroom affecting the learning outcomes. Teachers with a critical understanding of their students, their needs, learning objectives, learning space

and the availability of infrastructure and resources can use creative pedagogical interventions that are informed by posthuman perspectives, such as graphic assemblages to cater to diverse requirements in the learning process.

Further research can focus on various other posthuman perspectives that are inherent in teaching/learning methodologies in English language classrooms. This will add new dimensions to the existing practices, encouraging teachers to be informed practitioners who are aware of the complexities and nuances of the classroom assemblage and how every element, human and non-human, has its role to play in the entangled classroom spaces.

Conclusion

Summarizing the major findings of this study, we argue that learner agency is augmented through intra-acting in human-nonhuman entanglements. Additionally, learners' motivation increases due to factors such as the creative nature of the task with multiple possibilities, the inclusion of technology, the supporting role of the researcher, and the self-evaluation of the learners. The affect throughout the task is significant, with learners both being affected by and affecting the learning process. Furthermore, learners' speaking proficiency improves, particularly in terms of interaction, body language, voice and intonation, interconnectedness, pragmatic knowledge, and task completion, as well as in making longer, more complex sentences and speaking for extended periods. Higher-order thinking skills are also operationalized as learners create and narrate stories through graphic assemblages. The study also emphasizes the importance of integrating technology into the classroom to reform conventional story-telling practices. The findings of the study provide scope for the teachers and researchers to revisit and analyse how they have been engaging with educational practices and language teaching through posthuman perspectives to better account for the intricacies of learning. As graphic assemblages are wordless graphic panels put together arbitrarily, they can be used as pedagogical tools at any level of education for learners of any proficiency level, with tailor-made tasks.

Language classrooms are complex ecosystems, where technology-mediated interactions challenge the conventional teaching-learning processes. Defining or attempting to read the classroom dynamics using any single established theoretical framework would not guarantee an actual representation. This is where the posthuman framework becomes useful in interpreting and generating classroom dynamics. The posthuman perspective on English language teaching acknowledges the diminishing boundaries of various binaries, facilitating knowledge exchange without hierarchical restrictions (Karthika, 2024). When the learners operationalize their agency, they are found to be motivated enough to regulate the affects they create and to acknowledge the differences in perspectives that their peers produce. As the monopoly of knowledge shifts from being a capitalist possession of teachers to being distributed among various agencies with the aid of technology, education is undergoing a posthuman transformation.

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Appendix: Questionnaire for the semi-structured interview

- 1) What do you think of stories? And storytelling?
- 2) Did you enjoy the storytelling activity during the study? Can you share your experience?
 - What did you like the most?
 - Is there anything you did not like about the activity?
 - What challenges did you face?
- 3) Can you tell me what difference did you find between the three tasks?
 - How different was your experience in each task?
- 4) Do you find any difference between your first and second stories?
- 5) You have spoken longer, and your story is more elaborate in the last story. Why do you think that happened?
- 6) Your last story is more detailed, and you have used the graphic panel better and used the objects in the panel well. Can you tell me why that happened?
- 7) In your recording, you also sound very expressive and enthusiastic while narrating the last story compared to the previous one. How is it that you sound so motivated? What is the reason behind it?
- 8) Do you think this activity had an effect on your speaking proficiency? In what way?
- 9) What differences did you notice between the first and second narrative styles of the stories?
- 10) After the study period, did you have any encounters where you applied what you learned here through this activity?
- 11) Was there any situation where you remembered this activity and used those learnings in that situation?
- 12) How have you benefited from this activity?
- 13) Why do you think this activity will be useful in a language classroom, especially for engineering students?
- 14) Can you explain how you created the story out of those images and panels?
- 15) Did you use real-life events in your story? Or something that you have already watched?
- 16) The panel is something you created. How was your experience in creating the panel?
- 17) What did you find interesting about the website and creating the panel?
- 18) Your last story was better and more detailed. Do you feel the creation of the graphic panel had an impact?
- 19) Do you think the panel made you think more deeply about your story? How?
- 20) Were there any emotions attached or reasons behind why you chose certain elements from the website to create the panel?



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Validation and cut score's estimation for the online learning scale using Item Response Theory

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Keywords

Cut score;
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online learning scale;
psychometric properties;
student-centered learning.

Abstract

This study aims to validate the Online Learning Scale (OLS) and estimate the OLS's cut score. The sample was 1,459 undergraduate students across different universities and field studies in Thailand. The OLS was newly developed by synthesizing related literature, focus groups, and observations and was designed to measure online learning quality from student-centered perspectives. The 24 OLS items were validated using Classical Test Theory (CTT) and Item Response Theory (IRT). The OLS' cut score was estimated by analyzing the scale's lowest points of the test information function. The effectiveness of OLS' cut score was investigated by dividing groups of samples by cut score and analyzing their difference using Chi-square test and ANOVA with other variables. The results indicated that the OLS showed appropriate psychometric properties: 1) The Cronbach's alpha reliability was .94 and discrimination indices were .62 to .79, 2) CFA fit indices indicated good fit (CFI = .953, RMSEA = .053), and 3) The IRT difficulty parameters were arranged in order and in the range of -3.0 to 3.0, while the discrimination parameters exceeded 0.65 in all items. The estimated two cut scores (29 and 48 points) effectively distinguished the online learning quality delivered to the students.

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Introduction

The spread of the COVID-19 pandemic has brought about sudden and unprecedented changes to all levels of education. One of the most prominent changes is the adoption of full-scale online or remote learning, replacing face-to-face learning. Even though online learning is not entirely a novel concept, it was only employed as additional learning support outside the classroom context or a tool to develop additional knowledge and skills before the arrival of COVID-19 (Firmansyah et al., 2021; Pal & Vanijja, 2020; Zemsky, 2014). Therefore, the sudden and full-flung changes to online learning affected teachers regarding appropriate learning management, various learning strategies, learning resources, and personal well-being (Mulrooney & Kelly, 2020). For this reason, learners faced unreadiness in many areas, including learning strategies that were different from face-to-face learning in which different teachers had different ways of maneuvering learning methods and adapting themselves to the nature of online learning (Doucette et al., 2021; Pal & Vanijja, 2020). This idea is consistent with the authors' observation of our own classes in the major at the university, which demonstrated that learners mostly learned from lectures since teachers were not well prepared to teach online and lacked the technical skills necessary for learning. Teachers could not interact as they did in a regular classroom due to the lack of body language communication and immediate interactions, which caused difficulties. Also, students sometimes accidentally interrupted teachers' teaching, and teachers sometimes needed to impose rules for students to keep their cameras and microphones on during class time. Students' names were called to enhance class engagement.

Even though instruction was quite problematic, Thai universities must still conform to the educational standards and correspond to the teaching and learning imposed by the ASEAN University Network Quality Assurance when conducting classes. The mentioned educational quality control emphasized learners as the center in which learning activities should provide opportunities for learners to engage in the learning process, reflecting the impacts of learning engagement and student participation on the ability to seek knowledge and ways of self-learning independently (ASEAN University Network, 2020). From the global point of view, the study conducted by Miranda et al. (2021) revealed that tertiary education is currently in Education 4.0, which supports heutagogy, peeragogy, and cybergogy. Students are active learners and can design their learning styles and self-learning, whereas teachers perform the roles of mentors or coaches, collaborators, and points of reference. Therefore, the learning design in higher education should be based on the student-centered approach. The intended outcomes are both soft and hard skills via the assistance of technological tools, learning platforms, and online learning sources.

Although the COVID-19 situation has been increasingly improved and normalized, many universities around the world still adopt online learning, which has been proven to be an effective major learning platform, and there is a tendency to expand in the future. From learners' perspectives, some learners learned effectively online, thanks to the considerable convenience, and it was especially beneficial

to students from deprived families. In addition, it increased diversity in class (Dos Santos, 2022; Doucette et al., 2021; Jones & Sharma, 2020). Online learning is advantageous for self-directed learners because it contains a massive pool of available online resources for seeking additional knowledge and working with others on online platforms (Geng et al., 2019). Besides, students can revise lessons via recorded videos of online meetings. This also facilitates self-directed and student-centered learning, leading to life-long learning (Karatas et al., 2021; Chuwuedo et al., 2021; Sallah et al., 2019). Therefore, to summarize, there is a possibility that online learning will persist in higher education because the outcomes of all research bodies seem to go in the same direction, which indicates that online learning could be a major learning platform with abundant benefits to students.

Table 1. Existing scales related to online learning.

Author	Variable	Instrument	Sample	Validation
Artino and McCoach (2008)	perceived task value and self-efficacy for online learning	Online learning value and self-efficacy scale - 11 items, 7-point Likert-type scale ("completely disagree" to "completely agree") - 2 subscales: 1) task value, and 2) self-efficacy for learning with self-paced, online training	204 personnel from the U.S. Navy (in study 1) and 1,127 undergraduate U.S. Naval Academy students	- validity based on test content (experts) - validity based on internal structure (EFA, CFA) - validity based on relations with other variables (correlations, regression) - Cronbach's alpha reliability
Barnard et al. (2009)	self-regulation in online learning	Online self-regulated learning questionnaire (OSLQ) - 24 items, 5-point Likert-type scale ("strongly disagree" to "strongly agree") - 6 subscales: 1) environment structuring, 2) goal setting, 3) time management, 4) help seeking, 5) task strategies, and 6) self-evaluation	434 students enrolled in blended or hybrid class, and 204 students enrolled in online courses	- validity based on internal structure (EFA, CFA) - validity based on relations with other variables (CFA across two type of sample) - Cronbach's alpha reliability
Barrot et al. (2021)	challenges in online learning	Online learning challenges rating scale - 37 items, 6-point Likert-type scale ("not at all negligible" to "to a very great extent") - 7 subscales: 1) self-regulation challenges, 2) technological literacy and competency challenges, 3) student isolation challenges, 4) technological sufficiency challenges, 5) technological complexity challenges, 6) learning resource challenges, and 7) learning environment challenges	200 university students	- Cronbach's alpha reliability
- Bolliger and Martindale (2004) - Bolliger and Halupa (2012)	online learning satisfaction	Student satisfaction questionnaire in online environments - 24 items, 5-point Likert-type scale ("strongly disagree" to "strongly agree") - 5 subscales: 1) instructor, 2) technology, 3) course setup, 4) interaction, 5) outcomes, and 6) overall satisfaction	- 303 graduate students - 42 doctoral students	- validity based on internal structure (CFA) - Cronbach's alpha reliability
Cheon et al. (2021)	readiness for online learning	Online Learning Readiness Self-Check (OLRSC) - 23 items, 7-point Likert-type scale ("strongly disagree" to "strongly agree")	505 online learners with diverse background	- validity based on internal structure (EFA, CFA)
Author	Variable	Instrument	Sample	Validation
		- 6 subscales: 1) learning management, 2) interaction with peers, 3) technology management, 4) space management, 5) interaction with instructors, and 6) motivation management		
Deshwal et al. (2017)	online learner experience	Online learning experience scale - 20 items - 4 subscales: 1) pragmatic-pleasurable experience, 2) use-social experience, 3) hedonistic-exhaustive experience, and 4) sociability experience	150 students who enrolled in online learning platforms and academic content from universities	- validity based on internal structure (EFA) - reliability - validity based on relations with other variables (regression)
Hung et al. (2010)	readiness for online learning	Online Learning Readiness Scale (OLRS) - 18 items, 5-point Likert-type scale ("strongly disagree" to "strongly agree") - 5 subscales: 1) computer/internet self-efficacy, 2) self-directed learning, 3) learner control, 4) motivation for learning, and 5) online communication self-efficacy	1051 undergraduate students with different majors	- validity based on internal structure (CFA) - composite reliability - validity based on relations with other variables (convergent and discriminant validity)
Kaufmann et al. (2016)	perceptions about classroom climate	Online learning climate scale (OLCS) - 15 items, 7-point Likert-type scale ("strongly disagree" to "strongly agree") - 4 subscales: 1) instructor behaviors, 2) course structure, 3) student connectedness, and 4) course clarity	263 undergraduate students	- validity based on test content (experts) - validity based on internal structure (EFA) - Cronbach's alpha reliability - validity based on relations with other variables (convergent validity)
Sun and Rogers (2021)	self-efficacy in online learning	Online learning self-efficacy scale (OLSS) - 31 items, 6-point Likert-type scale ("strongly disagree" to "strongly agree") - 4 subscales: 1) technology use self-efficacy, 2) online learning task self-efficacy, 3) instructor and peer interaction and communication self-efficacy, and 4) self-regulation and motivation efficacy	366 undergraduate and graduate students	- validity based on test content (experts) - validity based on internal structure (EFA, CFA) - Cronbach's alpha reliability
Tsai et al. (2020)	self-efficacy in online learning	Self-efficacy questionnaire for online learning (SeQoL)	406 undergraduate and graduate students	- validity based on internal structure (CFA, Latent profile analysis)
Author	Variable	Instrument	Sample	Validation
		- 25 items, 11-point Likert-type scale ("cannot do at all" to "highly confident can do") - 5 subscales: 1) self-efficacy to complete an online course, 2) self-efficacy to interact socially with classmates, 3) self-efficacy to handle tools in a CMS, 4) self-efficacy to interact with instructors in an online course, and 5) self-efficacy to interact with classmates for academic purposes		- validity based on relations with other variables (concurrent and convergent validity) - reliability
Tzaflikou et al. (2022)	students' digital competence	Students' digital competence scale (SDiCoS) - 28 items, 5-point Likert-type scale ("strongly disagree" to "strongly agree") - 6 subscales: 1) search, find, access, 2) develop, apply, modify, 3) communicate, collaborate, share, 4) store, manage, delete, 5) evaluate, and 6) protect	156 undergraduate and graduate students	- validity based on internal structure (CFA) - validity based on relation with other variables (discriminant validity)
Wei and Chou (2020)	online learning perception	Online learning perception scale (OLPS) - 23 items, 5-point Likert-type scale ("strongly disagree" to "strongly agree") - 5 subscales: 1) accessibility, 2) interactivity, 3) adaptability, 4) knowledge acquisition, and 5) ease of loading	356 undergraduate students	- validity based on internal structure (EFA) - Cronbach's alpha reliability
Yesilyurt (2021)	readiness for online learning	Readiness for online learning scale (ROLS) - 9 items, 5-point scale - 2 subscales: 1) computer literacy and 2) computer-based self-confidence	306 undergraduate students	- validity based on internal structure (EFA, CFA) - validity based on relation with other variables (t-test, ANOVA)
Yilmaz and Karatas (2018)	online learning interaction	Perceptions of online interaction scale - 30 items, 5-point Likert-type scale - 3 subscales: 1) learner-content interaction, 2) learner-instructor interaction and 3) learner-learner interaction	177 undergraduate students	- validity based on test content (experts) - validity based on internal structure (EFA, CFA) - Cronbach's alpha reliability

Even though scales related to online learning have been developed, there is still a scarcity of measurement scales for online learning quality. The scales related to online learning that the researchers found are provided in Table 1. Table 1 revealed that there is no specific study aimed at developing a scale intended to measure the quality of online learning that aligns with student-centered learning. The existing scales focused on readiness, self-efficacy, self-regulation, challenges, satisfaction, classroom climate, experience, digital competence, perception, and interaction. Moreover, the validation of the psychometric properties of the existing scales still relied on the Classical Test Theory (CTT) by analyzing the internal consistency reliability, the validity based on internal structure using exploratory and confirmatory factor analysis, and validity based on other variables using the correlation coefficient. The limitation of CTT is that it is a sample-dependent measurement model that lacks invariance regarding psychometric properties when applied to other research samples (Hambleton & Jones, 1993).

Moreover, there is a research gap in estimating a cut score for interpreting outcomes of such online learning scales. The online learning scale should establish two or more cut scores, dividing the score range to partition the distribution of scale scores into several categories. These categories are used for descriptive purposes or to distinguish among students who received different quality online learning programs (American Educational Research Association [AERA] et al., 2014). Information acquired from the developing scale in this study will help universities design higher levels of quality in online courses, enhance the standard of online learning to respond to students' needs, improve students' learning outcomes, and provide validity for interpreting the measurement results.

Literature review

Student-centered online learning

During the initial period of effective online learning, academics focused on strategies that effectively deliver learning material; later, they realized there should be a specific online learning instruction, bringing about changes that turned the attention from delivering learning material to studying online learning instructional methods, as well as from teacher-centered to student-centered ways of learning (Ehlers, 2009; Junus et al., 2015). Student-centered learning refers to the type of learning where students are active learners who play a part in the learning design and initiators of knowledge via activities and group work. In contrast, teachers are facilitators who create a comfortable learning atmosphere, so students feel free to provide comments. By so doing, teachers provide the necessary guidance, feedback, motivation, and formative assessment to give rise to a meaningful learning process, which is in contrast to teacher-centered learning in which teachers are key people responsible for students' learning process by designing learning and communicating knowledge, while learners are passive learners (Froyd & Simpson, 2008; Keiler, 2018; Mascolo, 2009; Overby, 2011; Wright, 2011). To accomplish student-centered learning in higher education

(ASEAN University Network, 2020; Miranda et al., 2021), learners must seek knowledge, design learning strategies, and learn independently. They also need to participate in various activities cooperatively and collaboratively. There are online sources to assist their learning, and teachers are supporters who can relate existing knowledge to new knowledge to make lessons more intriguing for students to maintain their attention (Pornkul, 2009). Online learning encourages the development of student-centered learning, allowing students to set a goal and work on learning to achieve it as self-directed learners (Teo & Divakar, 2021).

Even though online learning can take the form of synchronous and asynchronous learning, it is observable that during online learning in Thai universities during and after the COVID-19 pandemic, teachers have employed teacher-centered learning via lectures on online programs and relied on attendance checking and tests as an assessment of learning outcomes. However, after teachers became more accustomed to online learning platforms, they adopted assistive features such as breakout rooms, polls, chats, whiteboards, and screen sharing in their teaching. Besides, there have been learning materials like video clips or learning slides to allow students to preview and review after classes. There have also been adjustments in learning materials such as books that could be scanned to access the file, which is convenient for students to study using different gadgets. Teaching videos are sometimes uploaded to cloud storage for the sake of revision. Assessments have been remodified through essay writing, open-book exams, or performance assessments via recorded online presentations. However, for specific fields that depend on practice and performance, like medicine, engineering, or fine arts, students were required to come to the university as exceptions during the lockdown period, under strict preventive measures such as wearing masks or attending classes in small groups. This goes in the same direction as a study by Marinoni et al. (2020) that asserted that online learning cannot completely substitute in-class learning for skills requiring practice and performance, such as science or arts. Moreover, some teachers invited guest speakers to give specific talks to compensate for field trips during lockdown.

It is noticeable that blended learning in colleges after the COVID-19 pandemic still plays a significant role even though on-site learning has come back, particularly in subjects that rely on lectures and special occasions such as a student's absence. Teachers would be asked to open the online meeting program and record the meeting so that students can review the lessons and catch up with their friends. At the graduate level, online education is the primary learning channel, and they only come to the university to take exams with other students. It is observable by teachers that online learning opens opportunities for students who reside or work in distant locations to obtain graduate education, which corresponds to the study conducted by Pal and Vanijja (2020) that points out the benefits of online meeting applications in both synchronous learning via the live feature, and asynchronous learning via recorded videos and shared files.

The relevant literature and observations suggest that after teachers and students have become familiar with online learning, there has been a shift from teacher-centered to student-centered, consistent with a study by Doucette et al. (2021). They found that the advantage of online learning is that it allows students to review lessons via video clips. The breakout rooms can be used to stimulate discussions and collaborative learning. Also, online learning has back channels such as chat or private chat that facilitate communication with teachers and among peers, which is even better than in-class learning.

Test theory

The model used to measure the scale's psychometric properties was based on Classical Test Theory (CTT) and Item Response Theory (IRT). CTT was analyzed using the sum score under the concept that actual abilities could be observed from the sum score and errors. IRT was analyzed using latent variables under the concept that latent variables of test takers' abilities could be measured from questions that were made on the same scale (Edelen & Reeve, 2007). Additionally, the model based on CTT is a sample-dependent model in which psychometric properties of the measurement vary according to the research sample used to analyze. This contrasts with the concept of IRT, which is a sample-independent model. If the empirical data fit with the model, the psychometric properties remain invariant across all samples (Hambleton & Jones, 1993). That is not all; when considering the measurement precision, it is discovered that the IRT model estimates the measurement precision using the item information function that estimates information based on different ability levels. In contrast, the CTT model adopts the same standard error of measurement across all ability levels, possibly generating bias in extremely high, extremely low, and moderate samples' abilities (Jabrayilov et al., 2016). Thus, the current study employed the IRT model to analyze the psychometric properties.

The estimation of the cut score using IRT

A cut or cutoff score refers to the score point used as a criterion to separate students into different groups. There are two concepts of setting a cut score, which are the test-centered and the student-centered. Aside from dividing students, a cut score is used in the outcome reports to obtain feedback necessary for improving students at diverse levels, affecting stakeholders' decisions (Tiyawongsuwan, 2011; Ziesky et al., 2008). There are various ways to perform both concepts of a cut score. This current OLS development studied a cut score of the developed scale to allow teachers or individuals who deal with online learning to use the feedback acquired from the scale in the adjustment or quality enhancement of online learning in tertiary education. Because OLS is a newly developed measurement, the test-centered cut score in which experts decide and determine the minimum passing criteria may not be an appropriate method. Therefore, the student-centered cut score was adopted using the contrasting-group method (Lin, 1989; Ziesky et al., 2008), which determines the cut score from the curve of the distribution of students' scores using the

test informative function obtained from the analysis based on the IRT. This also helps eliminate the limitations in the contrasting-group method, in which the score distribution possibly showed more than one cut score followed by more than one criterion. The test information function converts students' scores into a standardized value, making it feasible to determine the cut score.

However, according to Zumbo (2016), the difference between cut-score setting and standard-setting definitions is discussed. His study reveals that the definition of the cut score may refer to an arbitrariness of setting the cut score to determine whether to pass or fail. In contrast, the definition of standard-setting refers to the process of finding the cut-score point of a tool that meaningfully categorizes respondents into two or more groups. The cut score should indicate the minimum level of performance to pass each group. Therefore, the OLS study on estimating cut score was focused on determining the standard-setting of OLS.

There has been a controversy among experts regarding the use of test information in determining the cut score. Some claim that cut scores should be at a high information value to determine the cut score accurately and reliably. However, a study by Wyse and Babcock (2016) suggested that the high information value that could divide students with accuracy and reliability should be far from the cut scores. The cut score should be estimated at the point of low information value (Wyse, 2017). This notion aligns with the interpretation of the test information graph, which is a high information value that refers to the fact that the measurement can divide abilities with a high level of precision (Edelen & Reeve, 2007). In other words, the measurement can determine the point of the ability at the high information score with precision. Hence, the current research adopted the lowest point guideline of the test information graph to determine the cut scores. If the graph rose and plummeted before peaking again, the lowest point was determined as the cut score. However, when adopting the student-centered cut score method, we should ensure that the samples used show enough differences in the quality of online learning to ensure the precise estimation of the cut score. Therefore, the CTT was employed using the discrimination index to investigate differences in the samples' responses. If the value was high, it could be interpreted that there were heterogeneous online learning qualities (Hambleton & Jones, 1993).

From the study of relevant literature, it is crucial to develop the online learning scale (OLS) that measures the quality of online learning, which necessarily corresponds to a learner-centered approach and current online learning contexts, to obtain information that can be utilized to improve learning instruction. The OLS is a newly developed scale and should provide evidence of psychometric properties in reliability and validity analyzed by CTT and IRT to ensure its quality. The cut score estimation will also be conducted to interpret the measurement results and use them to improve online learning classrooms. The scale will be up-to-date and facilitative to the current online learning at the tertiary level, which has the potential to expand continuously. Therefore, the research questions were: 1) what are the psychometric properties of the OLS measurement? 2) how many groups should there be in the quality estimation of online learning?

3) what should be the value of cut scores for the OLS?

Research objectives

- 1) To validate the Online Learning Scale (OLS) for undergraduate students.
- 2) To estimate the OLS's cut score to distinguish online learning quality for blended and online learning in higher education.

Method

This research adopted a research and development (R&D) design (Gall et al., 2007; Gustiani, 2019), which is widely used to develop an educational assessment tool or product. The process of OLS development started with studying related literature, focus groups, and observation to collect information for designing OLS, then developing a preliminary OLS. The OLS underwent a pilot study and revision before being tested with the research sample to reveal its psychometric properties and validate its finalized version. Lastly, OLS's cut score was estimated to interpret OLS implementation effectively.

Sample

1,459 undergraduate students in Thailand were research samples. This study used stratified random sampling to cover samples' distribution in five types of universities, including public universities, Rajamangala University of Technology, Rajabhat universities, private universities, and community colleges, and four types of study fields, including health sciences, sciences and technology, humanities, and social sciences. Most students came from public universities, accounting for 70.53%, and 49.55% came from social sciences majors (the summary table of university types and study fields is provided in the appendix). The majority gender of samples was female (72.72%), and the average age of the samples was 20.84 ($SD = 2.33$, $Min = 17$, $Max = 43$).

Instrument

The instrument adopted in the current research is the Online Learning Scale (OLS). OLS was developed and synthesized from a literature review, a focus group of experts, and online classroom observation in a Thai university. This process aimed to develop an operational definition of online learner-centered learning that aligns with the current learning instruction. The operational definition of the current study is the following:

"Online Student-Centered Learning means students are mainly responsible for their learning, in which learners participate in the decision-making process to seek the most optimal way to enhance their learning and skills via analyzing problems and contributing factors of a specified incident. They are required to seek knowledge, participate in both online and offline activities, work in a team, perform their duties, exchange opinions with peers and teachers, plan, execute the plan, and summarize their learning outcomes. Ultimately, they

will have to present their learning outcomes to their teachers, peers, and the public via different media by producing a multimedia product suitable for online presentations."

To implement online student-centered learning, teachers' roles should include incorporating the existing knowledge into new knowledge and turning it into a lesson using discussion questions or applications to stimulate learners. Teachers support and facilitate group work, projects, and research studies that students are intrigued about. They also need to relocate time to provide advice and feedback and answer learners' questions outside the class time. They can invite guest speakers to compensate for some fieldwork. It is crucial to ensure that learners are clearly informed about the submission platforms and deadlines.

Online student-centered learning should involve both synchronous learning in a live environment and asynchronous learning, which relies on various applications and video recordings of the in-class teaching so that students can review lessons. Content files, activities, or video clips should be uploaded if they are interested in additional information. Online learning that adopts such meeting applications as Zoom, Microsoft Team, and Google Meet allows users to use breakout rooms to enable small discussions to exchange opinions or do other activities. Screen sharing allows users to give presentations, and students can learn from their peers. Also, students can answer questions by unmuting their microphones or sending messages on the chat box. Some learning content that heavily depends on practices should be taught on-site to enable actual practices, but they can integrate online learning into it.

After the operational definition was thoroughly coined, an item pool of 25 questions was generated from the relevant literature aligning with the operational definition. The OLS was developed using the 4-point Likert-type scale (never, rarely, sometimes, and often). This was adapted from *Frequency – five points* (never, rarely, sometimes, often, and always) in Likert-type scale response anchors of Vagias (2006), but the highest response (always) was eliminated because each content in OLS cannot always be performed in the classroom, it must be combinedly used according to learning activity, subject, or topic. The OLS items were analyzed for content validity by experts, and a pilot study with a sample consisting of 61 students was conducted to test its psychometric properties regarding reliability and the discrimination index before putting it into actual samples.

The analysis results of the psychometric properties in the pilot study revealed that Item 8 (*learners spend most of their time watching lectures in online learning*), a reverse-scale item, had a lower discrimination index of less than .30. Therefore, it had to be omitted before the scale was implemented with actual samples. The omission would not affect the measurement content because the content representation of this item was displayed in other items remaining in the OLS. In summary, there were 24 items of OLS in total, as shown in the appendices.

Data collection and data analysis

The OLS data was gathered using Google Forms. The link of OLS was sent electronically to multiple universities, determined by the types of universities and study fields (majors) mentioned in the sample section. The Institutional Review Board (IRB) approval of the ethical code of the research instrument was SWUEC 279/64s based on the Declaration of Helsinki, the Belmont Report and CIOMS guidelines. To analyze the OLS's psychometric properties, the items were analyzed in terms of the internal consistency reliability using Cronbach's alpha coefficient based on the CTT, test information, the expected a posteriori (EAP) reliability, the discrimination index, and the discrimination parameter (*a*) and difficulty parameter (*b*) based on the IRT.

The validity of the instrument was presented in three types as follows. The first type was content validity, in which relevance and representation between the items and objective to be measured, which were core components of content validity of the measurement, currently recognized as evidence based on test content (AERA et al., 2014), evaluated by eight experts. The second type was construct validity, currently known as evidence based on internal structure. Exploratory factor analysis and confirmatory factor analysis were employed. Lastly, criterion-related validity, currently known as evidence based on relations to other variables (AERA et al., 2014), was analyzed by correlation coefficient with other variables. The four variables were adapted from existing scales, including student-teacher engagement scale of Klincumhom (2013) (11 items, $r = .80 - .90$), online learning characteristics scale of North Carolina Community College System (n.d.) and Penn State University (n.d.) (12 items, $r = .95$) (*reliability was analyzed in this study because the original value was not provided*), self-directed learning scale of Yang et al. (2020) (5 items, $r = .96$), and self-assessment scale of Yan (2018) (10 items, $r = .79 - .90$). The four scales were sent to the sample together with the OLS. These four scales are provided in the appendix.

To estimate the effectiveness of the cut score, the Chi-square test was employed to test differences between students according to the cut scores, university types and majors, and online learning outcomes, using ANOVA to test differences between students and the psychological variables of online learning. The software for data analysis was R with multiple packages. First, the *psych* package (Revelle, 2024) was used to analyze Cronbach's alpha coefficient and the discrimination index in the CTT. Second, the *mirt* package (Chalmers, 2023) was used to analyze the psychometric properties based on the IRT. Third, the *lavaan* package (Rosseel et al., 2023) was used to analyze factor analysis.

Result

Validation of OLS psychometric properties

Evidence based on test content

To investigate the content validity of the OLS, eight experts were consulted to assess the relevance and representation between OLS items and the operational definition. These experts were selected from various academic fields, including

health sciences, sciences and technology, humanities, social sciences, and instructional media and technology specialists. Additionally, all of them had prior experience in online teaching. To evaluate the items, the eight experts assigned three points to items they found to be relevant and well-represented, two points to items where they were uncertain about their relevance and representation, and one point to items lacking relevance and representation.

Subsequently, the researchers collected the experts' ratings and calculated the average score by dividing the total points earned by the number of experts. Items with scores exceeding 2.5 were considered to exhibit relevance and representation. Following this assessment, the researcher made necessary improvements and adjustments to the items based on the feedback provided by the experts before implementing the OLS. The scores from eight experts were between 2.50 – 3.00, which indicated that the items were relevant and represented the quality of online learning. Evidence based on internal structure

Evidence based on internal structure was analyzed using exploratory factor analysis (EFA) to investigate the number of factors of the OLS and confirmatory factor analysis (CFA) to confirm the EFA result. To ensure the measurement quality, apart from designing random sampling to cover the student population, the researchers inspected the discrimination index of the OLS using corrected item-total correlation to ensure diversity of the samples' responses under the criterion of at least .30 (Ferketich, 1991). The analysis revealed that all 24 items in OLS obtained discrimination index values from .62 to .79, as illustrated in Table 2. Additionally, the internal consistency reliability of the OLS was analyzed using Cronbach's alpha coefficient to consider eliminating some items in the complete scale under the criterion of at least .70 (George & Mallery, 2003, as cited in Gliem & Gliem, 2003). It was discovered that the OLS obtained a reliability value of .96.

The results of EFA showed that the OLS possessed one factor, determined by the high factor loading value loaded in factor 1, as shown in Table 2. Later, to confirm one trait of OLS, the results of CFA revealed that the Chi-Square value was 1274.71 ($df = 247$), and the p-value was .000, reflecting the misfit between the model and the empirical data. Nevertheless, because of the sensitivity to a large sample size of the Chi-square test, other fit indicators were taken into consideration (Weston & Gore, 2006). It was discovered that the CFI value was .953, which exceeded the basic criterion of .90. The GFI was .922, which exceeded the criterion of .90. The AGFI value was .905, which was again over .90. The RMSEA value was .053, which was lower than .06. The RMR value was .02 which was lower than .05. This supported the conclusion that the model fit with the empirical data. The CFA showed that the factor loading values of all 24 items were positive, ranging from .614 to .788, with a statistical significance of .05 in all items, as shown in Table 2 and Figure 1.

The analysis of the psychometric properties of the measurement based on the IRT consists of the analysis of the threshold (difficulty) parameter, the discrimination parameter, test information, item information, and the Expected a Posteriori (EAP) reliability. To elaborate, the threshold parameter refers to the difficulty of the cut score in each score range of the items. There were four score ranges in the OLS; therefore, there were three thresholds (b_1, b_2, b_3). The threshold parameter values should be in order (monotonicity) and should be in the range of -3.0 to 3.0, whereas the discrimination parameter value (a) should be at least 0.65 (Baker, 2001; Bichi & Talib, 2018). These were the criteria used to qualify the items.

To analyze model fit, the Partial Credit Model (PCM) and the Graded Response Model (GRM) were analyzed based on the AIC, BIC, log2 likelihood, whose value was supposed to be lower, and the Chi-Square test. If the p-value had a statistical significance, it meant GRM had a better fit than PCM. The analysis results revealed that AIC, BIC, and log2 likelihood values of GRM (AIC = 60222.76, BIC = 60730.17, and log2 likelihood = -30015.38) were lower than those in PCM (AIC = 61766.34, BIC = 62152.18, and log2 likelihood = -30810.17), while the p-value had a statistical significance (p-value < .000), meaning the GRM showed a higher level of fit than that in PCM. For this reason, GRM was adopted to analyze the psychometric properties of the OLS, as shown in Table 2.

The analysis results of the threshold parameter and the discrimination parameter of the OLS revealed that the threshold parameter values ranged from -2.595 to 1.533. It was discovered that all items exceeded the basic criterion scores of -3.0 to 3.0 and followed the threshold arrangement (as shown in the item characteristic curve in Figure 2). The discrimination parameter values ranged from 1.752 to 3.107, which exceeded the criteria. The analysis of the item information revealed that all items were distributed according to different abilities (θ). Some items indicated a high level of item information, such as Items 1, 6, 8, 20, and 22, as shown in the item information function in Figure 2.

The analysis of the test information function of the OLS demonstrated that the highest information values in the ability (θ) range of -3.0 to 1.5, meaning the measurement was suitable for estimating all ranges from low to high ranges of online learning quality (θ) from -4 to 3 and the standard errors were in the same ranges. After considering the lower standard errors (SE) (red dashes) and the peaks, we could divide students into three groups. The analysis of the EAP reliability showed that the value was .95, which was extremely high. EAP is comparable to reliability in the CTT, which uses the same interpretation methods (Adams, 2005). The test information function and the reliability graph based on the IRT of the OLS are shown in Figure 3.

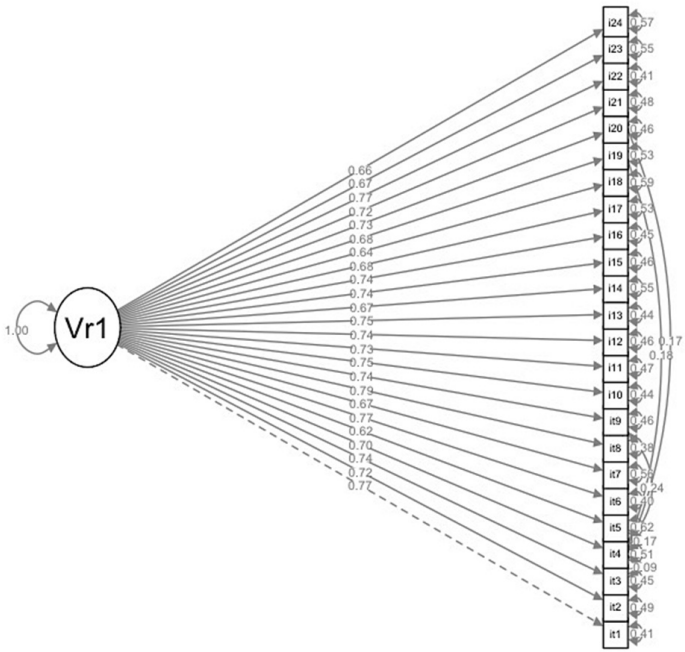


Figure 1. The result of the confirmatory factor analysis of the OLS measurement.

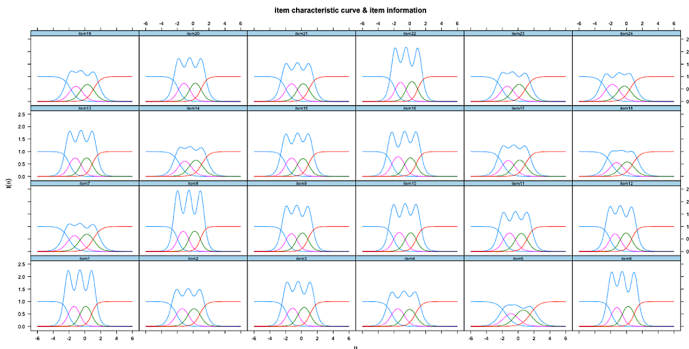


Figure 2. The item characteristic curve and the item information function of the OLS.

Table 2. The summary of psychometric properties' validation of the Online Learning Scale (OLS).

Item	Discrimination Index	EFA		CFA				IRT					
		Factor 1	Factor 2	Uniqueness	b	SE	Factor Loading	Wald	R ²	a	b ₁	b ₂	b ₃
1	.77	.771		.379	1.000		.770	.594	.2979	-2.098	-.627	.832	
2	.72	.717		.486	.975	.033	.718	29.321*	.515	2.403	-2.121	-.637	.847
3	.75	.750		.343	1.006	.033	.744	30.558*	.553	2.640	-1.838	-.422	1.089
4	.70	.703	.357	.378	.949	.033	.700	28.438*	.490	2.315	-2.291	-.759	.696
5	.62	.621	-.328	.442	.930	.038	.617	24.617*	.381	1.752	-1.546	-.256	1.533
6	.77	.770		.405	1.024	.032	.773	32.077*	.598	2.929	-1.887	-.536	.973
7	.67	.665		.556	.925	.034	.666	26.845*	.443	2.050	-2.039	-.585	1.069
8	.79	.785		.383	1.029	.031	.787	32.802*	.620	3.107	-1.987	-.549	.909
9	.75	.751		.340	1.019	.034	.738	30.317*	.545	2.663	-1.934	-.599	.822
10	.75	.747		.432	1.011	.033	.747	30.731*	.557	2.719	-2.058	-.597	.804
11	.73	.732		.411	1.004	.034	.731	29.980*	.534	2.474	-1.862	-.344	1.125
12	.73	.736		.412	.998	.033	.735	30.182*	.540	2.648	-2.093	-.766	.663
13	.74	.744		.445	1.017	.033	.746	30.732*	.557	2.665	-1.940	-.501	.934
14	.67	.674		.519	1.001	.037	.674	27.233*	.454	2.098	-1.722	-.382	1.093
15	.74	.735		.446	1.016	.034	.738	30.328*	.545	2.582	-1.994	-.512	.888
16	.74	.739		.424	.968	.032	.739	30.356*	.546	2.651	-2.289	-.669	.796
17	.69	.688		.477	.993	.036	.685	27.756*	.469	2.164	-1.938	-.540	.906
18	.65	.647		.512	.987	.038	.644	25.850*	.415	1.940	-1.892	-.606	.778
19	.69	.689		.467	.993	.036	.684	27.714*	.468	2.142	-1.780	-.466	1.089
20	.74	.740		.416	1.014	.034	.734	30.117*	.539	2.594	-1.864	-.446	.994
21	.72	.724		.427	.996	.034	.719	29.360*	.516	2.433	-1.970	-.517	.941
22	.77	.768		.394	1.029	.032	.769	31.835*	.591	2.908	-1.857	-.478	1.002
23	.67	.667		.536	.942	.035	.670	27.056*	.449	2.100	-2.047	-.683	.915
24	.65	.658		.475	.893	.034	.655	26.367*	.429	2.068	-2.595	-.972	.435

Note: * means p-value < .05, ** means p-value < .01, *** means p-value < .001.

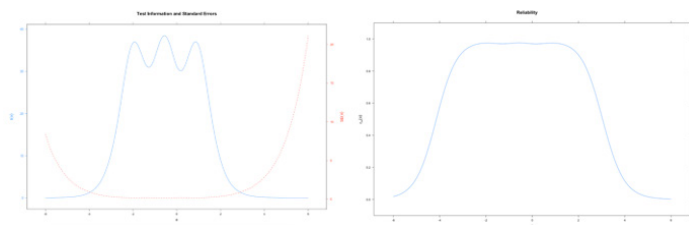


Figure 3. The test information function (left) and the EAP reliability graph (right) of the OLS.

Evidence based on relations to other variables

Evidence based on relations to other variables was established by calculating correlation coefficients between OLS scores and four distinct variables scores: student-teacher engagement (STE), online learning characteristics (OLC), self-directed learning (SDL), and self-assessment (SA). This analysis aimed to demonstrate convergent validity, also known as validity based on relations to other variables. Convergent validity suggests that the developed scale should exhibit a moderate correlation coefficient with these other relevant variables (AERA et al., 2014).

The analysis utilized the Pearson correlation coefficient to examine the relationships between OLS and the abovementioned five variables. The results indicated a statistically significant moderate positive correlation at a significance level of .01. Specifically, OLS demonstrated correlation coefficients of .656 with online learning assessment, .621 with student-teacher engagement, .650 with online learning characteristics, .625 with self-directed learning, and .603 with self-assessment. These findings are summarized in Table 3.

Table 3. The correlation coefficients between OLS scores and five variables.

Variables	OLS	OLA	STE	OLC	SDL	SA
OLS	1.000					
OLA	0.656**	1.000				
STE	0.621**	0.606**	1.000			
OLC	0.581**	0.650**	0.543**	1.000		
SDL	0.544**	0.625**	0.519**	0.918**	1.000	
SA	0.585**	0.672**	0.560**	0.920**	0.884**	1.000

Note: * means p-value < .05, ** means p-value < .01, *** means p-value < .001.

Cut score's estimation

A sum score of the students' responses was collected to estimate the information distribution and the result showed that the sum score of the OLS ranged between 0 and 72, with a mean score of 44.019 (SD = 14.019) and a median of 46 points. The graph showing the distribution of the sum score of the OLS measurement is shown in Figure 4.

The estimation of a cut score relied on the analysis of the OLS information by looking for the lowest point of information after peaking in the information curve that is also the highest in the ability (θ) from -4 to 4. According to Figure 3, the measurement precision was high during the ability (θ) range of -4 to 3, and there were three peaks in the test information function. The two lowest points in between the three peaks were analyzed. They showed that the information graph hit the lowest at the ability (θ) level of -1.3 and 0.2, with the information values of 30.96 and 30.09,

respectively. The sum score of students' responses in the OLS reflecting the online learning quality at the locations 1.3 and 0.2, not exceeding ± 0.03 , showed that the mean scores of the responses were 22.92 and 48.24, respectively. Thus, the numbers were rounded to determine the cut scores of 23 and 48, respectively. Therefore, there were three levels of interpretation, including learners who needed assistance while learning online (0-22 points), learners receiving standard online learning quality (23-47 points), and learners receiving effective online learning quality (48 points or more). The test information function that estimates the cut scores is shown in Figure 5.

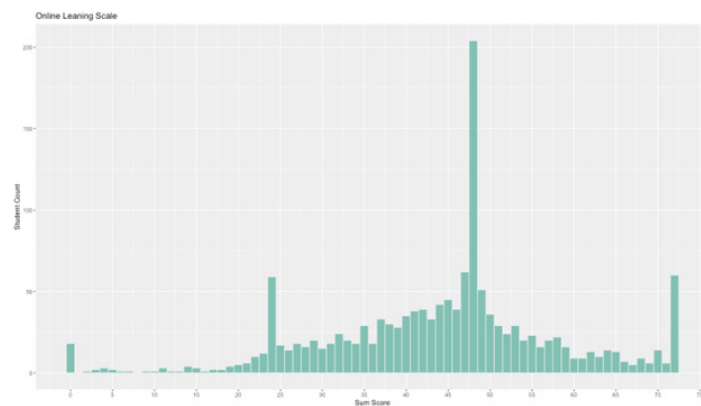


Figure 4. Sum score of the OLS measurement.

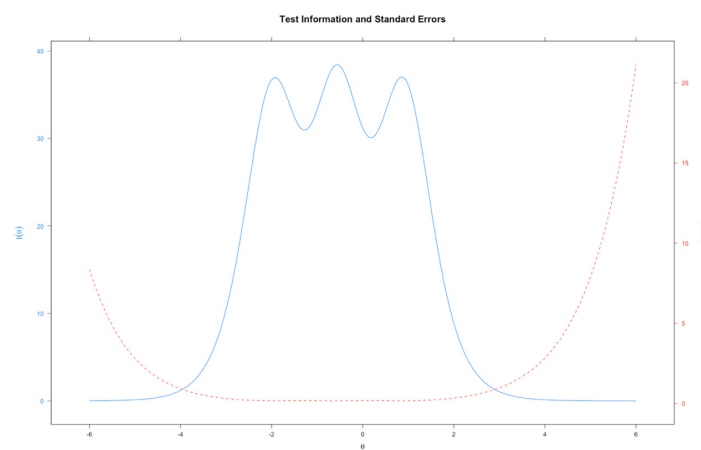


Figure 5. The estimation of the cut scores in the information graph.

Investigation of cut score's effectiveness

After the cut scores were determined, the effectiveness of the cut scores was investigated by dividing students' responses into three groups according to the estimated cut scores and analyzing their basic statistics. It was discovered that Group 1 consisted of 72 people ($M = 11.514$, $SD = 8.711$), while Group 2 was made up of 722 people ($M = 37.057$, $SD = 7.537$), and Group 3 had 665 people ($M = 55.295$, $SD = 8.195$), as shown in Figure 6.

After dividing the responses into three groups, differences in the dependent variables between the samples were based on university types, majors, and the outcomes of online learning responses in each learning outcome. These included the perception of online learning outcomes compared to in-

class learning, cognitive, performance, and affective aspects, using the Chi-square test to analyze this portion. The sums of students varied because the answer "Other" from some respondents was omitted from each learning outcome. The Chi-square test results of the three groups of students divided according to universities and majors revealed no difference in the university types. However, there was a difference in majors, as shown in Table 4 and Table 5.

Table 4. The analysis of the Chi-square test classified by universities.

Group	Universities					total
	Public university	Rajamangala University of Technology	Rajabhat universities	private universities	community colleges	
1	51 (5.0%)	10 (4.8%)	5 (3.1%)	4 (11.4%)	1 (5.9%)	71 (4.9%)
2	519 (50.4%)	103 (49.0%)	77 (47.5%)	13 (37.1%)	7 (41.2%)	719 (49.5%)
3	459 (44.6%)	97 (46.2%)	80 (49.4%)	18 (51.4%)	9 (52.9%)	663 (45.6%)
total	1029 (100%)	210 (100%)	162 (100%)	35 (100%)	17 (100%)	1453 (100%)
Pearson Chi-square = 7.035, Cramer's V = 0.049, p-value = 0.533						

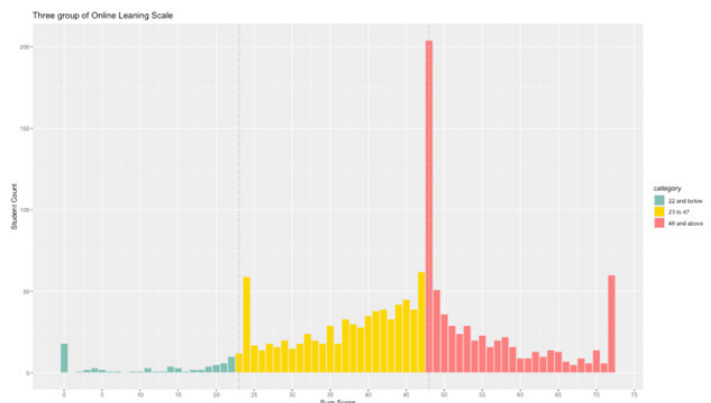


Figure 6. Basic statistics of online learning quality of three groups.

Table 5. The analysis of the Chi-square test classified by majors.

Group	Majors				total
	health sciences	sciences and technology	humanities	social sciences	
1	2 (2.7%)	5 (5.2%)	38 (6.7%)	27 (3.6%)	72 (4.9%)
2	22 (30.1%)	43 (44.3%)	296 (52.4%)	360 (49.8%)	721 (49.5%)
3	49 (67.1%)	49 (50.5%)	231 (40.9%)	336 (46.5%)	665 (45.6%)
total	73 (100%)	97 (100%)	565 (100%)	723 (100%)	1458 (100%)
Pearson Chi-square = 24.328, Cramer's V = 0.091, p-value < .001					

The Chi-square test was used with students' responses, in which the perception of online learning outcomes in comparison to those of in-class learning was categorized into "better," "worse," and "not changed." The cognitive, performance, and affective aspects could be divided into "more," "less," and "not changed." The result showed that all three groups of students showed differences in all aspects with a statistical significance of .05, as shown in Table 6.

The effectiveness of the cut scores was also analyzed using one-way ANOVA with the four variables in psychometric properties, including student-teacher engagement, online learning characteristics, self-directed learning, and self-assessment. The adopted data was the mean score of all four variables with a score range between 0-3 points. The result revealed that the variance of three groups of students varied in all variables, with a statistical significance of .001, as shown in Table 7.

Table 6. The analysis of the Chi-square test classified by learning outcomes.

Learning Outcomes					
	Group	better	not changed	worse	Total
Learning outcomes received from online classroom compares to traditional classroom	1	13 (4.0%)	19 (3.5%)	40 (7.1%)	72 (5.0%)
	2	149 (46.0%)	280 (51.0%)	280 (49.6%)	709 (49.3%)
	3	162 (50.0%)	250 (45.5%)	245 (43.4%)	657 (45.7%)
	total	324 (100%)	549 (100%)	565 (100%)	1438 (100%)
	Pearson Chi-Square = 11.150, Cramer's V = 0.062, p-value = .025				
Cognitive aspect outcomes received from online learning	Group	more	not changed	less	Total
	1	8 (3.9%)	11 (2.3%)	52 (6.9%)	71 (5.0%)
	2	85 (41.1%)	222 (46.9%)	401 (53.3%)	708 (49.4%)
	3	114 (55.1%)	240 (50.7%)	299 (39.8%)	653 (45.6%)
	total	207 (100%)	473 (100%)	752 (100%)	1432 (100%)
Pearson Chi-Square = 11.150, Cramer's V = 0.062, p-value < .001					
Performance aspect outcomes received from online learning	Group	more	not changed	less	Total
	1	8 (3.2%)	15 (3.4%)	49 (6.5%)	71 (5.0%)
	2	114 (45.2%)	198 (45.0%)	402 (53.1%)	708 (49.3%)
	3	130 (51.6%)	227 (51.6%)	306 (40.4%)	653 (45.8%)
	total	252 (100%)	440 (100%)	757 (100%)	1432 (100%)
Pearson Chi-Square = 21.804, Cramer's V = 0.087, p-value < .001					
Affective aspect outcomes received from online learning	Group	more	not changed	less	Total
	1	7 (2.6%)	32 (4.7%)	33 (6.5%)	72 (4.9%)
	2	108 (40.3%)	327 (48.3%)	284 (55.7%)	719 (49.4%)
	3	153 (57.1%)	318 (47.0%)	193 (37.8%)	664 (45.6%)
	total	268 (100%)	677 (100%)	510 (100%)	1455 (100%)
Pearson Chi-Square = 28.903, Cramer's V = 0.100, p-value < .001					

Table 7. The results of ANOVA analysis with four psychological variables.

Variables	ANOVA				Levene's test			
	F	dfl	dff	p	F	dfl	dff	p
1. Student-teacher engagement	185.902***	2	187.679	<.001	10.900	2	1456	<.001
2. Online learning characteristics	183.981***	2	186.799	<.001	18.169	2	1456	<.001
3. Self-directed learning	151.842***	2	187.091	<.001	20.585	2	1456	<.001
4. Self-assessment	169.273***	2	185.960	<.001	29.616	2	1456	<.001

Note: * means p-value < .05, ** means p-value < .01, *** means p-value < .001.

The analysis of the post hoc test was used to compare each group based on the variables, using the Games-Howell post hoc test because each variable had a diverse level of fluctuation. It was obvious in Levene's test with the statistical significance. The result demonstrated that Group 1 differed from Groups 2 and 3 with a statistical significance of .001, and Group 2 differed from Group 3 with a statistical significance of .001 in all variables. The analysis result of the post-hoc test is shown in Table 8.

Table 8. The result of post hoc test.

Post hoc test					
Student-teacher engagement	Group		Group		
	1	2	1	2	3
1 mean difference	-	0.853 (p < .001)	1.312 (p < .001)		
2 mean difference	-		0.458 (p < .001)		
3 mean difference	-				
Online learning characteristics	Group		Group		
	1	2	1	2	3
1 mean difference	-	0.653 (p < .001)	1.137 (p < .001)		
2 mean difference	-		0.484 (p < .001)		
3 mean difference	-				
Self-directed learning	Group		Group		
	1	2	1	2	3
1 mean difference	-	0.611 (p < .001)	1.081 (p < .001)		
2 mean difference	-		0.470 (p < .001)		
3 mean difference	-				
Self-assessment	Group		Group		
	1	2	1	2	3
1 mean difference	-	0.689 (p < .001)	1.131 (p < .001)		
2 mean difference	-		0.442 (p < .001)		
3 mean difference	-				

Discussion

The analysis results of OLS validation revealed agreement between CTT and IRT in the case of the low discrimination index below .3 of the items in the initial scale developed before the pilot study. This reflected that both theories provided an alignment of analysis results. However, in the current study, IRT provided more information about

scale development than the use of CTT, meaning that the researchers could analyze the difficulty parameter of each threshold, and the information ensured the monotonicity of the difficulty parameter of each item. This further supports the quality of the OLS. Also, the IRT offered the highest level of information on the students' abilities of each item. The information function could be further utilized to analyze the appropriate cut scores for the respondent-centered method. Therefore, although the results of the psychometric properties analysis based on both theories went in the same direction, the scale developed based on the IRT could offer more beneficial information if the basic requirements of the IRT were met.

The EFA and CFA analysis results were consistent, reflecting internal validity and featuring crucial components of online learning instruction. The researchers also found that the discrimination index and CFA's factor loading were highly related. The five items with the most standard component weights (β) were Item 8 stating that learners participated in thought-provoking activities, giving rise to learning and skill development ($\beta = .787, SE = .031$), followed by Item 6 stating that learners analyzed problems and contributing factors of a specified incident ($\beta = .773, SE = .032$), Item 1 stating that teachers integrated existing knowledge into a new lesson ($\beta = .770, SE = .032$), Item 22 stating that learners reflected important knowledge gained from lessons ($\beta = .769, SE = .032$), and Item 10 stating that learners were given distinct responsibilities in group works, projects, and research studies in online learning ($\beta = .747, SE = .033$), respectively. Of all five items, it is apparent that the results corresponded to other studies related to online learner-centered learning because, in four out of the five mentioned items, learners played a major role in self-learning via learning activities, problem-solving, self-assessment, and self-monitoring learning.

The analysis results of the cut scores determined based on the peaks on the test information curve revealed that there were three peaks that could be used to divide the respondents into three groups, including learners who needed assistance while learning online (0-22 points), learners receiving online standard learning (23-47 points), and learners receiving effective online learning (48 points or more). To divide the respondents into the mentioned groups, the effectiveness of the cut scores was analyzed using the Chi-square test and ANOVA with learning-related variables to ensure the effectiveness of the cut scores, discovering that majors were quality variables of online learning instruction that showed differences with the statistical significance of .05. The analysis results demonstrated that students in health sciences and sciences and technology belonged to Group 3, while those in humanities and social sciences could be categorized in Group 2, which corresponded to learning instruction characteristics and availability of technology. In other words, students in sciences and technology were technologically ready due to the Thai university learning context, based on observations and inquiring university officials. It was found that there had been blended learning, which integrated online learning even before the arrival of COVID-19 in sciences as well as sciences and technology. Additionally, most students in both majors are self-directed. Because most students went to tutorial schools before

entering universities, they were accustomed to analyzing their strengths and weaknesses, selecting their learning styles, and self-assessment. According to the study by Disponsant (2022) and Wonglertwisawakorn et al. (2019), most subjects that students studied in tutorial schools for university admission were Physics, Chemistry, Biology, Math, and English, and 84.4% of them studied sciences. On the contrary, humanities and social sciences students might be unfamiliar with the mentioned learning styles. Therefore, they needed time to adapt and monitor their learning online.

The analysis results of the effectiveness of the cut scores using the Chi-square test with variables concerning self-study outcomes in the cognitive, psychomotor, and affective domains. The comparison with the traditional learning revealed that Group 3 students obtained a higher cognitive level along with the other areas with a statistical significance of .05. This reflected that the measurement was effective in setting Group 3 apart from Group 1 and 2, which were in line with the effectiveness of the cut scores using ANOVA with student-teacher engagement, online learning characteristics, self-directed learning, and self-assessment. It was discovered that respondents from each group perceived different outcomes in each variable with a statistical significance of .001, and the outcomes were arranged from low to high according to the nature of the group. Group 1 had lower outcomes than Group 2, and Group 2 had lower outcomes than Group 3, reflecting the effectiveness of the cut scores using the test information function. This is supporting evidence that the cut scores could be used to divide the online learning qualities.

It is suggested that the validation of the scale's quality and the estimation of cut scores reflect that the OLS contains appropriate psychometric properties supported by the two theories. Furthermore, the division of online learning quality into three groups could divide students effectively. University teachers could adopt the OLS with their students to explore areas in online learning that students need assistance with. It was found that 5% of the students, as could be seen from the total of Group 1 students in each variable, as shown in Table 4. Teachers could also assess their own online instruction quality from the items in the scale. Moreover, the researchers found the significance of conducting an in-depth study of Group 1 students, 3-5% of the total, in order to study concerns and problems that happened during online learning. Identifying the Group 1 students could help them learn better in an online environment (Mulrooney & Kelly, 2020). The educational institute should also oversee and assist teachers whose classes contain Group 1 students.

Conclusions and recommendations

In this study, the researchers aimed to validate OLS for undergraduate students and to estimate the OLS's cut score to distinguish online learning quality for blended and online learning in higher education. The data to validate OLS are from the responses of 1,459 undergraduate students. The OLS, a 4-point Likert scale, consists of 24 items and one trait. The OLS is validated by analyzing the psychometric properties based on the IRT approach, as well as evidence based on test content (experts), internal structure (EFA and

CFA), and relations to other variables (correlation). The estimation of cut scores is based on test information, which is divided students into three categories. The estimated cut scores are validated by the Chi-square test of online learning outcomes and variables related to online learning, including student-teacher engagement, online learning characteristics, self-directed learning, and self-assessment.

Regarding policy implementation, the researchers recommend that the results of the Chi-square test that investigates differences among the three groups of students, based on the types of universities and majors, illustrate that more differences were discovered in the type of majors than the type of universities. Hence, assistance should focus on majors that require more assistance, such as humanities and social sciences, rather than health, science, and technology. To promote effective online learning in Thai universities, the effort should not only focus on the teaching approach but also on infrastructures to support online learning environments, such as IT devices, high-speed Internet access, and digital literacy (Mulrooney & Kelly, 2020; Lawthong et al., 2024).

For OLS applications, users should not use this scale to judge online course quality; instead, OLS should be used to acquire information to find areas for improvement and enhance the quality of online learning. In other words, OLS should be used for formative, not summative, purposes. Other evidence should be included to determine the design of effective online learning for higher education instructors. The strength point of OLS is that instructors can receive feedback on their teaching from student perspectives who respond to this scale, not from the instructor's own perceptions.

Future studies should focus on students' actual online learning outcomes because the current study estimates learning outcomes from students' self-perception by perceived scales. Moreover, all 24 items in the OLS have high reliability; therefore, the OLS has the potential to be developed into a short form. Also, accuracy and consistency indices should be investigated (Wyse & Hao, 2012) to study the effectiveness of the OLS's cut scores.

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Appendices

Appendix A. The Online Learning Scale (OLS).

Online Learning Scale's Items	N	R	S	O
1) Teachers integrated existing knowledge into a new lesson.				
2) Learners studied additional video clips, lessons, and exercises.				
3) Teachers made an interesting introduction into the lesson by using applications or discussion questions.				
4) Learners searched for additional knowledge both online and offline to do group works, projects, or research.				
5) Learners studied from guest speakers who were experts in different fields.				
6) Learners analyzed problems and contributing factors of a specified incident.				
7) Learners studied online, on site, and outside the class time.				
8) Learners participated in thought-provoking activities, giving rise to learning and skill development				
9) Learners participated in group works, projects, and research in the stages of planning, implementation, making an outcome summary, and online self-directed study.				
10) Learners were given distinct responsibilities in group works, projects, and research studies in online learning.				
11) Online activities enhanced students' knowledge.				
12) Learners and peers collaboratively studied online.				
13) Learners had a chance to exchange opinions and discuss with friends, both online and offline.				
14) Learners were assigned group works on Breakout Rooms.				
15) Learners talked and exchanged opinions with teachers during online classes.				
16) Learners were allowed to inquire or answer students' questions using several functions such as using the "unmute" feature or the chat box.				
17) Learners produced multimedia to present assigned tasks.				
18) Learners presented their works by screen sharing.				
19) Learners presented group works/ projects/ research to the public via various online channels.				
20) Teachers supported and facilitated group works, projects, and research through online learning.				
21) Teachers allocated time for students' consultations and answering students' questions outside the normal class time.				
22) Learners reflected important knowledge gained from lessons.				
23) Learners studied both online and offline.				
24) Teachers clearly informed students about submission platforms such as e-mail, Line, blogs, and more, and deadlines.				

Note: N = Never, R = Rarely, S = Sometimes, and O = Often

Appendix B. The summary of university types and study fields.

Type of University	Field of study					Total
	health science	science and technology	humanity	social science	other	
public university	63	58	558	350	0	1,029
Rajamangala university of technology	0	17	2	191	0	210
Rajabhat university	0	14	3	145	0	162
private university	0	6	0	29	0	35
community university	8	2	0	7	0	17
others	2	0	2	1	1	6
Total	73	97	565	723	1	1,459

Appendix C. Four scales used in correlation analysis with other variables.

Scale	SD	D	A	SA
Teacher-Student Engagement Scale				
1) Teachers relentlessly attempted to tackle any obstacle students faced in online learning				
2) Teachers were enthusiastic to teach online.				
3) Teachers dedicated themselves to online teaching.				
4) Teachers were always available when students needed advice.				
5) Teachers kept students informed about the objectives of each class.				
6) Teachers made interesting plans for online learning activities.				
7) Teachers designed appropriate online learning media.				
8) Teachers made the class atmosphere facilitative to online learning.				
9) Teachers controlled students' behaviors to suit online learning.				
10) Teachers were able to solve urgent problems during online learning.				
11) Teachers were able to cover all the intended content in an online class in time.				
Online Learning Characteristics Scale				
1) Learners were able to understand new knowledge in a short period of time.				
2) Learners were able to find suitable solutions for unfamiliar problems.				
3) Learners were able to study well when they involved self-study in the process.				
4) Learners preferred both self-study and studying in groups.				
5) Learners were able to discuss with strangers.				
6) Learners required minimum guidance from teachers.				
7) Online learning corresponded to students' ways of life.				
8) Learners were satisfied with different methods of online learning (such as messages, videos, podcasts, online discussions, and video conferences).				
9) Learners tended to establish goals and deadlines for their own works.				
10) Learners refused to give up or quit merely because things seemed difficult.				
11) Learners were confident that they could succeed in online learning.				
12) Learners felt joyful when studying online.				
Self-Directed Learning Scale				
1) Learners could control themselves when studying online.				
2) Learners played a significant role in online learning.				
3) Learners could study or work effectively despite disturbances.				
4) Learners constantly enjoyed studying without teachers' supervision.				
5) Writing and posting messages in online platforms helped students arrange their own thoughts.				
Self-Assessment Scale				
1) Learners enjoyed reviewing lessons and doing extra exercises even though they were proficient in the content.				
Scale				
2) Learners tended to ask themselves questions to enhance their own understanding in the lessons.				
3) Learners checked the accuracy of each task by comparing their answers with different sources.				
4) Learners asked teachers to provide feedback to develop their works.				
5) Learners asked their peers to provide feedback to develop their works.				
6) Learners could assess their own work qualities.				
7) Learners tended to recheck the accuracy of the works when they felt unsure.				
8) Learners recognized the learning methods that best suited themselves.				
9) Learners observed their own mistakes and weaknesses when doing exercises to fill the loopholes.				
10) Learners paid attention to their own self-assessment to bring about improvements in the future assessments.				

Note: SD = Strongly Disagree, D = Disagree, A = Agree, and SA = Strongly Agree. Four scales are translated from Thai to English.



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Gratitude: Humanising pedagogy in higher education

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Keywords

Gratitude;
higher education;
humanising pedagogy;
Singapore;
wellbeing.

Abstract

Psychology has largely viewed human functioning from a deficit model in the past but has since turned to a more optimistic, positive psychological lens. Gratitude is a well-researched concept associated with a broad range of psychology theories, such as Fredrickson's broaden and build theory and Algoe's find, remind, and bind theory. Research studies revealed that gratitude is one of the strongest predictors of wellbeing and is strongly linked with better psychological and subjective wellbeing. However, gratitude is rarely studied in higher education contexts, making it critical to understand if and how gratitude can impact learners' wellbeing positively, which, in turn, may lead to better performance in their studies and improvements in their overall wellbeing. This research study employs a qualitative approach, using semi-structured interviews to capture the experiences and perspectives of students and lecturers in higher education in relation to gratitude. Findings revealed that gratitude leads to positive emotions, better relationships, and prosocial behaviours. Additionally, gratitude was found to improve students' wellbeing and increase their engagement and motivation levels towards learning. To integrate gratitude into the academic curriculum, discourses surrounding gratitude must be reconsidered, and intentional learning spaces for gratitude should also be developed.

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Introduction

A happy soul is the best shield for a cruel world.
(Atticus, 2016, n. p.).

In the past, psychology has focused exclusively on weaknesses and deficits. Individuals' functioning was scrutinised from a diagnostic lens which requires healing and repairing (Csikszentmihalyi & Seligman, 2000). A bulk of psychology deals with psychological disorders and negative aspects of life, while little is known about how normal people flourish under conditions that are less hostile in some societies today (Fredrickson, 2001). According to Hale et al. (2019), it is likely that many societies around the globe are generally affluent, whose members live in relative comfort and have had their physiological and safety needs met. As such, it is expected that people today might be more interested in exploring ways to lead more fulfilling lives. Hence, psychology has shifted its focus to more positive aspects, focusing on strengths and flourishing (Csikszentmihalyi & Seligman, 2000). The notion of positive psychology is to re-examine an average individual to find out what enables them to thrive, what is going in the right direction and what improves their wellbeing (Sheldon & King, 2001). With the evolution of positive psychology into its third wave, the direction of inquiry is now heading towards navigating various groups and systems and becoming increasingly more multidisciplinary and multicultural to consider a broader range of methods (Lomas et al., 2021).

Singapore is renowned for its world-class education system (Lee & Gopinathan, 2020), although this comes at a price. Students are challenged by intense competition and the pressure to perform. A recent survey conducted in Singapore revealed that undergraduates cited work and educational commitments as causing them the most stress (Lim, 2022). This finding was supported by the alarming spike in the proportion of youths aged 18-29 with poor mental health to over 25% (Goh, 2023). Across the globe, youth suicide remains a major concern (Allen et al., 2024), being the leading cause of death amongst Singaporean youths amongst youths aged 10-29 in the years 2019 to 2021 (Samaritans of Singapore, 2022) and Australians aged 15-24 (Australian Institute of Health and Welfare, 2023).

One central assertion in Brookfield et al.'s (2024) book on teaching well is that 'teaching well' is a concept that is dynamic and always relevant. However, this concept will evolve with what practitioners find out about how students learn in changing contexts and different learning environments. Efforts to establish approaches to 'teaching well' are critical, and it is also equally vital to understand that 'teaching well' is not just about pedagogical approaches but also includes ensuring students' wellbeing. In attempts to alleviate the impact of the highly competitive education system, Singapore's Ministry of Education introduced mental health literacy and support in higher education institutions, including various mental health programmes and resources, focusing on increasing awareness, self-care, as well as early help-seeking behaviours (Rizal, 2023). Moreover, Singapore's educational policy direction is also heading towards holistic development, such as leveraging students' strengths and abilities, recognising the need for developing positive

and conducive learning climates for students and having competent, caring teachers (Lee & Gopinathan, 2020). A possible entry point to facilitate positive learning climates in higher education could be to humanise pedagogy using gratitude.

Gratitude

Academic literature discussing the concept of gratitude has repeatedly documented positive results (Lomas et al., 2021; Watkins & Bell, 2017). Emmons and McCullough (2003) posited that gratitude requires one to acknowledge the accomplishment of a desirable outcome, and this desirable outcome originates from an external source. Gratitude can be understood as an affective trait, a mood, or an emotional state (Locklear et al., 2023). It can also be defined as an emotion experienced when an individual affirms a benefit that happened to them and recognises that another individual is largely responsible for this benefit (Watkins, 2014; Watkins & McCurrach, 2017). McCullough et al. (2002) proposed the moral affect theory towards understanding gratitude as a moral emotion, where gratitude serves the functions of a moral barometer, moral reinforcer, and moral motivator. Those high in affective trait gratitude typically experience gratitude more frequently since they have a low threshold for gratitude (Watkins & Bell, 2017).

Furthermore, Emmons et al. (2003) explained that people with high gratitude dispositions should possess four facets: intensity, frequency, span, and density. Similarly, individuals with a high gratitude disposition also possess three lower-order traits. They should be high in abundance, appreciation of simple pleasures and an appreciation for others. It is also interesting to note that appreciation, a cognitive component of dispositional gratitude, permeates the three lower-order traits. According to Watkins (2014), one must first recognise the gift to experience gratitude. Subsequently, recognising the goodness of the gift, the goodness of the giver, and the gratuitousness of the gift increases the likelihood of one experiencing gratitude (Watkins, 2014). This is consistent with Emmons and Mirshra's (2011) perspective that gratitude involves people's endorsement that their desirable outcome or gift is attributed to the giver, and gratitude is typically directed towards another person or entity (Emmons & McCullough, 2003).

Positive emotions and education

Fredrickson's broaden and build theory of positive emotions (2004) suggests that positive emotions seemingly expand individuals' transient thought-action repertoires and form their long-lasting personal resources, which she applied to the understanding of gratitude. Gratitude, like other positive emotions, produces flourishing in addition to signalling flourishing. Fredrickson (2004) argued that negative emotions in traditional theories often boil down to a specific set of urges or behavioural options, which apply to life-threatening situations when swift decisions are required, whereas positive emotions broaden individuals' mindsets and build enduring personal resources (Fredrickson, 1988). In particular, gratitude propels people to engage in a wide

range of prosocial behaviours creatively (McCullough et al., 2002) instead of merely repaying the deed tit-for-tat (Fredrickson, 2004).

Algoe's (2012) find, remind, and bind theory is an extension of Fredrickson's broaden and build theory, which looks at the social functions of gratitude. Algoe (2012) suggests that gratitude aids in the maintenance of the most important relationships people have in their lives, with those they care about and rely on. According to the find, remind and bind theory, gratitude enables one to identify new aspects of their partner that they are grateful for or remind them of their partner's existing characteristics that they are grateful for, which eventually binds the two in the dyad more closely together. She mentioned that grateful people are more likely to have higher intrinsic motivation towards taking actions that would result in the enhancement of the relationship (Algoe & Haidt, 2009).

One study that explored the integration of gratitude in the class was Noland et al.'s (2017) study. However, their study focused exclusively on the effect of gratitude on happiness and not other aspects of students' wellbeing. Other researchers have explored the role of gratitude in education (Howells, 2004) and gratitude in educational philosophy (Bostad, 2021), but none has drawn direct links to examine how gratitude can be incorporated into pedagogy, with considerations of students' well-being and specifically in the higher education context. Hence, this gap lends itself to the objective of this study, which is to investigate the effect of gratitude on students' performance in higher education and explore ways in which gratitude can be used to humanise pedagogy in higher education. With this objective being the cornerstone of this study, this research study investigates the effect of gratitude on students' performance and wellbeing and explores ways for gratitude to be integrated into pedagogical approaches in higher education classrooms.

Literature review

Several studies indicate that gratitude has strong relations to all aspects of wellbeing (Bono et al., 2022; Cregg & Cheavens, 2021; Wood et al., 2010). In their meta-analysis, Wood et al. (2010) revealed that gratitude was correlated with traits associated with positive emotional functioning, lower dysfunction, and positive social relationships. Similarly, Măirean et al. (2019) found that all dimensions of trait gratitude had positive relations to the dimensions of psychological wellbeing. Gratitude has been demonstrated to enhance subjective wellbeing through grateful processing (Watkins et al., 2015). An intervention study on the effects of a positive psychology course on student wellbeing found meaningful improvements (Maybury, 2013), such as improvements in students' happiness, mindfulness, hope and positive orientations for the future. Similarly, Kardas et al. (2019) found gratitude to be the strongest predictor of wellbeing. While gratitude has been extensively researched in areas like anthropology and social psychology, the application of gratitude in education is still in its infancy stage (Howells, 2014). Nonetheless, gratitude contributes to high levels of student satisfaction amongst undergraduates and feelings of gratitude are driven by helping behaviours,

care, perceived effort and environment (Cownie, 2017). Specifically, reciprocal engagement was perceived by one student to be helpful for more engagement in the course unit since there is more feedback and help provided (Cownie, 2017). Moreover, Cownie's study (2017) also revealed that the reciprocal student-academic relationship presents an explicit and intentional attempt to avoid disappointing the helpful lecturer.

While gratitude is a natural occurrence for some teachers, others find the need to cultivate gratitude intentionally (Wilson & Foster, 2018). Wilson and Foster (2018) detailed a form of gratitude language that fits into the teaching context, inviting teachers to incorporate this language into discourses and classroom discussions such as through gratitude circles or simply by greeting each student, ideally by name and expressing gratitude for their presence. This seems analogous to the recent discourse on humanising academia through the recalibration of kindness in higher education pedagogy (Tan, 2022).

Howells (2004) brought attention to understanding gratitude in education contexts and how the practice of gratitude by both students and teachers can improve academic learning. Additionally, a randomised controlled trial found that gratitude journals resulted in higher levels of gratefulness in participants (Lai & O'Carroll, 2017). Among high school students, a new approach to gratitude intervention included a combination of psycho-education top-down technique and a bottom-up social media app that supported students' personal and social well-being, with improvements in outcomes in trait gratitude (Bono et al., 2020). Though not specifically designed for implementation in schools, school-based positive psychology interventions (PPI) have produced promising outcomes in terms of student wellbeing, academic outcome, school climate and even teacher wellbeing (Shankland & Rosset, 2017). Furthermore, gratitude interventions are most effective when both meaning and positivity are prioritised, as those who only focus on either positivity or meaning enjoy fleeting benefits (Atad & Russo-Netzer, 2022).

Generally, there are two common gratitude interventions to cultivate gratitude (Dickens, 2017), and they are having a gratitude journal and a behavioural expression of gratitude. Gratitude journals require individuals to list things for which they are grateful regularly (Wood et al., 2010), while the behavioural expression of gratitude encourages the expression of grateful feelings to others (Wood et al., 2010). The gratitude letter is the most cited behavioural expression, in which one writes gratitude letters to the person to whom they are grateful and then reads the letters to their benefactors (Seligman et al., 2005). The advantages of such interventions include low cost, time effectiveness, ease of understanding, and implementation (Dickens, 2017).

However, Wood et al. (2010) cautioned against understanding gratitude simply as being grateful to others. Instead, it should also be conceptualised as a life orientation that involves one's deliberate efforts to focus on and appreciate positive aspects of life. Otherwise, a person with high gratitude may tend to attribute their independent success to the efforts of others, as pointed out by McCullough et al. (2002). Gratitude

was least experienced in young and middle-aged adults and the most in older adults (Chopik, 2019), as gratitude may be an adaptive evolutionary mechanism that brings people together in groups (Algoe, 2012). With increased concerns about mental health issues amongst young people (Goh, 2023), it is crucial that research investigates improving the wellbeing of youths in the classroom. Since gratitude has such robust connections to wellbeing, it might be able to affect students' wellbeing positively, in turn leading to better academic performance in higher education institutions. Therefore, the current study aims to gain insight into the effects of gratitude on students' performance in higher education institutions in Singapore and how gratitude interventions can be integrated into lessons as a pedagogical approach.

Methodology

Qualitative research uses a holistic approach to understand the human experience under specific circumstances (Rahman, 2016). Since this study is interested in subjective experiences of gratitude that may influence students' wellbeing, a qualitative research method has been adopted. The advantages of qualitative data collection methods include revealing diversified truths (Fraser, 2004) and allowing theories to surface (Eyisi, 2016). This research study used purposive sampling and snowball sampling. Purposive sampling is a form of non-probability sampling where the researcher chooses participants based on specific criteria, encompassing those knowledgeable about the research topic (Rai & Thapa, 2015).

For this study, five student participants were chosen based on the criteria that they are currently enrolled in a higher education institution and taking an undergraduate course within the institution. Five lecturer participants, on the other hand, were recruited from various disciplines in a particular higher education institution. This study recruits both student and lecturer participants for the practice of inclusivity to hear from both perspectives. Since interviews for this study were conducted individually, informed consent was direct, and harm was kept minimal as participants were free to withdraw their comments, unlike participation in focus group discussions (Iphofen & Tolich, 2018). Participants were provided with a participant information sheet consisting of a summary of this study, potential benefits and harms, as well as how the collected data would be stored and used. Informed consent was obtained based on voluntary participation and the freedom to withdraw at any time.

Participants were contacted via WhatsApp texts, and interviews (see Appendices A and B) were organised and conducted through the Zoom application. Interviews allow for a comprehensive understanding of the phenomena, as well as the subjective experiences of individuals (Jain, 2021). Besides, interviews involve interactions, and the researcher can probe for unambiguous responses and look for complete answers in almost any subject matter. It also helps to deepen understanding of the phenomena being investigated and is closer to the phenomena in real life (Alshenqeeti, 2014). The identity of participants would be protected by assigning them pseudonyms such as "S1(student 1)" or "L1(lecturer

1)". Data collected are stored in a password-protected folder accessible only to the researchers. The data collected were analysed using Braun and Clarke's thematic analysis (2012), which consists of six phases. The six stages of the thematic analysis process are becoming familiar with the data, identifying and generating initial codes, searching for themes, reviewing potential themes, and defining and naming themes (Braun & Clarke, 2012). Thematic analysis is an excellent method for picking out, arranging, and providing insights into trends and deciphering the meaning inherent within the data sets (Braun & Clarke, 2012). Coupled with the flexibility and accessibility that thematic analysis affords, it is appropriate to analyse this study's interview data since knowledge of gratitude's role in higher education pedagogy is relatively scant.

Brown and Danaher (2019) emphasised the CHE (Connectivity, Humanness and Empathy) principles to facilitate semi-structured interviews in education research. The importance of connectivity was emphasised as semi-structured interviews probe participants' stories and personal experiences, which can be intrusive. Hence, it is important to ensure that participants feel valued when they share their personal experiences by the interviewers adopting a modest attitude and empathising with their experiences (Dickson-Swift et al., 2007). This will potentially facilitate the development of novel approaches to humanising pedagogy and 'teach well' through the incorporation of gratitude. Humanness (Brown & Danaher, 2019) was another principle considered, leading to the recruitment of both student and lecturer participants for the practice of inclusivity to hear from both perspectives in order to minimise power imbalance in the research-participant relationship (Drolet et al., 2023).

Findings

The findings revealed that appreciation was an important part of gratitude's definition for most of the participants, although appreciation was slightly different across descriptions. Gratitude was associated with positive emotions and evoked prosocial behaviours that helped strengthen relationships. Culture was another recurring theme in participants' responses, suggesting its impact on gratitude. Student participants suggest that gratitude improves their wellbeing which in turn increases their motivation and engagement levels, leading to improved performance. In addition, the data revealed that lecturer participants endorsed gratitude's ability to be cultivated in the classroom and incorporated into pedagogy through altering discourses surrounding gratitude and intentionally creating space for gratitude. The next sections present the main themes of this study derived from a thematic analysis of the data (see Appendix C).

Positive emotions

Gratitude evoked positive emotions for all participants. The most commonly endorsed emotion among all participants is happiness. S4 mentioned that gratitude can "inflate the little things" and "focus on small things, preventing detrimental actions or impulsiveness in the long run", as well as "acting

as a barrier to maladaptive strategies". Furthermore, S4 added that gratitude helps one focus and expand on the small positive things. L1 mentioned warmth. S5 attributed the happiness felt to experiencing gratitude to the sense of achievement she felt. However, S2 suggested that gratitude contributes to the thankfulness of what has already been achieved. S2 also associated gratitude with having a more positive outlook on life. L5 similarly feels at peace with himself as gratitude reminds him of his achievements. S3 reported that gratitude helps her to learn to appreciate what she already has, hence feeling less stressed. She also experienced a sense of relief when she expressed gratitude as she placed importance on letting the giver know how much they had helped before it was too late.

When others express their gratitude to her, S3 verbalised feelings of fulfilment as she has done something that made someone else feel good. S3 also experiences a sense of pride due to the acknowledgement of the sufficient amount of effort invested. In addition, S5 feels more at peace. From a lecturer's perspective, L1 thought gratitude impacts students' emotional regulation.

Strengthening relationships

L1 introduced the idea of 're-membling', a concept derived from narrative therapy, which involves purposive engagement with significant people in one's past that helps shape one's present or future identity. However, S5 had more neutral inclinations of gratitude's effect on relationships. Although S5 agrees that "gratitude is part and parcel of relationship", gratitude is something that she 'won't put important emphasis on'. Furthermore, S5 is "unsure if gratitude will improve relationships but if we do not repay the favour, the relationship will worsen". S3 said that gratitude helps her to "appreciate present relationships". Likewise, S1 mentioned that gratitude helps with her relationship in the long term where she becomes closer to others. S1 further added that whether or not the benefactor is influenced by the benefit received depends on the relationship quality because "if there is a relationship, there is already rapport" and "those who know each other will feel stronger gratitude and rapport" but if the benefactor 'is a stranger then the stranger would not bother'.

Similarly, S2 pointed out that gratitude can strengthen relationships by "reminding us about the good things" of the other person since she felt that "with any relationship there are conflicts and when conflicts happen, the focus is usually on who is right or wrong" but "when you start to focus on the good of this person or what you are thankful for, then the negatives seem less important". S2 also revealed that gratitude results in mutual affirmation. S3 and S4 expressed similar sentiments as S3 felt that expressing gratitude helps her "understand how much the other person mean to me" and similarly, S4 suggested gratitude's ability to strengthen relationships since there is more appreciation and understanding for each other. S3 added that when gratitude is expressed to teachers, the student-teacher relationship improves. For L1, he thought about taking steps to let coworkers know that they are being appreciated, helps to improve his relationship with them since he was in

a managerial role and coworkers have commented that he seems to not appreciate others' efforts. However, according to S1, people express gratitude to varying degrees and hence, it is not feasible to impose one's own expectations on others.

Prosocial behaviours

Gratitude also seems to evoke prosocial behaviours. S1 mentioned she expresses feelings of gratitude to others through gifting to show appreciation and she would call people randomly to check on their wellbeing or text to show appreciation. S1 also considers the personality or love language of the other person and cited an example: "If they like to spend time with me then I will give them my time". Other behaviours cited by students are thanking people verbally, gifting and treating people to meals. L1 has the habit of recording gratitude in a gratitude journal and reaching out to people who have impacted his life. For instance, L1 talked about sending flowers to past teachers out of the blue, without any special occasions. L1 also mentioned that the expectation of gratitude when doing certain things is not helpful and he prefers not to talk about what he has done for others as "goodness should happen quietly". S5 defined gratitude as something self-sacrificial, such as time or something precious to oneself. This similarity was also observed in S2's response of the giver's choice of going the extra mile for her. Additionally, S5 said that when she experiences gratitude, she feels motivated to continue her work.

Appreciation

Appreciation was a prevalent theme across students' and lecturers' definitions of gratitude, albeit appreciation comes in different forms. For S1, L2 and L4, gratitude is about appreciation of the little things in life that are often neglected. L4 mentioned that having accommodation, good friendships, colleagues, a safe environment and basic essentials are things that people often take for granted, which S1 similarly mentioned. Analogously, L2 gives credit for the current times that individuals are situated in, the state of being alive and in a safe country with good governance like Singapore. For S3, gratitude is about appreciation for a kind deed done by another person. For S4, L1 and L4, gratitude manifests in forms of appreciation that are more intrapersonal. S4 stated that she was grateful for things she already has, and L4 mentioned the same but added that she also appreciates things that she does not have, whereas L1 stated that gratitude can also be self-appreciation. For L5 and L3, gratitude as a form of appreciation can be quite generic, as no specification of appreciation was mentioned. L3 noted that gratitude is something reciprocal or that gratitude is "two ways" where "one is the appreciation of gratitude while the other one comes from receiving kindness from someone else" while L5 mentioned that gratitude means to be appreciative of his family members and closest friends since people very easily forget and neglect people who have supported them in the past and he finds a need to be thankful and not take those people for granted. L2 mentioned that as a teacher, it is nice to be appreciated, such as when he

receives an email or word of thanks from students. L1 also finds that gratitude comes to him in words of appreciation from others, where he is able to see that people are "doing well or their lives are shifting because of the conversations we have" and also seeing that "people have appreciated and taken note of resources provided, whether they are advice or material things". L3 would explicitly express her appreciation for students' contributions and participation in class. S2 mentioned that gratitude broadens her perspective.

Students' wellbeing, engagement, and motivation in the classroom

Most of the student participants identified an improvement in wellbeing as a result of practising gratitude, which has led to higher engagement and motivation levels. Specifically, S2, S3 and S5 mentioned gratitude's association with wellbeing. S2 said that gratitude has a certain connection to students' mental wellbeing as "gratitude helps us to focus on the good parts of school" while both S3 and S5 added that gratitude helps with mental health, grades and performance. Other than academic performance, S5 thought that gratitude aids in self-improvement as well and gave the example that a more confident person would be able to express their ideas better to their friends and would be deemed more favourable in group settings. In a similar vein, S3 suggests that gratitude leads to a good social life. S3 also has better focus when she practises gratitude. S1 said that encouragement from others played a big role in increasing her motivation to learn and she is grateful that "we (classmates) are all in this together". S2 elaborated that gratitude prevents her from being too anxious so that she would not become dysfunctional. L2 mentioned that some students "are smart to engage teachers and show appreciation" and this enables them to "develop good relationships with teachers and experience a higher level of engagement so that they can learn things they really want to learn". L1 revealed that he only chooses to teach a certain module if he is able to personally connect with the module since he knows that in such modules, whatever he does can make a difference and students can at least take away practical things from classes.

From a student's perspective, S3 thought that teachers would feel more motivated to teach as their ultimate aim is to help students. Hence, they are more motivated to keep going if students express gratitude, implying that the student has had a satisfactory education experience with the teacher. S3 also feels more focused. L3 shares that the experience of gratitude increases the likelihood of students doing well as their motivation to remain in the programme increases. Gratitude boosts confidence which helps a student to write better theses and to be more efficient, according to S4. According to this student, with more confidence, a student can share opinions in class without holding back. A related input from S5 is that intrinsic motivation stemming from gratitude increases engagement as gratitude enables her to perceive that her efforts are appreciated and do not go unseen. Furthermore, S4 mentioned that teachers will be more motivated to teach in a way that is more engaging with gratitude in place. S2 hinted that gratitude helps a student be in a state of mind where they would be able to do their best and aids in long-term perseverance. S2 also

said that gratitude propels her to move forward regardless of her academic achievement, as she remains grateful for what she has already completed and looks forward to upcoming opportunities to perform instead of dwelling on the bad. Furthermore, practising gratitude reminds S2 of her purpose in life and focuses on her core values, which are truly important. L1 agreed that he has more energy when he is more engaged and when students are appreciative, they would similarly engage and be more connected to ideas and concepts taught in class.

Conscious and intentional space for gratitude

Another theme that prevailed is that gratitude is often not something that occurs naturally to many. L1 said that self-awareness was critical and precedes gratitude. L1 further added that in other countries, the training or academic prerequisite is to be engaged and vulnerable enough to ensure sufficient engagement. S2 believes that gratitude can be cultivated or obtained through practice. S1 thought that students need to know the objectives and purpose of studying, before they can determine areas to be grateful for. L1 and L3 similarly shared the idea of cultivating gratitude within oneself first; for L1, gratitude is living and practising gratitude as a lifestyle, and likewise, for L3, she sees gratitude as a mindset and a form of mindfulness, putting herself in the right mindset as that will affect the energy and relationships in class. L3 explained that she will never walk into a classroom with negative energy because "it doesn't matter what is happening in my life outside of the classroom", but when she steps into the classroom, she thought that "students come first, and they expect 100% from you" as a teacher. L3 also detailed that intonation should be intentionally adjusted to encourage students to feel welcomed, safe and comfortable. L4 mentioned that when gratitude is introduced, students enjoy gratitude and feel comforted. Additionally, L3 mentioned that she would share about herself openly before asking students to share in class to facilitate reciprocal conversations, as she felt that students would respond accordingly when they recognised her authenticity. L3 strongly believes in having kindness in the curriculum, and there is value in practising compassion in the classroom. L4 expressed concerns regarding students' willingness to share as gratitude can be quite a personal and intimate topic, hence having a safe space for students to share would be vital.

Gratitude discourses

The role of language and discourse seems to come out strongly amongst participants' responses as well. Interestingly, L2 shared that gratitude would involve appreciation if gratitude were to be related to people. L2 also mentioned that he has no elaborate language for gratitude. For L3, language plays an important role in introducing gratitude, and she also found that conversations, debates and discussions can be helpful ways to infuse gratitude into the classroom. L1 brought in ideas from narrative therapy, such as definitional ceremonies and re-membering where gratitude can be applicable. L1 shared that re-membering involves detailing what one appreciates about significant members in one's

life, while definitional ceremonies involve witness(es) and collective documentation of accomplishments or narratives. Modules on self-discovery were suggested by L1 to incorporate gratitude into the classroom, with the condition that students must be mentally present in class and with a certain level of vulnerability, as he thought that teachers could teach about gratitude, but it should begin with students' self-reflection. The idea of collaboration and reciprocity is also strongly evident. L2 shared about the Appreciative Pause technique (Brookfield & Preskill, 2016), which involves asking all students to verbalise what they appreciate about a classmate and the trick is that the lecturer is excluded. L2 also mentioned the Circle of Voices (Brookfield & Preskill, 2016), similar to the definitional ceremony and the re-membering conversations raised by L1.

Impact of culture on gratitude

All the lecturers touched on culture as a factor that might affect gratitude. L2 pointed out that Singapore has a "very materialistic culture", often "fast-paced" and "time is money". Singaporeans are also "not usually extroverted" and the fact that Trompenaars and Hampden-Turner (2011) commented that Singaporeans are oftentimes 'neutral', akin to poker players, in their emotional expressions. Analogously, L5 thought that Asians are not very expressive, and it may seem abrupt to introduce gratitude, though he recommended introducing gratitude right in the beginning during welcome orientations, and teachers can revise gratitude concepts at the onset of lectures. L1, L3 and L4 also shared similar sentiments with L2 about Singapore being competitive and specifically, L1 thought that students are "predisposed to asking what the benefit is" and that they are incentivised rather than being intrinsically motivated towards the practice of gratitude. L4 shared that students, especially international ones, struggle with financial success, and they are driven to do well in material wealth rather than in school examinations, possibly due to Singapore's status as a capitalist state. L4 further mentioned that survival is important to students, and they are very often trained to pursue financial success and material gain instead of something of interest. Additionally, L4 thought that for international students, gratitude may not be a familiar concept at first mention, and there is a need to simplify the term so that they are able to understand gratitude and "ideas start coming to them and start coming to life".

The next section discusses and summarises all the findings derived from the thematic analysis of the study.

Discussion

This study found that practising gratitude leads to experiencing positive emotions, strengthening of relationships and prosocial behaviours. Appreciation made up a huge part of gratitude. There are also promising accounts of gratitude increasing engagement in learning in higher education institutions, as well as gratitude increasing students' wellbeing. Possibilities of incorporating gratitude into higher education pedagogy and learning will also be discussed, including the effect of culture on gratitude.

The majority of the participants highlighted appreciation when asked to define gratitude. Essentially, appreciation involves reappraising the benefit, which increases its subjective value (Watkins, 2013). Gratitude is activated by a benefit (Watkins, 2013), and in order for one to experience gratitude, there are four cognitive patterns or recognition of gratitude that precede (Watkins, 2001). According to Watkins (2014), one must first recognise the gift in order to experience gratitude at all. In this study, this was demonstrated by the wide range of examples given, such as the often-neglected little things in life cited by S1, L2 and L4, which include having accommodation, good friendships, colleagues, a safe environment, and essentials. Similarly, L2 appreciates the current times which individuals are situated in, the state of being alive and in a safe country with good governance like Singapore.

The second part of recognition is recognising the goodness of the gift, though not explicitly mentioned by any participant in this study. Subsequently, the third part involves recognising the goodness of the giver, which S2 pointed out, feeling seen as the giver went the extra mile for her, implying that the gift or benefit comes at a cost. S2 also mentioned that the gift was something that the giver "didn't have to but chose to do that", which is also linked to the gratuitousness of the gift, something unnecessary. Although gratitude is typically directed towards another person or entity, like L5's appreciation of his family and close friends, gratitude is also experienced from events not directed to any giver or benefactor, such as appreciation of one's own abilities or environment that facilitates success (Wood et al., 2010). This was supported by S4 and L4's gratitude towards things they already have and L1's self-appreciation. Additionally, L3 noted that gratitude is something reciprocal or that gratitude is "two ways" where "one is the appreciation of gratitude while the other one comes from receiving kindness from someone else". Appreciation also manifests as expressions of gratitude, such as L2's receipt of email or word of thanks from students expressing their appreciation. When participants spoke about appreciation directed towards them, there seemed also to be a sense of accomplishment. For example, L1 found that gratitude comes to him as words of appreciation from others, where he is able to see that people are "doing well or their lives are shifting because of the conversations we have" and also seeing that "people have appreciated and taken note of resources provided, whether they are advice or material things". In terms of expressing appreciation, L3 explicitly acknowledges students' contributions and participation in class.

Gratitude also leads to positive emotions. All participants in this study, students, and lecturers alike, reported feeling positive emotions when gratitude is involved, and these positive emotions seem to point towards better wellbeing. S4 mentioned that gratitude can "inflate the little things" and "focus on small things, preventing detrimental actions or impulsiveness in the long run", as well as "acting as a barrier to maladaptive strategies". This suggests gratitude's potential as a buffer due to the protective effect of positive emotions (Wood et al., 2010). According to the positive affect hypothesis, as the experience of gratitude and positive emotions increases, life satisfaction increases as

well (Wood et al., 2010). S4 added that gratitude helps one focus and expand on the small positive things, conforming with Fredrickson's broaden and build theory of positive emotions (2013), which states that positive emotions expand individuals' transient thought-action repertoire. Particularly, gratitude enables an individual to consider a wide range of prosocial behaviour and activates the urge for an individual to act prosocially, possibly towards the giver or others, or both, to reflect their gratitude (Fredrickson, 2004). Fredrickson (2004) also emphasised that the aforementioned prosocial behaviours inspired by gratitude are creative. Moreover, aligned with positive emotions' ability to build enduring resources, gratitude builds and strengthens social relationships (Emmons & Shelton, 2002) and drives reciprocal altruism (Trivers, 1971), which becomes a reserve of social support in times of need. Fredrickson (2004) added that gratitude also builds individuals' skills for loving and showing appreciation. Besides, S5 attributed her happiness when experiencing gratitude to the sense of achievement she felt. Analogously, S2 related having gratitude to having a more positive outlook in life.

Participants also endorsed that gratitude strengthens their relationships. S1 reported that gratitude enhances her relationships in the long term as she becomes closer to others, while S3 said that gratitude helps her to "appreciate present relationships", which coincides with the find, remind and bind theory's tenet that care, approval and understanding are present in the responsive individual (Algoe, 2012). Gratitude builds and maintains relationships through promoting social affiliation and facilitating socially inclusive behaviours, usually towards one's benefactor, even if such behaviours are cost-bearing (Bartlett et al., 2012). This was supported by Caleon et al.'s (2017) study, which revealed that gratitude was able to increase students' relatedness with their family and peers. Additionally, S1 considers the personality or love language of the other person and cites an example: "If they like to spend time with me, then I will give them my time". A possible explanation is Algoe's find, remind, and bind theory, which argues that the responsiveness of the act of kindness to the recipient's needs and preferences predicts gratitude (Algoe et al., 2008). The personalised expression of gratitude mirrors Fredrickson's (2004) take that gratitude also builds individuals' skills for loving and showing appreciation.

Furthermore, when a relationship is perceived to be valuable, gratitude changes from an immediate exchange of a favour received to a commitment to maintain the relationship (Gordon et al., 2012). For instance, when teachers make extra effort to help students, these behaviours are perceived to be additional investments to develop mutually beneficial relationships, absent from economic exchange (Fazal-e-Hasan et al., 2021). On top of that, L1 suggested that re-memembering conversations could be useful for the introduction of gratitude into the classroom. Re-memembering helps individuals appreciate the contributions of significant others towards their lives and identify the value of one's identity that has led to such contributions, as well as the inverse (Dulwich Centre, 2019). This was true in this study since S3 felt that expressing gratitude helps her "understand how much the other person means to me" and S4 felt that gratitude strengthens relationships since there is more

appreciation and understanding for each other. In another study, final-year students found that their relationships with peers became more collaborative, as compared to previous years (Cownie, 2017). Hence, this echoes Fredrickson's (2004) argument that gratitude builds enduring social relationships. S5 thought that gratitude aids in self-improvement and thought that a more confident person would be able to express their ideas better to their friends and would be more well-liked in groups; similarly, gratitude leads to a good social life, according to S3. S1 also specified that encouragement from others played a big role in increasing her motivation to learn. These responses were consistent with Kardaş and Yalcin's (2021) study that perceived social support is correlated with wellbeing and resilience positively, due to the satisfaction of needs. It is also interesting to note that participants' responses in this study constitute fragments of the PERMA model of wellbeing (Seligman, 2018), including positive emotions, engagement, relationship and meaning, with some mentions of reminders of achievements, which suggests gratitude's positive association with wellbeing.

Gratitude also seems to enhance students' academic performance, such as the academic thinking process (Howells, 2004). L3 felt that the experience of gratitude increases the likelihood of students doing well and increases their motivation to remain in the programme. L3's response was supported by a recent study which states that cultivating gratitude was also found to increase autonomous motivation (King & Datu, 2018). Effects of practising gratitude include improving the academic thinking process and deepening the understanding of concepts, being more engaged in learning, greater motivation, a higher sense of confidence, better learning strategies and a higher sense of interconnectedness (Howells, 2004). This is consistent with the theme of engagement found in students' and teachers' responses. L2 mentioned that some students "are smart to engage teachers and show appreciation" and this enables them to "develop good relationships with teachers and experience a higher level of engagement so that they can learn things they really want to learn" and similarly, L3 expressed that the experience of gratitude increases the likelihood of students doing well as their motivation to remain in the programme increases. From a student's perspective, S5 perceived that the intrinsic motivation stemming from gratitude would increase engagement while S2 thought that gratitude propels her to move forward regardless of her academic achievement as she remains grateful for what she has already completed and looks forward to upcoming opportunities to perform instead of dwelling in the bad. This is as such because intrinsic goals aid in failure recovery and increase happiness levels (North et al., 2014).

Interestingly, the effects of gratitude, like having more motivation, were only reaped by students who engaged in high intensities of gratitude practice, such as daily engagement with a gratitude journal activity (Nawa & Yamagishi, 2021). In a similar vein, L1 propounded that self-awareness and a certain level of vulnerability and engagement need to be present before gratitude responses can occur. Gratitude increases individuals' awareness of daily events that they are grateful towards, leading to greater appreciation towards the benefits that they receive (Nawa & Yamagishi, 2021). The intentional practice of gratitude

increases students' resilience in challenging periods (Ngo, 2015). Likewise, Howells (2004) proposed the 'State of Preparedness' approach, where students are invited to assume responsibility for their learning by asking them to put forward outcomes if they were to sit through a boring lecture with dissatisfaction and complaint and contrasting that with having an attitude of gratitude. Furthermore, this approach helps students gain awareness of their innermost attitudes and the impact of such attitudes on their learning (Howells, 2004). The timeliness of introducing gratitude at the onset or in the first year of commencing higher education was highlighted by L5 and supported by Teakel et al. (2024). L1 revealed that he only chooses to teach a certain module if he is able to personally connect with the module since he knows that in such modules, whatever he does can make a difference, and students can at least take away practical things from classes. When an inner attitude of gratitude was chosen, students and supervisors were prompted to explore alternative ways of perceiving and responding (Howells et al., 2017). Moreover, in the upward spiral of lifestyle change, Fredrickson and Joiner (2018) argued that positive emotions increase individuals' awareness, which brings about flexible and innovative behavioural choices. L4 mentioned that when gratitude is introduced, students enjoy gratitude and feel comforted. Concerns regarding students' willingness to share were raised by L4 as gratitude can be quite a personal and intimate topic; hence, having a safe space for students to share would be vital. Gratitude practice, therefore, helps students and lecturers see alternative perspectives by diverting focus to the positive contributions from and towards others, as well as the possibility of students being pedagogical partners (Chng, 2019).

To cultivate gratitude in the classroom, altering discourses surrounding gratitude and intentionally creating space for gratitude seem feasible. L3 argued that language plays an important role in introducing gratitude, and based on her previous teaching experiences, conversations, debates, and discussions can be helpful ways to infuse gratitude into the classroom. L2 mentioned that he has no elaborate language for gratitude, possibly implying the ease of accessing gratitude. For L3, language plays an important role in introducing gratitude, and she also found that conversations, debates and discussions can be helpful ways to infuse gratitude into the classroom. L1 brought in ideas from narrative therapy, such as definitional ceremonies and re-membering where gratitude can be applicable. L1 shared that remembering involves detailing what one appreciates about significant members in one's life, while definitional ceremonies involve witness(es) and collective documentation of accomplishments or narratives. Algoe's find, remind, and bind theory (2012) espouses a similar tenet of gratitude being essential in the formation and maintenance of people's most important relationships. This also corresponds to the idea that gratitude is a way of recognising the other as giving suggests voluntary recognition, and returning due to gratitude suggests a form of giving that parallels the first giver's recognition (Howells, 2014).

In this context, L2 also mentioned the Circle of Voices (Brookfield & Preskill, 2016), a discussion protocol similar to the definitional ceremony and the re-membering conversations raised by L1 as all three approaches prompt

participants to actively identify others' contributions in conversations witnessed by others. Moreover, students and lecturers alike agreed on gratitude's potential to be cultivated through intentional practice. For instance, L1 and L3 similarly shared the idea of cultivating gratitude within oneself first; for L1, gratitude is living and practising gratitude as a lifestyle, and likewise, for L3, she sees gratitude as a mindset and a form of mindfulness, putting herself in the right mindset as that will affect the energy and relationships in class. Amongst participants' responses, collaboration and reciprocity are also strongly evident. L3 believes that role modelling as a lecturer helps students to start practising gratitude. She would share about herself openly before asking students to share in class as she felt that students would respond accordingly when they recognised her authenticity. L3 also intentionally creates a safe space for discussion without judgement and encourages different opinions so as to develop harmonious teacher-student relationships as L3 strongly believes in having kindness in the curriculum and that there is value to practise compassion in the classroom.

L3's belief in pedagogical kindness and being compassionate is consistent with Tan's (2022) framework for a compassionate teacher, starting with mindsight and mindfulness practice, involving a state of mind which is consciously aware of present happenings. Such a state of mind parallels the desirable prerequisites suggested by L1, like vulnerability and self-awareness, in order for students to be engaged in gratitude practice in the classroom. The humanisation of higher education pedagogy can possibly reference Rogers's (1961) conceptualisation of the therapeutic relationship, which he believes can be generalised to all human relationships, including those in the classroom. According to Rogers (1961), the development of a relationship between the teacher and the class that is characterised by unconditional positive regard, empathy and genuineness will most likely lead to self-directedness, less anxiety and more self-discipline in students.

Hence, this relationship between the teacher and the class also ameliorates the power differences between students and lecturers, though largely unmentioned (Chng, 2019). Besides, Lee et al. (2015) proposed that gratitude leads to better wellbeing as the basic psychological needs of autonomy, relatedness and competence are met (Ryan & Deci, 2001). The provision of space and platform for students' learning ventures is not unfamiliar locally, as observed in the NUS Young Educators in Science (YES) programme that provides opportunities for undergraduates to come up with educational materials to educate the public about physics and such outreach activities contributes to students' portfolios which helps to track their individualised self-designed learning (Sow, 2018) and the use of podcasts to express students' interpretation in a 'Home' module, which is shared publicly, instead of traditional written assignments (McMorran, 2018). Furthermore, as Chng (2019) discussed the possibilities of students being partners in higher education, there is mention of creating the right conditions for learning, as well as reducing barriers to learning, achieved through some level of collaboration. The collaborative element is espoused by Aspland and Fox (2022), spelling out possibilities like infusing pedagogical kindness into the

academic community of inquiry. Taken together, building a collaborative academic climate that fosters gratitude is vital and sees the potential of constructivist learning.

Gratitude practices are also influenced by culture. In Asian collectivist cultures, students seem to have internalised teachers or lecturers as authoritative figures and motivation is not clearly distinguished as controlled or autonomous (King & Datu, 2018). Singapore's culture, however, is a unique blend of collectivist and individualistic culture (Yeo & Pang, 2017). In this study, L2 pointed out that Singapore has a 'very materialistic culture', is often 'fast paced' and 'time is money'. Singaporeans are also 'not usually extroverted'. L4 expressed similar sentiments about Singapore being competitive. L1 echoed the aforementioned challenges and thought that students are 'predisposed to asking what the benefit is' and are incentivised rather than intrinsically motivated towards the practice of gratitude. L5 finds that Asians are 'not so expressive' and the introduction of gratitude may seem abrupt. Culture can, hence, be a barrier towards students' access to gratitude practice. However, L5 suggested that gratitude can be introduced at the very beginning or start of a programme or in lectures so that students would be aware of gratitude, which in turn makes it easier for the lecturer to link back to gratitude once in a while. Alluding to L3's response, L4 also acknowledged language's role in facilitating gratitude and suggested that gratitude should be broken down and simplified to account for international students' comprehension.

Conclusion

In conclusion, this study examined the potential of incorporating gratitude into pedagogy and the results from the thematic analysis showed that gratitude, in fact, leads to positive emotions and strengthening of relationships and evokes prosocial behaviours. Individuals are likely to engage in more creative ways of expressing gratitude by showing appreciation. In this study, we see gratitude as a way of humanising pedagogy and 'teaching well' by considering the wellbeing of students in the classroom and not simply metrifying the success of the class only through excellent academic results and outstanding performances. We believe that if students and lecturers display positive wellbeing, it will be very likely for the students to enjoy the learning process and produce excellent academic results.

To incorporate gratitude into the classroom, intentional space must be created for gratitude consciously, including the alteration of gratitude discourses. Based on the findings of this study, some suggestions of how lecturers can introduce and integrate the concept of gratitude into the classroom include:

- Creating a safe, collaborative, and conducive learning environment where students can express themselves freely and learn from their peers;
- Encouraging wellbeing literacy by having a discussion of what gratitude means to the individual students in the classroom;

- Having an appreciation activity where students can send one another post-it notes expressing why they appreciate that particular classmate or lecturer at the end of the module;
- Sharing and appreciating a light-hearted moment in class about their day before the lesson starts; and
- Conducting a short reflection session where students can share something they are grateful for in their lives with the lecturer.

Research studies can possibly investigate dismantling power differences and increasing sensitivity to culture so that introducing gratitude into the classroom can be more effective and seamless. The findings of this study can also be extended to create quantitative surveys to gather perspectives of stakeholders on gratitude from a larger sample.

In addition, the use of technology is not unfamiliar in wellbeing education (Rudolph et al., 2024). Technological tools have aided in the increase in youths' wellbeing and have observed success through the accessibility and allowance for creativity (Allen et al., 2024), hence being suitable for the planning and executing of engaging lessons (Lahtinen & Salmivalli, 2020). Moreover, advancements in technology have opened up the possibility of tapping into artificial intelligence to implement wellbeing education (Allen et al., 2024). It is now critical to explore how technology and AI can help integrate gratitude into classroom practices and positively impact the wellbeing of both students and educators.

It is very likely that humanising pedagogical approaches through gratitude, we can positively impact the development and wellbeing of students. It is worth remembering if we reflect upon the quote at the start of this article that the only genuine shield we have against a turbulent world is through the nurturing of a happy soul.

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The oxymoronic pursuit of pleasurable academic writing. An interview with Helen Sword.

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Jürgen Rudolph ^B	B	Director of Research & Learning Innovation, Kaplan Higher Education Academy, Singapore
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Keywords

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Abstract

Helen Sword, Professor Emeritus at the University of Auckland, New Zealand, specialises in modernist poetry and academic writing. In 2023, she was elected a Fellow of the Royal Society Te Apārangi for her ground-breaking scholarship on academic writing, which skillfully integrates theory and practice. Sword has inspired countless writers with her insightful and practical guides to becoming an accomplished and stylish academic writer, even within the constraints of academic conventions. Her notable books on academic writing include *The writer's diet* (2016a; first published in 2007), *Stylish academic writing* (2012a), *Air & light & time & space: How successful academics write* (2017), and *Writing with pleasure* (2023).

In this multifaceted interview, Sword discusses her journey to becoming an expert on academic writing, the current state of academic prose, and strategies for writing more stylishly and pleurably. She shares her unorthodox research methods, which draw upon her background in literary studies and poetry, and emphasises the importance of the behavioural, artisanal, social, and emotional dimensions of writing. Sword also addresses the challenges posed by academic conventions and the role of generative AI, such as ChatGPT.

Throughout the conversation, Sword discusses practical tips and exercises for academics seeking to enhance their writing, find their voice, and rediscover the pleasures of the craft. She encourages academic writers to experiment, take risks, and trust in their ability to communicate complex ideas with clarity and style. Sword's insights will resonate with academics across disciplines who aspire to write more engagingly, creatively, and joyfully.

Writing and teaching as a vocation

Jürgen Rudolph (JR): We feel incredibly fortunate that you have agreed to be interviewed by us. We have been reading three of your books in our bi-weekly Writing Group one chapter at a time: *Air & light & time & space. How successful academics write* (Sword, 2017), *Stylish academic writing* (Sword, 2012a), and *Writing with pleasure* (Sword, 2023). Our online community of practice meets every other Friday with members from Australia, Greece, Ireland, Singapore, Turkey and the UK.

Our heartiest congratulations on your recent election as a Fellow of the Royal Society Te Apārangi! The society described you as “a world-leading expert on academic writing across the disciplines” and “an international authority on modernist poetry”. Your “ground-breaking scholarship on academic writing has been praised by... [your] peers for its rigorous evidence base and its skilful integration of theory and practice” (Royal Society of New Zealand, 2023).

According to your Wikipedia page, you grew up in southern California. You moved east and gained an MA at Indiana University in 1986 before completing a PhD in comparative literature at Princeton University in 1991. You taught for ten years in the English department of Indiana University before moving to the University of Auckland in 2001, where you became a full professor. Could you please tell us about your school and university experiences? What made you want to be a professor? How did you become such an excellent and prolific writer?

Helen Sword (HS): I've always loved writing, ever since I was a young child. At school, I was awkward and uncoordinated at school sports but praised for my reading and writing skills, so I naturally gravitated towards what I felt competent in and was encouraged for.

I'm telling that story now because, having worked with thousands of academic and professional writers from around the world, I've met so many people whose formative experiences around writing have been very different from mine. For me, it was easy to love writing because I was told that I was good at it, and I never really questioned that judgment. But since then I've met many academics who were told in high school that they'd never be writers, or who didn't grow up in households that cherished books as my family did. They had much bigger barriers to overcome on their way to becoming successful writers than I ever did. I was very fortunate in that respect.

For me, it was easy to love writing because I was told I was good at it, and I never really questioned that judgment.

I was one of those kids who adored their teachers. So in primary school, I wanted to be a primary teacher; in high school I wanted to be a high school teacher; and by the time I got to university, I naturally wanted to become a university lecturer – so I earned my PhD in comparative literature and eventually got a job in the English Department at Indiana University. At that point I thought I'd gone as high as I could go on the teaching ladder – but then, after I moved



Figure 1. Helen Sword as a teenager in California.

to New Zealand in 2001, I started working in an academic development center, teaching the teachers. I had to laugh – being a professor wasn't enough, I had to *teach* the professors!

My “writing about writing” is an extension of all that – another form of teaching, another rung on the “teaching the teachers” ladder. The “how to write” genre is so often based on anecdote and personal experience; I wanted to give it a proper research base. But my writing on writing has been informed by several other research strands as well. As a literary scholar and poet, I was trained to close-read literary texts; so in hindsight I can see it as a natural progression that I started close-reading academic texts in much the same way. That led to me writing about academic writing across the disciplines, and from there I started researching the habits and emotions of academic writers as well as their writing style.

It's been quite a journey! Back in the 1990s, when I was going up for tenure in modernist literary studies at Indiana University, I never could have imagined that I would end up doing all the other things I've done since then – but in hindsight I can see that it all makes sense.

Writing about writing... is another form of teaching.

The sorry state of academic writing in higher education

Fadhil Ismail (FI): In *Stylish academic writing*, you note: “For many academics, ‘stylish academic writing’ is at best an oxymoron and at worst a risky business” (Sword, 2012a, p. vii). To further quote you: “There is a massive gap between what most readers consider to be good writing and what academics typically produce and publish. I'm talking about a



Figure 2. Helen Sword teaching.

deeper, duller kind of disciplinary monotony, a compulsory proclivity for discursive obscurantism and circumambulatory diction (translation: an addiction to big words and soggy syntax)." (Sword, 2012a, p. 3). You observe that most articles on higher education were "very badly written" (Sword, 2012a, p. 4), encountering "gratuitous educational jargon and serpentine syntax" (p. 5). Do you have any explanation for the sorry state of academic writing overall and in Higher Education in particular?

HS: I started writing about academic writing because of my experiences with reading higher education research. Coming from literary studies, I was so used to the jargon in my own field that I didn't really notice it. But when I moved into the field of academic development and started trawling through higher education journals in search of interesting articles on tertiary learning and teaching, I was shocked to find how many of them were virtually unreadable. If people doing higher education research were trying to communicate their research findings to colleagues in other disciplines, I asked myself, why were they writing in such an inaccessible way? And, more importantly, what could be done about it?

Higher education research is a relatively young social science discipline, which I think results in a heightened sense of insecurity. Many social scientists overcompensate for that insecurity with jargon-laden prose and convoluted, passive-voice sentences, often in a misguided attempt to sound "scientific." Humanities scholars have their own writing

quirks, of course; but in the social sciences, I've found that many academics suffer from an almost paralysing fear of not being taken seriously as researchers. When I looked at higher education writing more closely for my 2009 article "Writing higher education differently: A manifesto on style" (Sword, 2009), I found a surprising lack of consensus even on basic issues such as whether or not to use first-person pronouns in academic articles. The field still seemed to be figuring out its own stylistic conventions. (Interestingly, in a follow-up study looking at the same higher education journals a decade later, I found a remarkable shift between 2007 and 2017 toward much higher levels of first-person pronoun usage; but many scholars in the discipline persist even today in writing impersonal, passive prose (Sword, 2019)).

By the time my 2009 "manifesto on style" was published, I had already decided to broaden my writing research beyond higher education alone. I started asking academics from across the disciplines, 'What kind of writing do you value most? What does "stylish academic writing" mean to you?' (If you don't like the word *stylish*, by the way, I always tell people to feel free to replace it with *engaging* or *impactful* or *readable* or even just *good*). Over and over again, my respondents told me that they don't like academic jargon; they want to read accessible, story-driven prose; they enjoy books and articles that make a human connection. So I had to ask the question: Why aren't we all writing that way? What's stopping us?

Overall, I believe that most "bad" academic writing stems not from a deliberate effort to obfuscate but from insecurity and fear. Writers don't necessarily intend to be opaque, but they may lack the skills – and, more importantly, the confidence – to break away from the conventions they've learned or absorbed by osmosis. There's a widespread, remarkably persistent belief in academe that if you use clear, simple language and a personal voice, your papers will get rejected by peer reviewers. That fear is occasionally well-founded, for sure; but my research dispels that myth by showcasing examples of stylish scholarly writing that breaks the mould – and of writers who have been praised and rewarded for writing like human beings rather than robots on Mars.

FI: It is as if the serpentine syntax is like a defensive, protective cover of the conventions.

HS: Yes. It's a protective cover against attack. I think it was George Orwell, who talked about...

JR: ...in "Politics and the English language" (Orwell, 2000)...

HS: ...writers turning to long words and exhausted idioms, which he likened to a cuttlefish spurting out black ink to hide itself. [All laugh.] Orwell saw that as something politicians were doing deliberately, in order to obfuscate and confuse. But I don't believe that most academic writers are trying to pull something over on their readers. They're writing that way, as Fadhil said, mainly as a protective gesture. Another way I've heard jargon described is as a kind of barbed wire that's been put up to keep ordinary readers out.

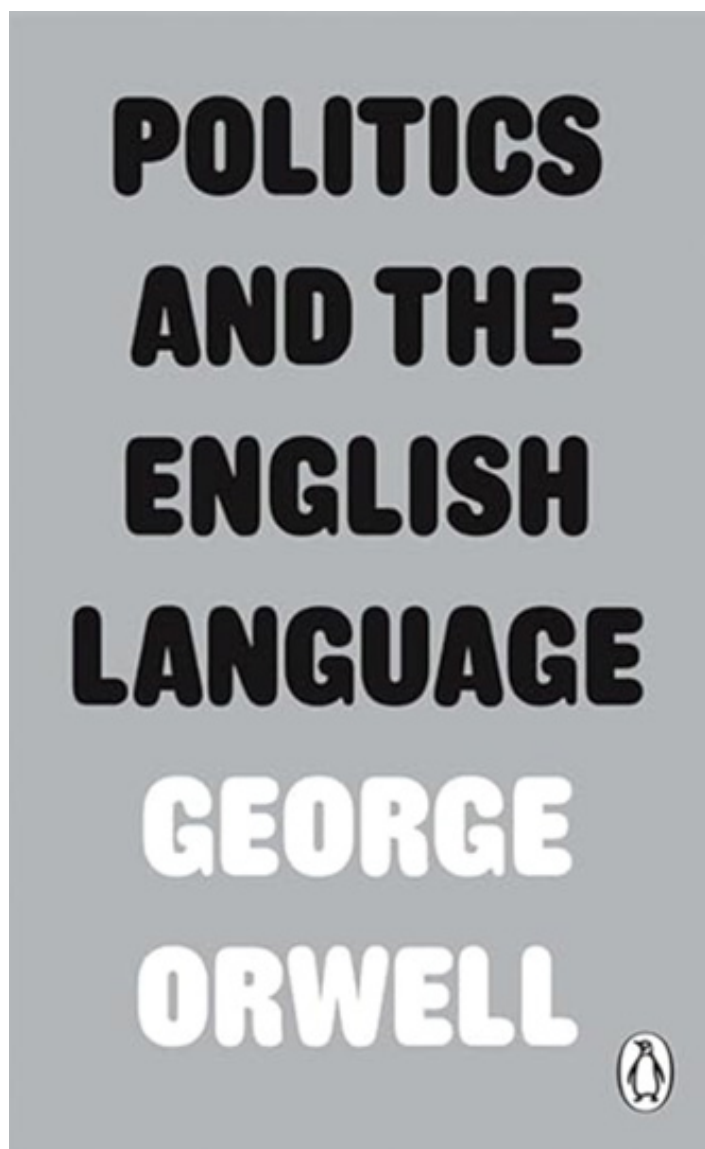


Figure 3. Book cover of Orwell's *Politics of the English language* (first published in 1946). The text is included in Orwell (2000).

Breaking academic conventions

Vanessa Stafford (VS): You were saying that writers are afraid to do it differently. My question talks about the reasons why they are afraid. In your observation, stylish academic writers use "interesting, eye-catching titles and subtitles; first-person anecdotes or asides that humanize the author and give the text an individual flavor; catchy opening paragraphs that recount an interesting story, ask a challenging question", etc. (Sword, 2012a, p. 8). Do you sometimes see the need to compromise, for instance, in the context of certain academic journals that demand a less stylish writing style? How can we balance your advice of breaking down academic boundaries with prevailing academic conventions?

HS: Many writers worry that their 'stylish academic writing' will get rejected by reviewers, but when I speak to journal editors, they say the opposite – 'Please, give us more engaging writing!' For example, when I first published my article "Writing higher education differently" in *Studies in Higher Education*, the editor at the time, Malcolm Tight, welcomed it enthusiastically. Later he even wrote a cover

blurb for my book, *Stylish academic writing*. The message I hear again and again from academic editors and publishers is that they're desperate for clear, accessible writing.

The resistance often comes from the authors themselves out of fear, as we've discussed. It can also come from conservative peer reviewers acting as gatekeepers, trying to create clones of themselves. Ironically, academic research is supposed to be all about creativity and pushing boundaries, yet there's this gatekeeping mechanism that says 'No, you must conform to the lowest common denominator'. But I do think editors are hungrier for stylish writing than you might expect.

For writers who want to start testing those academic boundaries (which may turn out to be illusory!), my advice is to start small: just try one or two things, maybe a slightly more interesting title or a catchy opening paragraph, and wait to see the reaction. Over time, as writers get positive feedback, they become emboldened to take more stylistic risks. I've had many people tell me 'I got the grant!' or 'My paper got accepted!' after they zinged up their writing with an engaging title or a compelling metaphor. One scholar I've worked with extensively, a criminologist, uses poetry, fictional narratives, and dramatic techniques in his articles; these days, he's recognised and applauded for his engaging style, but it took courage and confidence for him to take the first step.

The very phrasing of your question betrays the assumption that, as academics, we're *supposed* to be conservative and disciplined! But I believe the opposite: as researchers working at the frontiers of new knowledge, it's our job to accept and explore unconventional styles appropriate to our aims.

Of course, that can be quite tricky if you're a PhD student and your supervisor is more traditionally-minded. You may need to choose between finding a new supervisor aligned with your values, or just getting through your doctorate while toning down your style for now. Ideally, though, you'd have an open-minded supervisor encouraging you to develop an authentic scholarly voice from the start.

The criminology scholar I mentioned had a doctoral supervisor like that, who greenlighted and encouraged his experiments with style. But I've heard many stories of supervisors shutting down students' attempts at innovation, often while telling them "It's for your own good." Personally, I think that's nonsense. Strategically opposing that power structure while you're still a student can be challenging, but if you can find the right balance between convention and innovation, it can lay important emotional groundwork for your future academic career.

Tempting titles

FI: It does remind me of my PhD and how I had to stick to conventions and survive. I now have a chance to push boundaries and be more stylish. Your chapter on "Tempting titles" (Sword, 2012a) is one of my favourites. It's so inspiring, and it opens up doors. To what extent does a catchy title

influence the remainder of the article? Do you have any favourite examples of tempting titles? How does the title shape the writing of that article?

HS: That's a great question. I've published some books and articles where I had the title in mind from the start and others where the title only emerged towards the very end of the writing process. Either way, the title plays a crucial role in influencing the reader's expectations. As I mention in *Stylish academic writing*, the title is like the front door of your house or apartment: either it invites your reader in or it warns them to stay away. If you have a catchy title that piques your reader's interest, but then the content doesn't deliver on that promise, they will likely feel disappointed. Conversely, when you knock on the door of an article with a conventional title, you know exactly what you'll find inside. [All laugh].

One of my favourite examples of an engaging-and-informative title is one I encountered at an educational conference some years ago: "'Throwing a sheep" at Marshall McLuhan'. The phrase 'throwing a sheep' referred to a popular Facebook phenomenon at the time, and Marshall McLuhan is a widely recognised commentator on new media, so the title not only caught my attention but also provided me with enough context to make an informed decision about whether to attend the panel. Unsurprisingly, that session was very well-attended; the title did an excellent job of drawing people in.

Of course, such an unconventional title may deter some scholars who assume that it lacks seriousness. But for me, the 'throwing a sheep' example shows how a clever title can capture attention and generate interest. I love the movie title 'Snakes on a Plane' – it tells you exactly what you're in for! [All laugh].

JR: When I was reading your chapter, it inspired me to be a little bit more daring. I'm happy to tell you that our article "ChatGPT: Bullshit spewer or the end of traditional assessments in higher education?" (Rudolph et al., 2023) has been cited more than a thousand times. We strongly suspect that much of its popularity is due to the title.

The gold standard of clarity in complexity

VS: Awkwardly, because I promote everything that Jürgen does to my cohort, I've had to swear often because of that title! Thank you for that. [All laugh.] As a songwriter, I struggle with my academic voice, solid academic writing, and complex ideas or expressions. One of my favourite pieces of advice in *Stylish academic writing* is your adoption of David Green's (2009) grid that discusses clear versus difficult language and simple versus complex ideas. You posit that "stylish academic writers... mostly gravitate toward... complex ideas communicated in clear, comprehensible language" (Sword, 2012a, p. 152). Could you please discuss your observations on how academics can write more stylishly and avoid the pitfalls of saying a simple idea in an overly complex way in order to sound "more academic"?

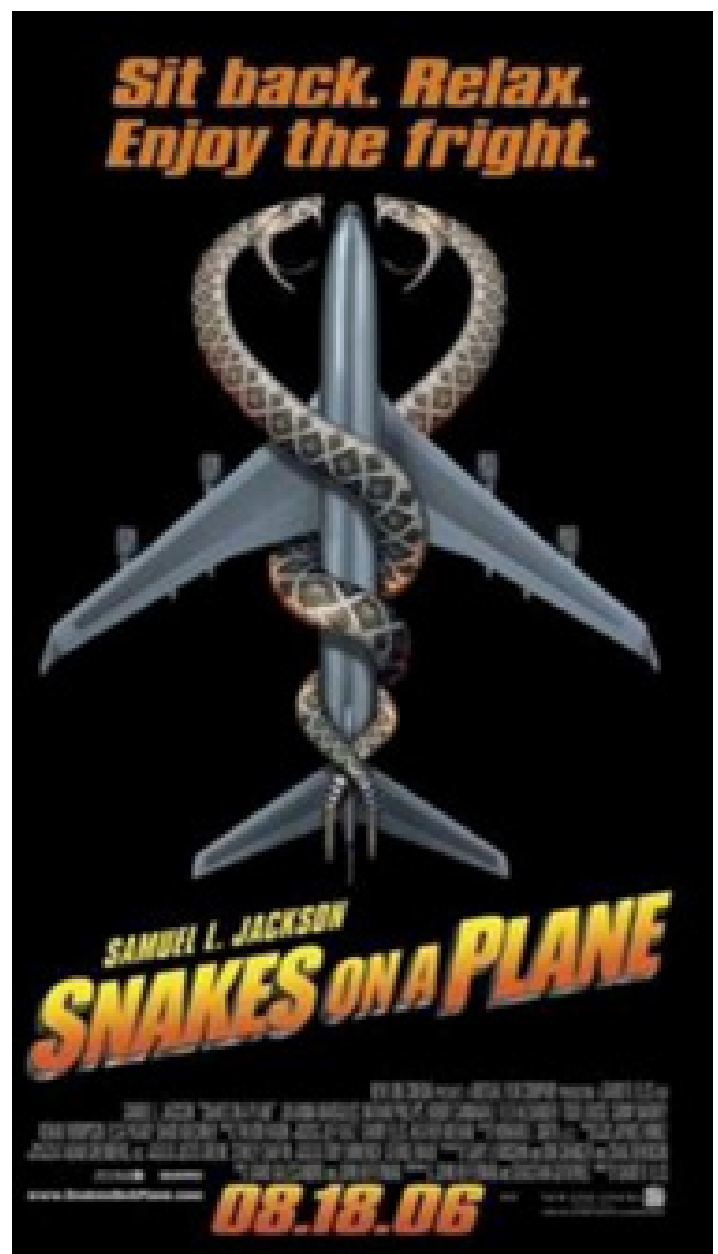


Figure 4. Poster art of the New Line Cinema film. Source: http://www.impawards.com/2006/snakes_on_a_plane_ver4.html#google_vignette. Fair use.

HS: My aim in writing *Stylish academic writing* was to break down effective writing techniques one by one and show writers different ways to implement them while also pointing out common pitfalls to avoid. My online Writer's Diet Test (www.writersdiet.com) provides a heuristic framework, based on a very simple algorithm, for internalising and activating those principles. It's a tool that's actually been designed to make itself obsolete: the goal is for you to write your way out of needing the test at all, as crafting clear, stylish writing becomes more and more natural and automatic.

When I run workshops on *Stylish academic writing*, I always start by asking participants to describe what they think constitutes 'stylish academic writing' in their own discipline. At this point I can pretty confidently predict that the elements they describe will align closely with my book's table of contents. One ideal that most academic writers agree on is the value of producing clear, well-crafted prose

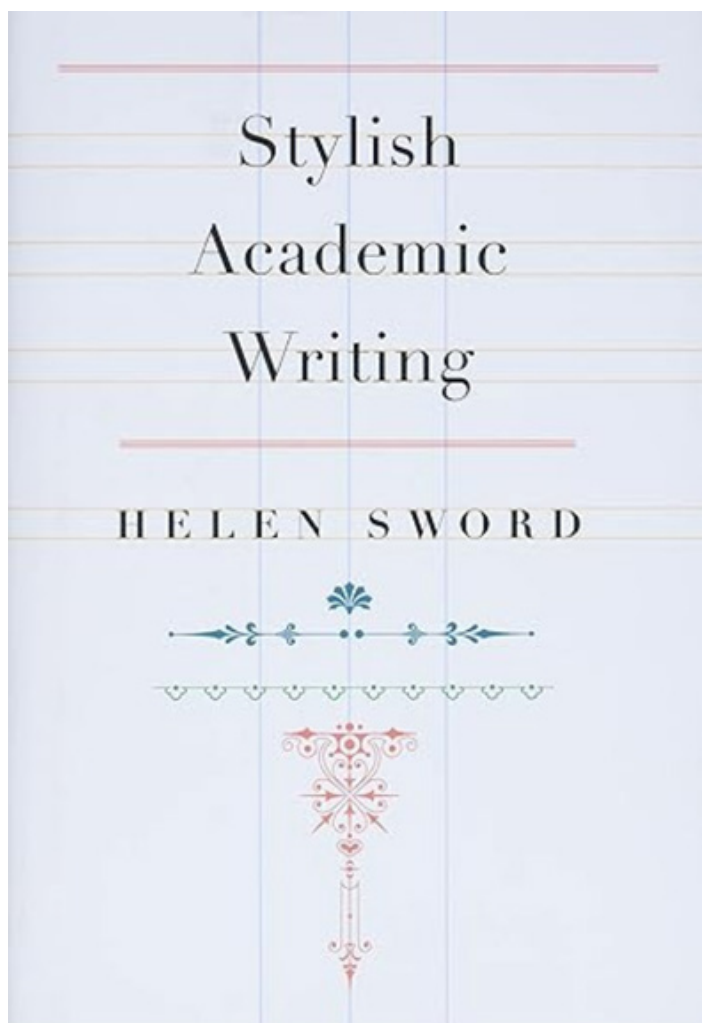


Figure 5. Book cover of Sword (2012a).

that illuminates complex ideas and arguments. But to do so you need master a collection of specific techniques, which is what the book sets out to teach you.

The closest thing to a magic learning potion that I know of is *reverse-engineering*. Find pieces of writing that you particularly admire, ideally by academics in your discipline, and examine them closely to see how they work on the level of syntax and style. For PhD students especially, those are the pieces that you can then take to your supervisor and say, 'This is what I'm striving for'.

You can also do this with articles or books in other disciplines, or with nonfiction prose, good journalism – anything you read that makes you think, 'That's really good. I wish I could write like that.' Then, apply what you've noticed to your own work. If your exemplar opens strong with a story while you tend toward ponderous, abstract introductions, rewrite your opening paragraph to start with a story next time. If your exemplar uses interesting metaphors to convey a complex concept, see if you can do the same. As Steven Pinker (2014) exhorts in his book *The sense of style*, try to uncover the 'tricks behind the mirror' of your favorite prose.

The closest thing to a magic learning potion that I know of is reverse-engineering... try to uncover the 'tricks behind the mirror' of your favorite prose.

An unorthodox research approach

Shannon Tan (ST): You have analysed numerous works on academic writing, evaluated countless samples of academic writing and asked excellent writers to share their writing experiences in your books. Could you please tell us more about your method in writing about academic writing – that is, your approach, process, and methodology?

HS: My approach to each book evolved organically; none of it has been based on prior design or disciplinary conventions. I was trained as a humanities scholar and poet rather than as a social scientist, so I'm comfortable with ambiguity, mess, and the idea of writing to discover what I'm trying to say – quite a liberating perspective!

I can chart a clear progression through my four books on writing, starting with *The writer's diet* (2016a), my first foray into writing about writing. Back in the 1990s I had a little one-page handout that I used to give to my undergraduate students, with basic editorial advice such as 'circle every *be*-verb and get rid of half of them'. I eventually thought, why not try to quantify this advice into a meaningful algorithm? So I analysed hundreds examples of writing and came up with some numerical cut-offs. For instance, I found that if more than around 4% of the words in your writing sample are *be*-verbs, your prose is likely to feel quite sluggish to your reader – unless, of course, you're Shakespeare (To be, or not to be) or Dickens ('It was the best of times, it was the worst of times') and you're using *be*-verbs intentionally for a specific stylistic effect. My methods were very low-tech; I used hard-copy printed texts, color-coded highlighters and Excel spreadsheets to work out the algorithms. Fifteen years later, especially when compared to generative AI chatbots such as ChatGPT or Claude, my online Writer's Diet Test at www.writersdiet.com looks pretty primitive. But in some ways it's a more powerful tool than ever, as it does something that those generative AI tools don't do: it really requires you to *think* about your sentence-level writing and to make your own decisions about how to write more clearly.

That early work on *The writer's diet* led to *Stylish academic writing*, in which I moved from looking at grammar, syntax and vocabulary to focus on academic style more generally. I assembled a dataset of 1,000 academic articles from ten different disciplines, which I analysed according to some very basic quantitative metrics; for example, I counted the number of articles in each discipline that did or didn't use first-person pronouns, or that did or didn't open with a story or anecdote. But at the same time I was close-reading those same texts through my lens as a literary scholar, noting how grammatical and syntactical patterns differed between fields such as, say, philosophy and psychology. Here, my lack of linguistic training proved quite helpful; I approached academic writing guides from a literary perspective rather than a linguistic one, unburdened by methodological jargon. While linguistics prose can be virtually impenetrable to non-linguists, I found that I could make topics such as grammar and syntax accessible to writers who had never learned those subjects in school.

When *Stylish academic writing* came out, I started getting invited to run writing workshops in various disciplines, including the sciences. At first I thought, 'What do I know about science writing?!' But I quickly came to realise that I could offer a uniquely pan-disciplinary perspective to discipline-based researchers, and that they, in turn, had a lot to teach me about their everyday lives as writers. As people started sharing their very human stories about their struggles with time, work, and family and their anxieties about writing, I saw that my next book needed to focus on the writers themselves, not just their writing: I needed to lift my gaze from the words on the page to the people who put them there.

So I developed this grandiose idea that I could travel the world interviewing successful academic writers, asking them questions about how they learned to write in their disciplines, how they get their writing done, and how they feel about their writing. I applied for a couple of research grants to finance my travel, and off I went! It was my first experience doing interviews; but beyond jumping through the hoops of getting ethics approval, I mainly just trusted my literary instincts and mined the transcripts for compelling metaphors, quotes, and stories. That research led to my 2017 book, *Air & light & time & space: How successful academics write*.

For that book, and later for *Writing with pleasure*, I used the writing workshops that I offered at universities and conferences around the world to gather questionnaire data from the attendees, which meant that my research participants helped to shape the book's direction and content. Though I didn't use a systematic coding methodology, I could easily spot emerging themes, such as the joy of solitary writing or the importance of intimate co-writing situations. And when I noticed my respondents describing the material nature of some of their own most pleasurable writing experiences, I consciously began to incorporate more material, sensory practices into my own writing process.

So as you can see, each of my four books on writing has emerged from the previous ones; but none of them has been written according to a template. I've developed a different methodology and format for each of them, and each of them has taught me something new about my own writing process. There have been points in each book when I've felt stuck in what my colleague Inger Mewburn calls the 'valley of shit' – those moments when you really wonder if you can keep going. In *Writing with pleasure*, I used humor to pull me out of the mudbath – to the extent of inviting my book's illustrator, Selina Tusitala Marsh, to draw me wallowing in the mire! But overall, researching and writing each book has been an immensely joyful and fulfilling experience, and I've been blessed with the material resources and academic freedom to experiment and explore.

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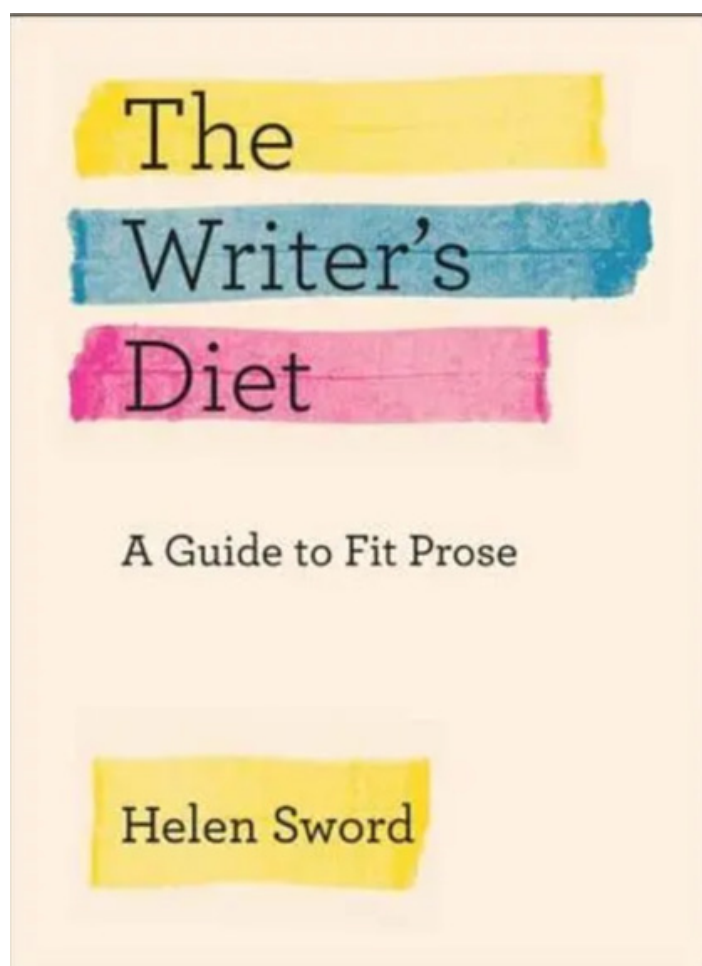


Figure 6. Book cover of Sword (2016a).



Figure 7. *The mudbath*. Illustration by Selina Tusitala Marsh (Sword, 2023, p. 183).

JR: When I read your books, they look perfectly organised. It was really fascinating to learn about your creative and maybe even, to some extent, serendipitous, anti-methodological process, if you will. Despite my own training as a social scientist, I'm also deeply skeptical about being overly methodological. It's also your writings which influenced me recently to read a lot more fiction again. I'm absolutely in love with fiction at the moment, and I can't stop reading. I find that extremely meaningful. On the other hand, I tested my writing on your Writer's Diet website (Sword, n.d.; see Sword, 2016a). Unfortunately, it was diagnosed as "flabby" as opposed to "fit". (The same could be said about my body shape.) Could you please share some general advice on how to make our writing 'fitter' and 'trimmer'?

Figure 8. Screenshot from Helen Sword's *The writer's diet* website with a random sample from Jürgen's writing.

HS: As I mentioned earlier, *The writer's diet* started out as a one-page handout for my undergraduate students; I used the diet and fitness metaphor to show them the importance of putting their sentences through a workout, kind of like going to the gym. My 'fit vs flabby' tagline was inspired by Richard Lanham's book *Revising prose*, which teaches you to calculate the 'lard factor' of your sentences – that is, the percentage of unnecessary words that you can remove – and then to rewrite them using Lanham's so-called 'paramedic method' for reviving moribund prose.

For over a decade, no one raised concerns about the 'writer's diet' metaphor. But eventually, I started getting complaints that I was conflating written texts with human beings and using potentially 'body shaming' language. By then, The Writer's Diet was well established as both a book and an online tool, and I knew that many readers found the diet/edit analogy useful. I probably wouldn't choose the same metaphor now; but I can't turn back the clock. Instead, I've updated the Writer's Diet website and free Microsoft Word app so that users can now change the metaphor if they want to. Instead of 'flabby', for example, you can now have your writing labeled as 'cloudy' or 'cluttered' or 'foggy'.

The core principles of The writer's diet align with the advice that you'll find in other classic writing guides such as William Zinsser's *On writing well* (2006), Joseph Williams'

Style (Williams & Colomb, 1995), and Strunk & White's *The elements of style* (2007). Write clear, active, verb-driven sentences whenever possible; favor concrete nouns and vivid verbs; avoid long sentences crammed full of confusing syntax; give your readers people, places and things that they can visualise and actions that they can illustrate with a hand gesture.

Of course, all academic writing inevitably involves complexity and abstraction. But as a rule of thumb, I advise scholarly and professional writers, whatever their discipline, to make sure that they include at least a few sentences per paragraph that pair a concrete subject and an action verb, with minimal abstract language. And rather than using the same vocabulary as every other academic writer you know – ‘usual suspect’ verbs such as *examine*, *analyse*, *understand* – try sprinkling in some unexpected, evocative word choices now and then.

In the writing sample that you shared with me, Jürgen, the main issue flagged by the Writer's Diet Test is "zombie nouns" – that's my pet name for *nominalisations*, which are abstract nouns derived from other parts of speech. I wrote an article called "Nominalizations are zombie nouns" for the *New York Times*, which in turn got made into a TED-Ed video that's had over a million views on YouTube – my single most successful academic publication to date! The phrase "zombie nouns" has now entered the lexicon; it's been quoted by Sir Harold Evans (2017), Steven Pinker (2014; 2020), and various other well-known writing experts.



Figure 9. Screenshot from Helen Sword's (2012b) zombie noun video on YouTube.

Now, I'm not suggesting that you should get rid of *all* your zombie nouns, or any other words highlighted in your test results. None of these words are inherently 'bad' or poor choices; it's just that you've used quite a high percentage of zombie nouns in your sample (6% or more), which in turn signals that your writing style is relatively abstract, you're asking your readers to work quite hard to understand your meaning.

There's nothing wrong with abstraction, of course – it's vital academic currency. But concrete language aligns better with how our brains process information. The more intangible concepts you try to cram into a single sentence

or paragraph, the harder it becomes for your readers to visualise your ideas and mentally represent them. I'm not saying that you should ditch the zombie nouns entirely; but do consider weeding out a few of them and replacing them with more concrete anchors such as examples, illustrations, and relatable human subjects. Abstract nouns give readers nothing tangible to hang onto. Shakespeare (2021, 5.1.16-17) described how poets turn "the forms of things unknown" into shapes that we can visualise; they give "to airy nothing / a local habitation and a name". That's what stylish academic writers do too.

Concrete language aligns better with how our brains process information. The more intangible concepts you try to cram into a single sentence or paragraph, the harder it becomes for your readers to visualise your ideas and mentally represent them.

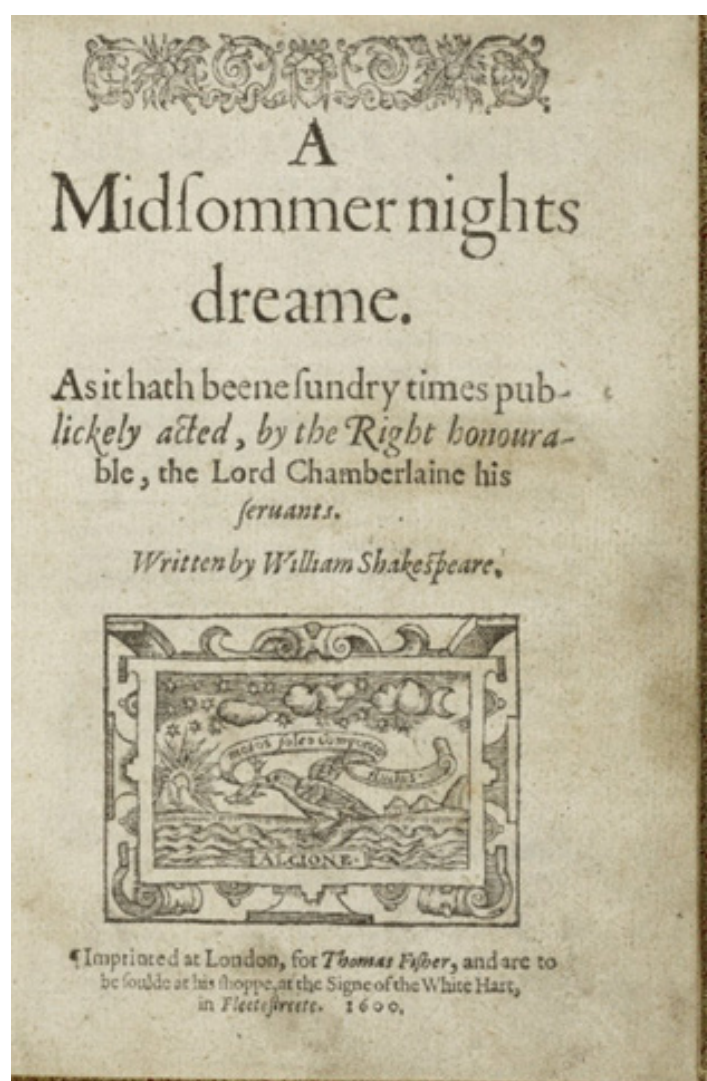


Figure 10. Title page of the 1600 edition of Shakespeare's *A midsummer night's dream*. LUNA: Folger Digital Image Collection. CC-BY-SA 4.0.

As for your other test results: well, you came out fine in the 'be-verbs' category, which is great. Your verbs are quite energetic – 'sparked', 'unveiled', 'advocating', 'citing' (see Figure 8) – so if you can bring a similar energy to your use

of nouns, you'll be fine. My advice for you, going forward, is to zoom out from this *specific* Writer's Diet diagnosis and test some other samples to see if you always use such a high percentage of abstract nouns. If so, you can make a deliberate effort to reduce your dependence on zombie nouns and to incorporate more concrete language into your writing, then retest from time to time to gauge your progress.

Members of my WriteSPACE community (www.helensword.com/writespace) have access to a premium tool called Writer's Diet Plus, which generates a personalised Action Plan based on your test results. But even if you're not a WriteSPACE member, there's a free guide available online that explains all the Writer's Diet diagnostic principles and algorithms (<https://writersdiet.com/writers-diet-help/>). And the book, of course, is the most valuable resource of all for evaluating your Writer's Diet Test results and tightening up your prose.

Write with delight!

Are you hungry for practical writing advice seasoned with pleasure? A WriteSPACE membership will empower you to write more stylishly, productively, creatively, and joyfully.

- Join a vibrant international writing community with members in 30+ countries.
- Supercharge your writing with exclusive resources and tools developed by acclaimed writing expert Dr. Helen Sword over three decades and used at hundreds of leading institutions around the world.
- Attend special events and workshops with invited global experts, or drop into our live online Writing Studio to work one-on-one with Dr. Sword and fellow writers.
- Receive discounts worth hundreds of dollars off premium courses and retreats.



TRY FREE FOR 30 DAYS

Figure 11. Helen Sword's WriteSPACE community website (<https://www.helensword.com/join-the-writespace-bl>).

JR: Thank you so much, that's super helpful.

Dimensions of writing (BASE)

FI: In *Air & light & time & space* (Sword, 2017), you adopt a holistic, inclusive approach toward academic writing and distinguish four "BASE habits": behavioural, artisanal, social and emotional habits. Could you please provide us with an overview of these habits and share some of your personal manifestations of them?

HS: The book contains three chapters on each of these habits, so there's a lot of material there. Plus, after the book came out, I co-published an article called "BASE pleasures: The behavioral, artisanal, social and emotional dimensions of academic writing" (Sword et al., 2019), which provides an analysis of additional data that didn't make it into the book. The BASE model moves us beyond thinking only about our behavioural and artisanal habits – that is, productivity and wordcraft – to focus on the social and emotional dimensions of writing as well, and above, on how all of these elements can work together to help us build a successful writing practice.

People often tell me, 'I need to write more' or 'I need to write faster' or 'I need to write better', and they go and buy books and enroll in workshops on how to do each of these things.



Figure 12. Book cover of Sword (2017).

But if you don't have a strong emotional base for what you're doing – that is, if your writing practice isn't undergirded by positive emotions to help you overcome the inevitable challenges – any new habits that you develop are unlikely to stick. Social support, likewise, turns out to be tremendously important; many of the successful academic writers whom I interviewed for the book mentioned key individuals who were crucial to their development and success as writers. So the behavioral, artisanal, social, and emotional dimensions all work together and reinforce each other.

That's why I developed my interactive "Writing BASE" diagnostic tool, which is accessible through the Writer's Diet website (click on the 'BASE' icon in the top right corner - see Figure 13). The tool invites you to reflect on your own BASE habits and offers tailored suggestions for holistic growth across all four dimensions. The wider and stronger your writing BASE, the better foundation you'll have for cultivating an abundant writing practice filled with 'air & light & time & space'.

My subsequent research on the BASE model (Sword et al., 2019) has shown that there's a particularly strong correlation between the emotional and artisanal dimensions, as well as the emotional and behavioral dimensions: if you rate yourself highly in one of these dimensions, you tend to do so in the other, and vice versa. Going back to the example

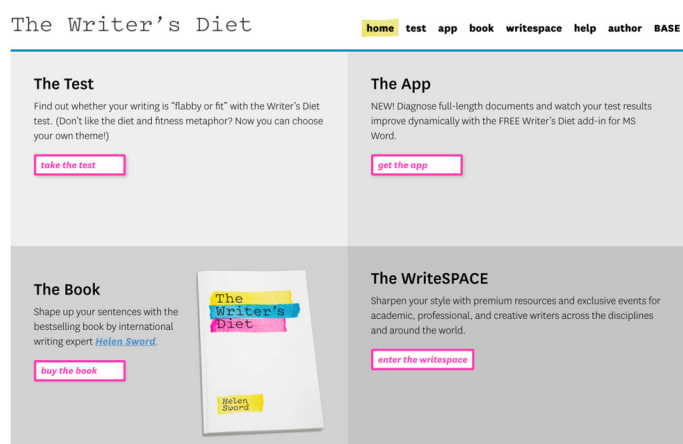


Figure 13. Helen Sword's Writer's Diet website (<https://writersdiet.com/>).

that I gave you right at the beginning of our conversation: I was told I was a good writer from an early age, so I put a lot of energy into developing my writing skills; conversely, my high level of skill led me to feel good about my writing. Which came first, the chicken or the egg? It doesn't really matter; my point here is that two strengths, emotional and artisanal, developed in tandem and reinforced each other.

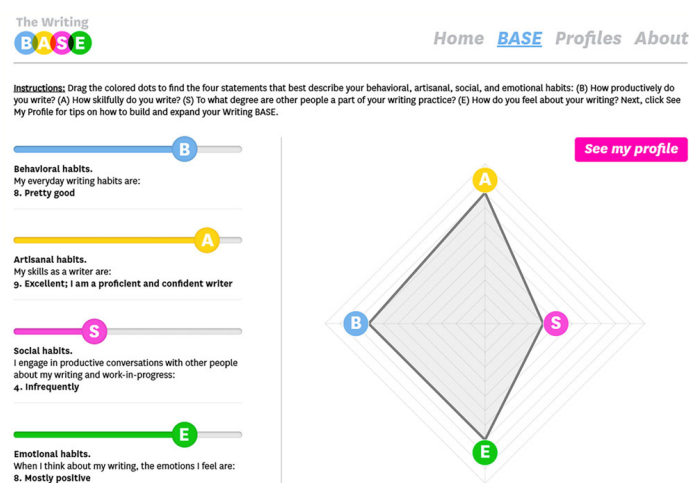


Figure 14. A sample BASE result. The coordinates $B = 8$, $A = 9$, $s = 4$, $E = 8$ have yielded the shape called 'The Lone Wolf' (Sword et al., 2019, p. 2485).

By the same token, if you really hate to write, you're less likely to put time and energy into developing your skills or getting your writing done; instead, you'll be looking for every possible excuse to run away from your writing. So if you want to create and sustain positive behavioral habits as a writer, you need to develop positive emotional habits to go with them – which is why, when I run workshops on 'how successful academics write', I call the emotional dimension 'the base of the BASE'. If your BASE profile indicates low self-confidence in all four dimensions – that's the "Pebble" profile, which suggests that you're building your writing practice on a very narrow BASE – I generally recommend that you start by addressing your negative emotions around writing and look for ways of bringing more positive energy to your writing practice.

Writing with pleasure (Sword, 2023) emerged directly from my BASE research. When I was researching *Air & light & time & space* (Sword, 2017), I gathered data from two different groups of informants: the 100 successful academic writers whom I interviewed, plus around 1,200 other academics who filled out a written data questionnaire. I asked both groups the same question: 'What are the main emotions that you associate with your academic writing?' For the anonymous questionnaire respondents, the most frequently mentioned emotion was *frustration*. (I later wrote an article called "Frustrated academic writers" (Sword et al., 2018) to try to figure out what that's all about!) But for the handpicked 'successful writers', the most frequently mentioned emotion word was pleasure. Academic writing guides tend to focus mainly on behavioural habits or stylistic advice, with little attention to the social dimensions of academic writing and even less on the value of cultivating positive emotions about writing. If they mention emotion at all, it's usually in the context of how awful writing makes us feel, how hard it all is, and how we need to shut up and stop complaining if we want to be productive – almost as though academics should regard emotion as a mark of shame rather than a sign of our humanity.

If your BASE profile indicates low self-confidence in all four dimensions... I generally recommend that you start by addressing your negative emotions around writing and look for ways of bringing more positive energy to your writing practice. That's why I wrote Writing with pleasure.

VS: In *Writing with pleasure* (Sword, 2023), you offer 18 fascinating pleasure prompts to your readers. Could you discuss a few that your students or even you yourself have found particularly useful? I absolutely loved the Butterflies and Cocoons (p. 43) and Compass Points (p. 209) prompts on transforming limiting beliefs into liberating truths. I personally reacted to those two, but I don't want you to be steered to those if that's not what you would say.

HS: There's so much material in there that I could talk about. I run an annual six-week online course called *The pleasure catalyst* for academic writers from around the world, mostly faculty and PhD students, who want to find more pleasure in their writing practice. Rather than taking them systematically through the 18 prompts, I focus on sections of the book that readers find particularly compelling.

One concept that seems to resonate with many people is the idea of "social balance" in writing – that is, finding a healthy personal balance between solitude and social interaction. It's not as simple as saying 'I'm an extrovert, you're an introvert'. For most people, the key is to set up your writing practice so that you can benefit from the pleasures of both modes, plus everything in between, such as writing on your own in a crowded café or sharing your writing with a friend in an intimate, trust-filled setting.

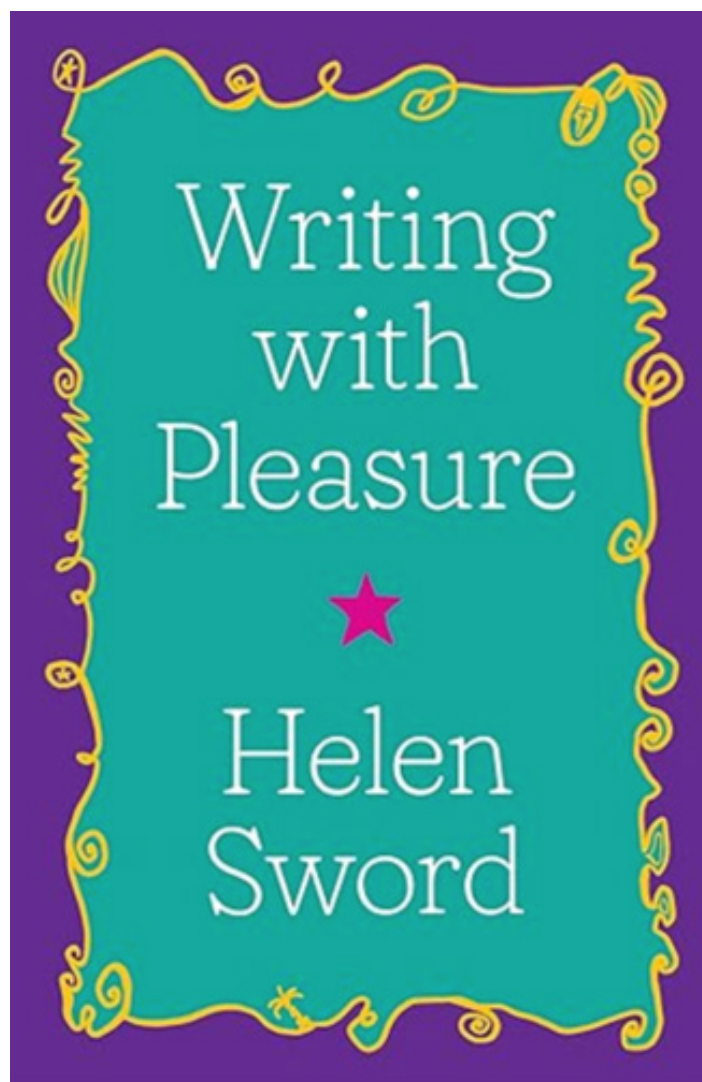


Figure 15. Book cover of Sword (2023).

The chapter that has most directly influenced my own writing practice is the one focusing on the physicality of the writing process: that is, the pleasures of notebooks, pens, coloured paper, and other analog tools (see Sword, 2023, chapter 6, "On the ground"). Many academics seem to fear that, if we're seen scribbling in a colourful notebook or walking in the park or putting beautiful flowers on our desk, we'll be dismissed by our colleagues as unprofessional and lacking in seriousness. But why shouldn't we embrace our full humanity in our scholarly life? Why shouldn't we nurture our bodies and minds with physical and aesthetic delight? The pleasure prompts in the 'On the ground' chapter encourage you to bring more colour, materiality, and handcraft into your writing process, not as a distraction from your intellectual work but as a way of strengthening it.

Another one of my favorite pleasure prompts is the one called 'Lifelines, Leylines, Desire Lines' (Sword, 2023, pp. 236-237). It comes towards the end of the book and encourages you to trace themes and metaphors that have been woven throughout your own writing life over time. It's been fun to watch the participants in my Pleasure Catalyst rediscovering modes of thinking and creating that have served them well in the past, then consciously reintegrating them into their writing practice today.



Figure 16. Helen Sword in the park.

Readers also enjoy the pleasure prompts that invite them to explore profound yet often-suppressed dimensions of their writing life through the complex terrain of metaphor. As a poet and poetry scholar, I've always loved metaphor. With *Writing with pleasure*, I just took the lid off! [All laugh.] Every chapter employs at least one central metaphor, and in some cases I run through a whole sequence of them; for example, my chapter on the writing process is titled 'Wind, river, stone', invoking elemental metaphors that represent the pleasures and challenges of pre-writing, drafting, and crafting, respectively.

I've always loved metaphor. With Writing with pleasure, I just took the lid off!

The chapter that I found trickiest to write was the one called 'Star Navigation' (Sword, 2023, Chapter 9), which is all about personal and cultural identity – how to carry the influences that made you who you are into your academic life and writing, rather than leaving them at the door. The chapter introduces non-Western concepts and epistemologies that have influenced me in my two decades of living in Aotearoa New Zealand, where Māori and Pasifika ways of thinking and being are part of the cultural landscape. I wasn't sure whether the star navigation metaphor would land with readers elsewhere in the world; but when I invited the participants in my Pleasure Catalyst to make their way through the pleasure prompts in that chapter, they told me that they found the exercise deeply empowering: 'Here's where I'm from, here's my standing place, and here are the stars and constellations – the core values and beliefs – that guide me on my journey'.

VS: Thank you for struggling to write that chapter; it's my favourite one.

HS: That's lovely to hear.

FI: In *Writing with pleasure*, you discuss the importance of having positive emotions to derive pleasure from writing. To our surprise, you state that you occasionally suffer from writer's block and impostor syndrome (when you write that you "decide the next morning, almost invariably, that everything I had written the previous day was rubbish" (Sword, 2023, p. 171)). What steps can writers take to

experience 'positive emotions' during the writing process and counter their imposter syndrome?

HS: It's funny to me that you call me 'prolific', because I often feel like the slowest writer in the world! Aside from *The writer's diet*, which is relatively short, each of my books on writing took me around five years to research, write, and revise, with at least two years dedicated to the core process of writing and self-editing. I really am excruciatingly slow.

I've written about all this in *Air & light & time & space* (Sword, 2017). Researching and writing that book – which is, after all, about the writing habits of successful academics – helped me reframe my own perceived sluggishness as a positive trait. Now, instead of labelling myself as 'finicky' and 'snail-paced' and 'excruciatingly slow' (as I just did a moment ago – old habits die hard!), I've learned to embrace my perfectionism and my reverence for the craft. Yes, I sometimes find it hard to release a sentence until I have worked it over at least 20 times – I'm not exaggerating! – but that's okay. My slowness is my superpower – and my interviews with one hundred successful academic writers confirmed that I'm not alone. Very few of the leading scholars I talked to produce top-notch work that just flows out effortlessly without intensive revision. Most, like me, work through draft after draft after draft.

So when I encourage academic writers to write with pleasure, I don't mean it's all going to be joyful dancing through the daisies. Any meaningful creative process entails light and shadow, or what I call *chiaroscuro*, after the Italian painting technique of using darkness to illuminate the foreground light. In *Writing with pleasure*, I offer readers techniques for reframing their negative emotions about writing, much as I've done for myself by transforming the pejorative label 'finicky' into the more positive 'meticulous' and 'craft-focused'. Instead of banishing the shadows, you can 'turn your roadblocks into your rocket fuel', as I like to put it (See my "What's Your Writing Roadblock? Quiz" at www.helensword.com/). The emotional process involves not just acknowledging what you regard as your flaws, but redefining them as strengths worth embracing.

That's where the metaphor can help. In *Writing with pleasure*, I explain how my own personal metaphor of *mosaic making* (something I also do as a personal hobby) helps me structure my writing and affirm my identity as a craftsperson in the medium of language. As a mosaicist, I know I'm always going to be arranging and rearranging the components of my work, looking for new patterns; and I'm always going to be dissatisfied when I have to glue it all down. That's just a part of my process – not something I need to beat myself up about.

For me, craft is everything. I love reading the work of other writers who are good at explaining the technical aspects of writing and can give me new insight and tools for improving my own craft – for example, Joseph Williams's *Style: Toward clarity and grace* (Williams & Colomb, 1995) or Steven Pinker's *The sense of style* (2014). And I especially value those writers whose own work is beautifully crafted – I was about to say 'whose craft is on display', but actually, the best-crafted writing is often not on display. William Butler

Yeats (2022, p. 45) wrote:

A line will take us hours maybe;
Yet if it does not seem a moment's thought,
Our stitching and unstitching has been naught.

The poet's job is to spend hours on a single line so it seems like 'a moment's thought'. The same paradox holds for stylish academic writers: I may have to spend hours on a single paragraph to ensure that it flows smoothly and easily for my readers, so easily that all my hard work becomes invisible.

JR: Earlier, you were already speaking, very briefly, about ChatGPT. What opportunities and threats, if any, do you see for academic writing when it comes to generative AI such as ChatGPT?

HS: I've written a bit about generative AI on my blog (<https://www.helensword.com/helen-sword-blog>), as a way of getting my head around its potential affordances and pleasures. As a craft-focused writer, I don't feel personally threatened by GenAI – at least not yet. Chatbots such as ChatGPT and Claude are very good at churning out a certain kind of bland, conventional prose, and they generally produce more active, concrete, legible sentences than the average undergraduate (or academic researcher!). But their attempts to imitate the prose style of specific authors are pretty clunky, partly because they're terrible at dealing with metaphor or, more generally, with nuances of style.

As a craft-focused writer, I don't feel personally threatened by GenAI – at least not yet. Chatbots such as ChatGPT and Claude are very good at churning out a certain kind of bland, conventional prose... they're terrible at dealing with metaphor or, more generally, with nuances of style.

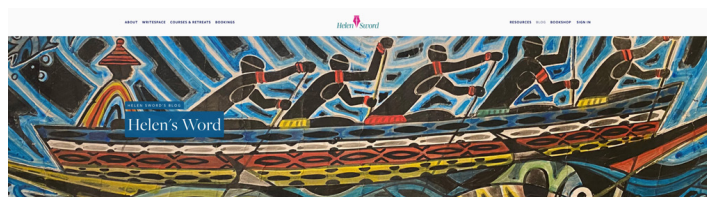


Figure 17. Helen Sword's blog. Screenshot.

I have great respect for the kinds of people who develop and use these tools. They really are extraordinary! And I'm certainly not a Luddite who believes we shouldn't be touching this stuff. But I don't think that any of us want to see our students – or, worse yet, our colleagues – outsourcing all their writing, and by extension their thinking, to machines. We still need human beings to learn to write and think for themselves. Otherwise, how can they possibly evaluate the efficacy of the tools?

As for opportunities: well, if you're a writer with a well-developed sense of style, plus a human brain and human feelings, I believe that your high-level writing abilities will become more and more valued, rather than less and less relevant, as time goes by. We've seen that happen with other

tools: for example, Photoshop hasn't put 'real artists' out of work, it's just enabled amateurs like me to play around with visual images.

As for opportunities: well, if you're a writer with a well-developed sense of style, plus a human brain and human feelings, I believe that your high-level writing abilities will become more and more valued, rather than less and less relevant, as time goes by.

JR: I'm in full agreement with everything you observe. It also doesn't help that generative AI chatbots do not have long-term memory. That's why they cannot really write something long, at least at this point. I think your caveat is very important that we are at a very early stage of all this development. At the moment, I also think that despite the initial amazement, it is actually rather disappointing in many respects. We should focus on our own humanity.

HS: If I were still the director of a higher education research centre, as I used to be, and if I had ChatGPT to help me write the annual report, that would certainly be tempting. [All laugh.] I could just input the information, and then the chatbot would turn all my bullet points into coherent prose and maybe add some useful charts and graphs. Those reports hardly get read anyway; in fact, for all I know, the dean's office already has a chatbot reading and summarising them. That would give me more hours for working on my books, which are hard to write and slow, so I really need that time!

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Follow the pleasure

VS: You mentioned that a book might be a five-year process, with the writing process being maybe two years. What advice would you give to keep the momentum of writing even when you don't feel like it or are busy with other tasks? How do you avoid beating yourself up when you have not met your writing goals for a particular day or week?

HS: One solution might be to set different kinds of goals – for example, what I call SAFE goals, which are Small, Achievable, Forgiving, and Easy!

Back when I first started writing about writing, I was an evangelist for what I call “the Church of Daily Writing,” based on the quasi-religious imagery employed by behavioural psychologist Robert Boice in his book *Professors as writers* (1990). Because Boice’s methods worked for me, I went around trying to convert everybody else I knew. But eventually I began to see that such a highly regimented, goal-driven way of working could in fact be counterproductive for some people, because it can lead to all kinds of anxiety and guilt. Any behaviour fueled by negative emotions rather than pleasure will eventually take people backwards.

In fact, as I’ve documented in my article “‘Write every day!’: a mantra dismantled” (Sword, 2016b), there’s no one practice that works for everyone. The best way to write is whatever way works for you!

That’s what a lot of those exercises and prompts in *Writing with pleasure* (Sword, 2023) are aimed at helping you figure out. Where and when do you actually enjoy writing, and how can you build on that pleasure? Maybe you notice that whenever you write by hand, new ideas come flowing in; so you say, ‘Right, I’ll do a bit of writing by hand every morning’. Or maybe you find that you write more clearly and fluently if you’ve gone for a walk or swim before your writing session; so you say, ‘Right, I’ll make that part of my regular routine’. Word goals can be really discouraging, as most people underestimate the number of words that they typically produce in an hour. Ultimately, a pleasure-focused approach is going to be more fruitful than saying, ‘I have to write this many words in this amount of time, or else I’m a failure.’

VS: That’s great advice.

HS: That’s my main advice. Follow the pleasure, follow the pleasure.

The best way to write is whatever way works for you!... Follow the pleasure.

Future plans

JR: Do you have any future plans that you would like to share with us?

HS: I’ve left university life, after more than three decades, and am now running my own writing business, which is called WriteSPACE (www.helensword.com/writespace). People keep asking me, ‘Oh, what’s the next book? What’s the next big project?’, but I don’t actually have one. All my energy now goes into the online resources that I create for my WriteSPACE members, such as online courses, digital tools, videos, podcasts, and live workshops for scholarly and professional writers from across the disciplines and at any stage of their career. I run a lot of free online events too, so I warmly encourage your readers to sign up for my newsletter (<https://helensword.substack.com>), which is the best way to stay in touch.

I love bringing people together from around the world into the virtual space, and I’ve always been fascinated by the interface between the digital and material worlds, so

that’s really become my sweet spot now. I do a lot of work with paper collage and other tactile, colorful media, which wasn’t really possible when I was a conventional academic. We’ve talked about the stylistic conventions of scholarly writing, but there are a lot of other conventions, too, that are telling us we shouldn’t be creative in certain kinds of ways, we shouldn’t speak in certain kinds of ways, we shouldn’t act in certain kinds of ways. It turns out that bringing the arts, color, and creativity into our intellectual lives makes us better scholars.

We’ve talked about stylistic conventions of writing, but there are a lot of other conventions, too, that are telling us we shouldn’t be creative in certain kinds of ways, we should speak in certain ways, we shouldn’t act in certain kinds of ways. It turns out that bringing the arts, color, and creativity into our intellectual lives makes us better scholars.



Figure 18. Helen Sword and Freddie. The same picture graces the cover of *Writing with pleasure* (Sword, 2023).

JR: Thank you so much for this wonderful interview!

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Negative effects of Generative AI on researchers: Publishing addiction, Dunning-Kruger effect and skill erosion

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Abstract

In this opinion piece, I strive to examine the negative effects of generative AI on researchers, highlighting three main issues: publishing addiction, the Dunning-Kruger effect, and skill erosion. First, generative AI may lead to publishing addiction. In neoliberal universities, merit is often based on the quantity of publications. Generative AI speeds up the writing and publishing process, causing researchers to focus on producing more work quickly rather than on quality. This shift may harm their well-being and relationships. Second, generative AI may worsen the Dunning-Kruger effect among researchers. Researchers might believe they possess expertise by merely engaging with AI-generated content. This overconfidence can mask their knowledge gaps, leading to a failure to recognize their own incompetence. Consequently, it may hinder learning and growth, as individuals might not seek further education or feedback. Lastly, reliance on generative AI may lead to skill erosion. As generative AI handles brainstorming, outlining, editing, and other scholarly activities, researchers might weaken their ability to develop rigorous research skills. I stress the importance of responsible AI use and ethical standards. Much like craftsmanship, true research requires careful effort and originality—qualities that AI cannot fully replicate. I also argue that efficiency in research writing is not the same as effectiveness. Just as King Midas learned to value life's true treasures after his seemingly blessed golden touch was washed away, researchers should embrace intellectual humility and strive for excellence in their work.

Prologue: King Midas and the AI dilemma

Once upon a time, a new entity, known as generative AI, subtly wove itself into the world of research. This marvel has the ability to conjure content, dissect data, and draft entire papers in seconds (Giray, 2023b). Initially, it seemed like a boon—a daemon lightening the scholars' load. Yet, beneath its sleek exterior and promises of efficiency lies a labyrinth of *hidden threats*.

In recent years, generative AI has become a disruptive force (Rudolph et al., 2024) in various fields. In fact, just talking about it “often engenders strong emotions, ranging from doomsday predictions to unbridled euphoria” (Rudolph et al., 2023, p. 342). This really has become the talk of the town because, for the first time in history, it's not just humans who have the prowess to navigate language. It's now also AI. Harari (2023) said that AI has already hacked the operating system of human civilization. That operating system is *language*.

For me and other researchers, it really has disrupted *how things work* and *how we do things* in the arena of research. One example is that we've found a powerful ally in doing the arduous process of research (Giray et al., 2024a). It's like Sisyphus now has a *soulless* but helpful golem in his cyclical venture of rolling a massive boulder up a hill. Better than having nothing at all. As an early-career researcher passionate about inquiring into the world around me, I spent a lot of time writing, digging through books and analyzing data. The process was indeed *painfully* slow but rewarding. Thanks to generative AI, researchers like me can accomplish in weeks what used to take months. It's no surprise that it has caused *mania* within higher educational institutions (HEIs) (Rudolph et al., 2024). While this seems good, it also has its bad and ugly sides (Ifelebuegu et al., 2023).

This whole generative AI story reminds me of the myth of King Midas (Auerbach, 2016): Midas was a king who loved gold so much that he wished everything he touched would turn into it. At first, this power seemed like a dream come true. He could turn anything into precious gold just by touching it. However, when he touched his food, it turned to gold and became inedible. When he embraced his daughter, she turned into a golden statue. His desire for easy riches eventually ruined the things he valued most.

The unintended consequences of generative AI are profound. Merton (1936) introduced the concept of *the law of unintended consequences*—which means that actions may have effects that were not foreseen or intended. These consequences are often subtle and not immediately apparent, much like how Midas did not foresee the tragic consequences of his golden touch. While generative AI offers incredible benefits, it also presents negative consequences, including fostering publishing addiction, overconfidence without corresponding skill or knowledge, and deteriorating writing skills among researchers. This paper delves into these pressing issues; it examines how the widespread use of generative AI may be reshaping the landscape of academic writing and research in ways that are not entirely positive.



Figure 1. AI-generated image. [Prompt: Create an image of a researcher surrounded by a messy pile of papers. The bossy AI robot controls him like a puppet on strings. Despite the mess, the researcher looks overly confident. No words. Comics style.]

Generative AI exacerbates publishing addiction

Many HEIs operate under a neoliberalist philosophy, where the intensification of workload has become the norm. This ideology emphasizes work intensification (i.e., increasing workloads and expectations, leading to longer hours and higher stress, without or barely with additional resources or compensation) and responsabilization (i.e., making staff accountable for their own success and productivity, often without adequate support) at both individual and organizational levels (Andrew, 2023). On an individual level, there is a strong emphasis on producing a high number of publications in high-impact journals indexed in Scopus and Web of Science. At the organizational level, this neoliberal approach fosters a culture of high-pressure metrification, where quantitative metrics like publication counts, citation indices, and impact factors become primary indicators of academic success and institutional prestige (Owan et al., 2024).

Hence, many academics are into publishing. The more papers they publish, the more they are productive, and the more they are depicted as *excellent*. But, publishing indeed is challenging and time-consuming, often taking from a few months to years to get published in quality journals. Academics take pride in their work because they have endured the arduous process, and they have overcome rigorous peer reviews, particularly from the often critical *Reviewer 2* (Peterson, 2020), and made extensive edits based on feedback. With generative AI, researchers now have convenient research assistants. This makes the process more efficient in terms of producing more papers, which is an indicator of *excellence* in many universities (Andrew, 2024). Generative AI is certainly useful for researchers, though it

may lead them to develop publishing addiction or worsen it if they already have one. This addiction involves an obsessive need to publish academic papers, often at the cost of quality and personal well-being. Like other addictions, it includes denial and an inability to stop (Finlay, 2021). It can harm the individual and their family and lead to the loss of social activities. People may also develop habits like constantly checking citations and h-index scores on Google Scholar or other scholarly databases (Finlay, 2021).

By browsing papers on ResearchGate and Academia, I noticed many academics uploading papers that are often barely edited outputs from AI tools. Some academics put them in the pre-print category and submit them to predatory journals that accept almost anything. For example, I saw one American researcher who published an insane number of papers in sub-par journals just to have his name published. He published more than 150 papers in total since 2023, the year that ChatGPT became well-known to the public. He used ChatGPT and often titled his papers with phrases like “a ChatGPT study,” “A chat with ChatGPT,” or “a ChatGPT reply.” In his papers, he would self-cite extensively; in one paper, he self-cited 49 times. ‘Twas a cunning shortcut in a neoliberal, metrified system in higher education.

This trend of publishing barely edited AI-generated papers in predatory journals deeply concerns me. It diminishes the quality of academic work and distorts the metrics used to evaluate a researcher’s impact. It’s unfair, confusing, and even infuriating. Instead of genuine research, it wastes time and resources. Voila, people can’t trust academic papers as much because of this.

Since AI has made everything faster, it has become a blessing for many academics coping with the “publish or perish” phenomenon (Elías, 2019). The pressure to publish may drive researchers to use unethical AI shortcuts. The hyper-competitive culture in academia compels researchers to publish in journals, often in English (Tudy, 2023), which poses challenges for non-native speakers (Di Bitetti & Ferreras, 2017). This mantra has real consequences; failure to publish can result in leaving an institution.

A concrete example is an English literature instructor I know from a private university who experienced this predicament during the chaotic COVID-19 pandemic period. Because the university was reducing its workforce to cut costs due to declining profits, it laid off employees who were not contributing much to the improvement of its research reputation. According to his students, he’s an excellent instructor. However, because he had an insufficient number of publications, the university still dismissed him. Fortunately, he was later employed by a high school.

Some researchers willingly submit to and publish in predatory journals (Yeo-Teh & Tang, 2021) for various reasons, including job security and securing funding. Others engage in what can be termed as *intellectual masturbation*—an academic pursuit that is self-indulgent, overly theoretical, or disconnected from practical application or real-world impact. This behavior involves publishing papers primarily to impress peers rather than making meaningful contributions to knowledge or solving practical problems. In the context

of publishing addiction, intellectual masturbation may occur when researchers prioritize the quantity of publications over quality or engage in research solely to enhance their CVs or reputations. One major problem is that since they want the research process to be so easy and instant, they publish haphazardly which results in papers with misinformation or fake references generated by AI (Giray, 2023c).

I don’t want to be a hypocrite. I admit I’ve become addicted to publishing. I believe this can improve my credibility and job prospects at higher-paying universities. But, this addiction is attributed partly to generative AI. It’s a handy tool that helps me publish more papers and increase my h-index. Now, I see that my academic goals have also grown. From being satisfied with a Master’s degree, I now aspire to pursue a PhD. Not just a local one, but an international one. In the academic market, I found that the most palatable candidates are those with international degrees. And I think using generative AI for research tasks like editing, analysis, proofreading, and translation could make this goal more possible. Generative AI is incredibly helpful for non-native English-speaking researchers like myself.

My strategy is to pursue a PhD by publication, a specialized route for individuals who have published extensively on a single topic. This approach is recognized in some countries like the UK and Australia. This is not much known in my country, the Philippines. Actually, I just don’t want to follow the usual path of pursuing a doctorate, which supposedly takes three years, but in my country, because of bureaucracy, it often takes five years on average in public settings, even if one takes the maximum number of units every semester. I also don’t want to deal with nonchalant, power-tripping, and/or toxic supervisors. In fact, toxic supervision practices (e.g., narcissistic and exploitative behaviors) are a major factor causing PhD students to discontinue their programs, which leads to mental health challenges and program delays (Okere, 2024).

The Philippine graduate school system is drowning in a sea of reporting demands that overshadow the essence of teaching. Professors typically delegate the reporting tasks to students, dividing them into groups to cover different segments of the syllabus. In each session, a group reports on their assigned segment while the professor passively sits at the back, occasionally inserting comments—sometimes unrelated, like organizational gossip or personal anecdotes. This tactic of offloading reporting responsibilities onto students has become an oppressive mechanism. This reduces teaching to a mere formality.

Aside from that, graduate students often find themselves cramming their theses into one year because that’s how the curriculum is structured, which is ironic given that graduate studies should be the most focused and prioritized phase of their education. During my MA, my colleague was asked to complete a thesis he didn’t want to do, a complete deviation from his original proposal. He was told to do this because it would aid in the university’s accreditation process, where his thesis adviser is involved. This power play left him feeling compelled to comply just to graduate.

The misunderstanding of vertically aligned degrees leads many university administrators to require students to pursue programs they don't want. For example, my colleague from a university specializing in teacher education was directed to MA in Linguistics instead of her preferred MA in Special Education because it was deemed more aligned with her Bachelor's degree. This policy restricts academic freedom, presenting students with a false choice and limiting opportunities for interdisciplinary and multipotential growth (Giray, 2023a). All the narratives show how Philippine graduate schools contribute to the dehumanization and alienation of students, transforming institutions into undemocratic, tyrannical environments—a troubling trend indeed. Coming from an urban poor community—I live near the railroad, where teenage pregnancy and under-the-table crimes are common—I face financial challenges and cannot afford the high tuition fees for a doctorate, more particularly at a top-tier university. Hence, my strategy is to secure a scholarship from the Department of Science and Technology. Although my research interests were initially in education and teaching, I now aim to align my research with their focus, which is on science and technology. Now, I focus on the intersection of generative AI and academic writing. I diligently write papers on this topic almost every day, filling notebooks with ideas and managing numerous Zotero attachments. My goal is to have ten published papers on this topic. I believe that generative AI can help alleviate my challenges with organization, language, and time. However, I have noticed recently that this dedication is somewhat evolving into a publishing addiction—causing me to often neglect physical exercise and even familial/social relationships.

Generative AI has made academic publishing faster and easier, but it may lead to publishing addiction, where researchers focus on quantity over quality. This addiction may harm personal well-being and degrade the integrity of academic work. Because of the temptation that generative AI brings, researchers may submit poorly edited AI-generated papers to predatory journals. Now, they're doing these shortcuts to research writing so that they retain their job. When people's jobs or lives are unstable and uncertain (precarious), they are less likely to do what is right because they fear losing what little security they have (Giroux, 2014). This wastes resources and erodes trust in scholarly publications. Indeed, balancing the use of AI with ethical practices is vital to maintaining the value of academic research.

Generative AI reinforces the Dunning-Kruger effect

While generative AI certainly helps students and faculty members to write (Giray et al., 2024b), it doesn't mean they have mastered the topic or become experts. Large Language Models (LLMs) can produce long, coherent essays with just one prompt. Students and faculty members may read it and believe they understand the material comprehensively and can make expert comments. Consequently, this results in overconfidence in both the AI and their own abilities.

This phenomenon is called the Dunning-Kruger Effect, a cognitive bias where people with low ability or knowledge in a specific area overestimate their competence (Kruger

& Dunning, 1999). They don't realize their lack of skill and mistakenly think they are more knowledgeable than they really are.

Scrolling through Facebook and Instagram, I'm constantly seeing ads from self-proclaimed AI experts. These ads often promise to save hours each week if one buys their course. These self-proclaimed AI experts on social media illustrate the Dunning-Kruger effect. They confidently claim expertise in AI but often lack deep knowledge. This overconfidence leads them to offer courses and certifications that may not provide real value. One even announced that his courses are "super useful for everyone" and that they shall "help you achieve real results and change your life today!" This highlights the overestimation of their abilities in a complex field like AI.

I recall an example. There's Mike, an environmental engineering major. I asked the class to discuss the concept of stress and its impact on them personally, with a one-week deadline. Mike submitted two papers instead of one, insisting I review both. Upon reading them, I suspected they were AI-generated. The task required personal reflection on digital stress, but his submissions had none. They were generic, robotic, and devoid of personal experience. Despite his previous struggles with essay writing, he was overconfident in his AI-generated work.

Another example involves a civil engineering student-researcher who relied heavily on AI for her paper. The paper was riddled with errors, vague methodologies, bland discussions, and poor citations. Despite this, she was proud of her work and believed it was award-worthy. Her overconfidence stemmed from her reliance on AI and how thick her paper is, not her understanding of the subject. Terms like "cutting-edge," "comprehensive" and "transformative" were used unnecessarily. This overconfidence is a growing problem among students. Some students believe they are already proficient just because they have submitted papers that look impressive, yet mainly AI-generated and vacuous. They think it's a magical tool that can bypass the hurdles of writing and automatically earn them an A+ as if they'd wished it from a shooting star.

Early career researchers often fall into the trap of believing they are superior because they use generative AI tools without understanding their limitations and biases. These tools can hallucinate and present inaccurate information. One IT instructor claimed he could produce outstanding research in one sitting with AI, ignoring the complexities of data collection, analysis, literature review, and intertextuality. This is misguided and ironic, especially since he should be more knowledgeable about AI's limitations, given his educational background

Let's go back to the American academic I was discussing previously, whose addiction to publishing has become more pronounced because of generative AI. I reckon he suffers from the Dunning-Kruger effect. This leads me to conclude that these two issues might be linked. Despite his specialization in accounting, he has used ChatGPT to publish papers on a wide range of unrelated topics, including Chinese herbs, gender discrimination, cosmology, education, Tai Chi,

Russian annexation, gynaecology, and even harvesting body parts from death row inmates.

I've realized I might be falling prey to the Dunning-Kruger effect myself. The allure of generative AI has led me to write papers outside my specialization. Recently, I delved into fields like mental health and addiction with the help of ChatGPT. This has been presumptuous of me, but I'm trying to be mindful of it now. Initially, I felt confident in my work until receiving feedback from experts in those fields. Their significant critiques have made me aware of my limitations. The use of ChatGPT to generate content on these diverse and unrelated subjects accentuates a huge disconnect between researchers' actual expertise and their perceived competence. The problem here is that they overestimate the understanding of these complex and varied subjects due to the seemingly authoritative outputs generated by generative AI.

Generative AI makes it easy for people to think they're experts when they're not. But they don't think of that. They think they are *qualified* and *excellent*. They have just sunk in the Dunning-Kruger quagmire. The deeper they sink into this circumstance, the more the risk becoming a fool, lost in the depths, destined to drown in their own overconfidence and ignorance. They can only escape this mucky quagmire when they finally realize they're stuck in it. When they pause their relentless movement/panicking (taking a moment to step back and reflect inwardly) and reach out for help (admitting their ignorance, asking experts), they might find a way out of the quagmire that has ensnared them.

Generative AI leads to skill erosion

In January 2023, my colleague introduced me to ChatGPT, and I was blown away by how fast it could spit out answers. It felt not only magical but charmingly infernal! I quickly realized that if I didn't start using it, I'd be missing out on some serious opportunities and the potential to improve my life for real. My thinking was pretty straightforward: *more papers = better job prospects*. Then, *better job prospects → fatter paycheck → better life*. I know life is not that simple, but I was all about maximizing my chances.

Pre-ChatGPT era, writing a 3000-word commentary would take me a good two months. One, because I'm always busy with work and other affairs, and two, because it involves a ton of investigation, talking to people, and endless editing and revising. For simple research papers, it was a whole six-month ordeal, and that's with a team of four collaborators hustling alongside me. Our brains were fried, and frustrations were high—some even threw in the towel at some moment in time. But, after all that, we'd celebrate by gaming or hitting up a mall food court. In my defense, we're young, ambitious, never-funded researchers. Thanks to ChatGPT and its cousins, we've slashed that time down to an average of just three months. And that's a whopping 200% boost in productivity!

Using AI to help with writing papers and research was a disruptive force. 'Disruptive' could mean for better or worse. It made me way more efficient. It gave me a gift of time

(Tregoning, 2023). I tripled my output and started racking up citations and publications in journals indexed by Scopus. But amidst all this newfound efficiency—I started wondering if I was actually becoming a better academic writer and researcher.

While generative AI tools are often praised for enhancing writing among non-native English-speaking researchers (Hwang et al., 2023), I've been thinking about my writing, and I'm starting to feel like something's off. I've been cranking out papers so quickly that I might be neglecting to improve my writing and research skills. It feels like they might be getting rusty.

Before generative AI was a thing, I'd spend a huge amount of time brainstorming, reading, and planning my writing. Drafting took a while, and I'd spend over a month proofreading and continually revising. Basic word processing and grammar tools were the primary tools I used. It was tough, but I knew it was worth the effort. With generative AI helping me, I can finish the same commentary paper in about two weeks or even a week if I'm not busy with other tasks. Sure, it saves a ton of time, but I'm skipping some important steps. Just like any skill, if you don't use it, you lose it (Bushuyev et al., 2024), and I think that's what's happening to me.

This reminds me of the concept of *desirable difficulties*, which I think I'm missing out on because of the automation provided by AI. Desirable difficulties are challenging and effortful tasks that lead to better long-term retention and understanding (Brown et al., 2014). Brainstorming is hard. Editing is not easy. Revising is backbreaking. But they all help me understand and appreciate the process of writing.

Right now, my writing process is all about writing a bunch of ideas down, even if it's messy. It's the idea of *shitty first drafts* (Lamott, 1995), which is a preliminary and important thing to do in any writing process. I just let the grammar go haywire, some sentences half-done, like a typhoon hit the page. The main thing is I'm just letting loose, spilling out all the stuff from my brain. Then, with AI, I transcribe it using Office Dictation in Microsoft Word, which writes what I say automatically. Then, I ask ChatGPT to fix it up. After some edits, voila, I now have a half-baked paper! Insufficiently cooked—but, at least, I've got one. The writing process has become more bearable than ever before.

Many researchers are seeing their writing and research skills decline because they rely heavily on AI. This dependence has led to concerns about compromised scholarly integrity, with instances of AI-generated content containing AI hallucinations, fake references, and blatant copying (Giray et al., 2024a). This undermines their ability to critically review literature and write research papers effectively.

For instance, a group of Chinese researchers in materials engineering used ChatGPT to write their paper's introduction, starting with the phrase "Certainly, here is a possible introduction for your topic" (Zhang et al., 2024). In another case involving Israeli medical researchers, in their paper's discussion, one can see an AI answer, "I'm very sorry, but I don't have access to real-time information or patient-

specific data, as I am an AI language model” (Bader et al., 2024).

How did editors and reviewers miss these issues? These problems spread across social media. If netizens hadn’t exposed them, they might still be overlooked. Netizens played a crucial role in bringing these issues to light, leading to retractions. These practices undermine academic rigor and erode critical thinking and scholarly writing skills among researchers. As AI tools proliferate, there’s mounting concern that these shortcuts could degrade the overall quality and reliability of academic research.

This is reminiscent of the tragedy of Air France Flight 447 in 2009, which serves as a poignant reminder of the perils of excessive reliance on automation (Oliver et al., 2017). When the autopilot failed due to icy airspeed sensors, the pilots had trouble flying manually in bad weather. Similarly, if we, researchers, lean too heavily on generative AI for editing, writing, and analysis and whatsoever, the risk of an academic crash looms large—jeopardizing the integrity essential for scholarly progress.

Generative AI’s ability to create content may lead to intellectual laziness (Nongxa, 2020). Researchers may not put in the necessary rigorous mental work or be unwilling to engage in deep thinking or critical analysis. They may rely too much on generative AI, losing touch with the skills of their craft. The instant gratification provided by generative AI can be very tempting. Once pursued, they may be gratified. But when everything’s instant, they can have negative effects.

This reminds me of instant noodles and canned foods. These conveniences may lead to a lack of appreciation for the process and effort required in traditional cooking or preparation. These instant options are often less nutritious and high in preservatives. Likewise, in intellectual pursuits, relying on instant answers or solutions can result in a shallow understanding and a diminished capacity for patience and critical thinking. In fact, this relates to what cognitive science says. If people give in to this instant gratification, it negatively affects their patience and self-control, leading to long-term consequences (Magen & Gross, 2007).

Just as neurons weaken from disuse (Brown et al., 2014), relying too much on generative AI for writing and research can erode our skills. Depending solely on automation can stagnate our skills, reducing the depth and quality of our work over time. We don’t want, of course, to experience *skill atrophy*—when we see ourselves declining in our abilities or proficiency because we lack practice or use.

Therefore, sometimes, it’s necessary to ask ChatGPT to get off our lawn (Jenkins, 2023) so that we can reflect and grow as researchers. In a model I’m currently crafting to help multilingual learners integrate generative AI in cheating-free L2 writing, there are certain stages in which AI must not be used so that they can develop their own critical thinking skills and writing abilities. At the same time, we, researchers, must focus on developing our skills and recognize that while generative AI may enhance efficiency, it should not replace our effectiveness in the core skills of thinking, writing, and researching.

Conclusion

To recapitulate, here is a summary of the negative effects of generative AI on researchers. It highlights three key areas of concern: the exacerbation of publishing addiction, the reinforcement of the Dunning-Kruger effect, and the erosion of skills.

Table 1. Negative effects of Generative AI among researchers.

Negative Effects	Key points
Generative AI exacerbates publishing addiction	- The ease of generating content with generative AI may encourage a focus on producing a high volume of publications rather than prioritizing quality. This shift in focus may lead to an increase in submissions to journals without adequate peer review, potentially undermining the integrity of scholarly work. - Generative AI tools may facilitate unethical self-citation practices, as researchers attempt to boost their metrics, such as h-index, by generating content that cites their previous work. This practice can distort the perceived impact of their work and skew the academic record. - The rush to publish quickly, made easier by generative AI, can result in the dissemination of unverified or incomplete information, which can mislead other researchers and the public.
Generative AI reinforces the Dunning-Kruger effect	- Generative AI may give individuals a false sense of expertise, as they may use sophisticated-sounding content without fully understanding the underlying concepts. This can lead to overconfidence in their knowledge and abilities. - Generative AI may lead students and researchers to overestimate their abilities, as they may rely heavily on AI-generated content without critically engaging with the material. This reliance can hinder the development of necessary skills to evaluate or challenge the information. - Students and academics may fail to recognize their own incompetence, exacerbated by generative AI, that masks the gaps in their knowledge. This can hinder genuine learning and growth, as individuals may not seek further education or feedback.
Generative AI leads to skill erosion	- Over-reliance on generative AI-generated outputs may result in a lack of critical thinking and analytical skills, as individuals might accept the generated content without scrutinizing its validity or accuracy. This could lead to the spread of misinformation and poorly reasoned arguments. - By bypassing traditional writing processes, such as brainstorming, outlining, and editing because of generative AI, students and academics may miss opportunities for skill development and personal growth in writing and research. These processes are crucial for honing one’s ability to communicate complex ideas clearly and effectively. - The erosion of skills due to generative AI can have long-term consequences, particularly for students and early-career researchers, who may become dependent on AI tools and less capable of producing independent, high-quality work. This dependence may limit their career prospects and ability to contribute meaningfully to their fields.

As summarized in Table 1, Generative AI has some serious downsides for researchers that we need to address. First, we’ve got to rethink our publication standards to focus more on quality than just pumping out a lot of content. AI makes it easy to churn out papers, but this can flood academia with low-quality work, contributing to *digital garbage*. We should tighten up peer reviews, set stricter standards, and create guidelines to avoid unethical practices and the rush to publish unverified research. Regular checks can help make sure only the best work gets through.

Secondly, we need to be careful with AI tools and not just treat them as a quick fix for everything. Generative AI could make people overconfident and give a false sense of expertise if they’re not using it wisely. Researchers and academics need to be trained on how to evaluate AI-generated content and understand its limits. Adding AI literacy to Master’s and PhD programs and offering workshops can help build critical thinking skills and prevent the Dunning-Kruger effect.

Finally, even with AI making things easier, we can’t let essential research skills slide. Over-relying on AI could dull our critical thinking and writing abilities. There is a higher

need to keep emphasizing traditional research skills like brainstorming, outlining, and editing. Academic tasks should be designed to make students engage with these skills actively, so they're prepared to do great work even if AI isn't around.

Epilogue: The researcher as a craftsperson

In this paper, I have highlighted the negative effects of Generative AI. While it certainly boosts productivity, the use of generative AI may lead to a focus on quick publications over deep, original insights, resulting in publishing addiction. It may also cause researchers to overestimate their skills (the Dunning-Kruger effect) and may erode their writing abilities. I can compare a true researcher to a skilled craftsperson who meticulously carves intricate designs into wood, metal, or stone. Each stroke of the chisel represents careful thought and vision. This craftsperson's work reflects years of honing their skills, developing techniques, and creating original masterpieces that stand out. In contrast, a machine programmed to replicate these designs quickly churns copies with mechanical efficiency. While it can mimic patterns and shapes, it lacks the human touch—the ability to innovate, adapt, and imbue each piece with meaning and creativity. Similarly, researchers who rely on generative AI for research writing may produce outputs efficiently, but they risk missing the nuanced perspectives and innovative approaches that define true scholarly work.

After being heartbroken, Midas was pitied by the god Dionysus, who told him to wash in the river Pactolus. He followed the instructions, and the golden touch was washed away. Then, he renounced his riches and became a wiser, humbler man. Just as King Midas learned to value life's true treasures, researchers must recognize and preserve the true value of their intellectual endeavors by practicing intellectual humility and striving for excellence in all their tasks.

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Hey, ChatGPT: How should we teach law to Generation AI?

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Keywords

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Abstract

Technology is no longer a tool but a skill. Teaching is a challenge in the age of Generative Artificial Intelligence (AI). However, the real problem seems to be not about what to teach but how to teach. So, this opinion piece aims to answer the following research question (RQ): How should we teach Generation AI? In this opinion piece, I share some teaching notes and propose five recommendations for AI use in education, especially in legal education.

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Introduction

In the information society, the question should not be only “What should we teach Generation AI?” (Waring, 2024) but “How should we teach Generation AI”? It is necessary to understand that there is a methodological turn in the epistemology to answer this question. Today, education is not just focused on the relationship between professor and student (Trigwell et al., 1999; Gillespie, 2005; Hoffman, 2014; Tan, 2019). There is a third element: technology (Giannini, 2023; O’Leary, 2020; Shomirzayev, 2020; Trammell, 2020; Or, 2023). In this study, one of the technologies discussed is Artificial Intelligence (AI).

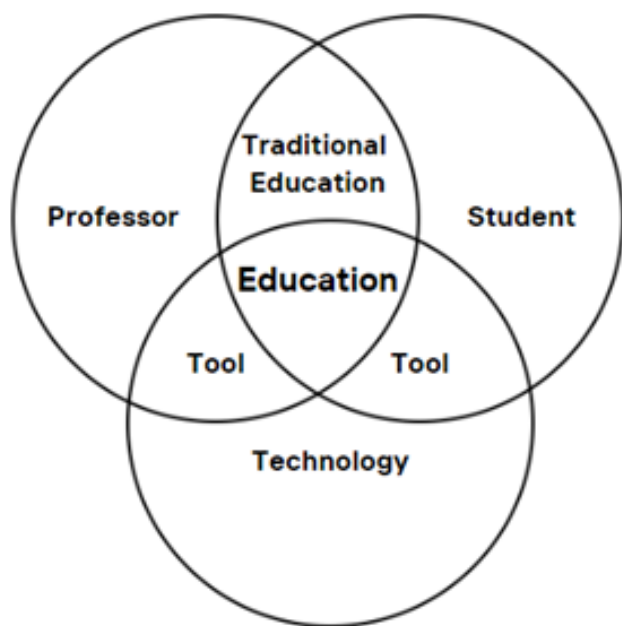


Figure 1: Education in an informational society.

Any educational practice must take technology into account (Stein, 1990; Jones et al., 2013; Smith, 2020; Barczentewicz, 2021; Jang et al., 2022; Rudolph et al., 2023). It is a variable the market demands (Esteve-Mon et al., 2020; Skantz-Åberg et al., 2020; Waring et al., 2020). Skills are created based on this demand (Albrahim, 2020; Trammell, 2020). Therefore, understanding and mastering technology is an indispensable skill for professionals, regardless of their field (Bond et al., 2020; Bedenlier et al., 2020; Sailer et al., 2021). This author will present ways of thinking about education based on teaching notes from a lecture in a tort law workshop.

How should we teach Generation AI?

AI is one of the different kinds of technology. First, in education, we must question what the students need (Ribeiro, & Passos, 2020; Carvalho et al., 2021). This need will be variable according to the discipline. I am a Professor of Law in Brazil. So, the competencies and abilities of Brazilian law students are defined by the Ministry of Education in the National Curriculum Guidelines for Undergraduate Law Courses. Even though the education system does not yet require AI skills, they constitute a market and professional demand. Their development is therefore highly

recommended. Mastering technology is one of the skills and abilities of the future lawyer (Davis, 2020; Boonin & Herrera, 2022) because it plays an important role in data protection (Santos Divino, 2019), legal design (Hagan, 2020), AI in courts (Ulenaers, 2020), smart city legal issues (Ismagilova et al., 2022), digital justice accessibility (Susskind, 2023), and others (Zou et al., 2019). There are several ways to develop this skill (Graben, 2021). In this opinion piece, I will demonstrate how to teach a law student to use Generative AI.

Do I need to use AI?

Developing technological skills is not just about mastering AI techniques. In law, other technological tools, such as electronic judicial procedures, must be mastered. Therefore, AI will only be necessary for legal education when it is indispensable for developing techniques and skills for its use. For example, I can use AI to learn and apply rules in a case. You can use AI to proofread a legal document. Furthermore, we can improve critical and legal reasoning using AI. Thinking about the future lawyer background, they need to understand how it can be used as a tool in legal practice to protect their client’s rights. First, AI has been widely used in Brazil to support judges in decision-making (Maia Filho & Junquilha, 2018). So, it is important to know the entirely automated decision-making process, in order to verify and identify what is made by AI and what is made by the human and counterargue. On the other hand, AI may not be necessary for all educational acts. When a lecture is expository, AI may not be useful. AI is also not appropriate when we want to develop interpersonal relationships.

Recommendation 1: Only use AI in education when necessary.

Where and what can AI be used for?

AI can be used at different times in the semester, but the main ones are during the education process and grading exams. An example is the AI used to automate the marking of multiple-choice questions. However, it is important to emphasise that AI should not replace the professor in the assessment process. The AI will only be used as an “assisting tool”. Furthermore, the law student can be supervised if the professor uses AI in the classroom. For example, AI can be used to analyse a database or identify statistical patterns in court decisions. On the other hand, if the professor authorises the use of AI outside the classroom, he must teach the law student how to use it, especially how to make more appropriate inputs.

Recommendation 2: Choose the right time to use AI.

How do I know the right time to use AI?

First, I must master how AI works. This is not a programming skill. The competence I’m referring to is one in which the professor knows AI functions, capabilities, and limitations. Why should I master how an AI works? First, I need to know what input to use. The more suitable the input, the better

the output. Moreover, I need to understand that Generative AI can give different outputs for the same input.

Knowing how AI works allows the professor to choose different learning methods and different times for its appropriate use. For example, the Brazilian legal system is based on civil law. Thus, we have a code for most legal disciplines. However, we have also adopted a system of precedents. Therefore, thinking about Brazilian law is a considerably complex task. To this end, we use the workshop at law school as a suitable method to avoid considerable theoretical study without practical application. The workshop predominantly uses the case study method.

In a tort law workshop, I used AI to analyse a case about tort liability in consumer relations. The aim was to use ChatGPT to:

- a) Identify possible theoretical flaws in the outputs;
- b) Identify mistakes in the AI's logical reasoning (Dai et al., 2019);
- c) Identify how AI works based on the different answers to the same question (Vaswani et al., 2017);
- d) Identify the adequacy of the answer to the Brazilian legal system (Law and precedents);
- e) Identify the personal limitations (of law students) to AI; f) Identify that AI can be wrong (Perkins & Roe, 2024);
- g) Develop a sense of responsibility in the use of AI (Bleher & Braun, 2022); h) Analyse and criticise the outputs;
- i) Develop better outputs;
- j) Develop human autonomy in the face of AI;
- k) Develop skills to master legal methodology through the use of AI; and
- l) Understand the impacts of using AI on law students and potential clients (Bao et al., 2022).

These objectives can only be achieved with proper digital literacy (Reddy et al., 2020; Tohara, 2021). Professors need to master the technology (Rojas-Osorio et al., 2024). They must be aware of its limitations (Ray, 2023), practical issues (Baidoo-Anu & Ansah, 2023), and ethical issues (Shope, 2021; Sobaih, 2024). About this latest situation (ethics), a New York lawyer cited fake cases generated by ChatGPT (Moran, 2023). In Brazil, a lawyer was also punished by the Superior Electoral Court for using the same tool (Guido, 2023).

From an experiential act, I identified i) the Unfamiliarity of some students with the existence of ChatGPT, ii) Unfamiliarity with ChatGPT's functionalities, iii) Difficulty preparing appropriate inputs, iv) Difficulty interpreting the outputs,

and v) Difficulty criticising the outputs. From this, I realised that the students needed more adequate training in AI, specifically Generative AI. Therefore, the three subsequent lessons were aimed at developing these skills. At the semester's end, some law students felt more comfortable using AI. However, some students stated that they did not like using AI as a tool because it was unpredictable.

Recommendation 3: Professors must be digitally literate.

If the professor does not master this skill, there will probably be consequences. First, the use of AI, even if supervised, may not be efficient. As a result, the objectives may not be achieved. Second, with no supervision, law students may develop inadequately or not develop the desired competence and skill. Finally, not knowing how AI works can lead to the exclusion of some students from the educational process.

Therefore, the right time to use AI in education is when both professors and students are digitally literate. However, we need to choose which type of activity I will use AI for.

How do I choose which type of activity I will use AI for?

In any type of activity, the professor needs to think about what competencies and skills he or she wants the student to develop. Even an exam is not suitable. We recommend using active teaching-learning methodologies whenever possible. I must use AI tools to achieve this if I want to develop critical reading skills. For example, we can use Socratic dialogue. On the other hand, if I want to use AI to improve my writing skills, I need to find an AI tool that matches my needs. It should be noted that mastering methodological activities requires planning. The professor will only be able to choose the type of activity best suited to the use of AI if they think critically in advance about what competence they want the student to develop.

Recommendation 4: The use of AI in education should be planned before the lecture begins.

We're looking for predictability. It allows us to anticipate possible challenges and overcome them before they happen. Moreover, even if it is impossible to solve them beforehand, planning will enable the professor to deal more adequately with unforeseen events. Therefore, luck is not an element in the educational relationship involving AI.

Another question that arises: What should be done when the student uses AI when it is not authorised? (Mohammadkarimi, 2023).

This question is directly tied to the type of activity that will be created by the professor. It can and will happen that a student delivers an activity done entirely by AI. How should the professor act in this situation? Firstly, if the professor has prohibited the use of AI and it is used in an exam, there is something methodologically wrong. The professor should rethink the teaching methodology if an activity can be carried out exclusively by AI without the student's input. This is a pain point for the professor. Many believe that

traditional education should stay. However, AI challenges traditional education (Dignum, 2021). So, if the aim is for the student to carry out an activity to develop a particular skill, that activity should be carried out so that the use of AI is not possible or, if possible, is minimal.

Recommendation 5: Avoid designing activities that can be done by AI alone.

I think this is the most difficult point: choosing activities that cannot be done entirely by AI. It is also important to highlight the difficulty of detecting the use of AI in academic work (Hassoulas et al., 2023; Chaka, 2023; 2024). That is why I mentioned earlier that there is an epistemological turn in education. We now need to integrate technologies as educational tools. However, we need to think about how to use them consciously to achieve the desired competencies and skills (Ifelebuegu, 2023). All these planning can prevent frustration on the part of the professor and ensure that the education is as effective and efficient as possible.

Conclusions and recommendations

It is believed that one of the ways of improving education (teaching and learning) is through experience reports. Teaching Tort Law with AI is a challenge. First, there is a need for digitally literate students. Secondly, there is no consensus on the AI use. Third, many students do not even have an ethical outlook on AI. Fourth, not all students have the electronic devices to use AI. However, teaching Tort Law with AI also brought positive results, as the students engaged with each other. In the end, some of the challenges were partially overcome. They developed interpersonal communication skills. They identified the problems that needed to be overcome. They demonstrated how to overcome these issues. Thus, some of these skills and competencies could not be developed in a traditional lecture.

The use of AI in education needs planning. Ideally, this planning should take place before the lecture begins. In this way, you can identify which students' skills and abilities will be developed, as well as the appropriate methodologies for their development. In addition, planning will make it possible to identify strengths and weaknesses and remedy them in good time. Finally, the professor will be prepared to deal with possible unforeseen circumstances. Given the above, the simple recommendations in this opinion piece are aimed at professors who intend to start or are already using AI in education.

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The personalizing power of error: Leveraging Artificial Intelligence in 21st century learning

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Abstract

This opinion piece explores the role of artificial intelligence in transforming the perception of errors into opportunities for personalized and lifelong learning. By leveraging AI's ability to systematically analyze error patterns, educational institutions can create controlled environments where errors are embraced as catalysts for learning growth. The introductory section sets the context, presenting AI as a tool for shaping Education 4.0 and addressing urgent needs in the 21st century. The body of this opinion piece delves into its central claim: AI is the mechanism that will allow not only to take advantage of error but to intentionally and controllably encourage students to fail in learning as a starting point to turn errors into a catalyst for personalized learning. Claim-related arguments are provided, including using AI to analyze errors and nurture a growth mindset, preparing students for future challenges, and reducing teacher workloads. The conclusion emphasizes the significance of adopting an error-driven approach to foster lifelong learning. Overall, the paper underscores AI's potential to revolutionize education by harnessing the power of errors.

Introduction

The digital revolution has begun to transform virtually every aspect of our society, and as we move towards an increasingly technological future, the need to adapt educational systems to the realities of the 21st century becomes imperative (Nayan et al., 2024). In this context, artificial intelligence (AI) emerges as a powerful tool with the potential to catalyze structural change in the way we teach and learn (Burbules et al., 2020). By leveraging its capacity to analyze data, personalize content, and turn errors into learning opportunities, AI promises to redefine education as we know it.

AI and Education 4.0: Present and future of educational systems?

According to Kim (2022), in the current digital era, education faces an unprecedented challenge: the need to adapt to the unique needs of each student. In this context, where education intersects with the development of the fourth industrial revolution, the so-called "Education 4.0" emerges (Aziz Hussin, 2018), which has gained relevance in recent years, advocating for a student-centered educational approach that leverages disruptive digital technologies to personalize learning (Bremner, 2021). Thus, as Huk (2021) points out, Education 4.0 is based on the premise that learning should be personalized, and adapted to the skills, interests, and learning styles of each individual.

Considering the above, Nabizadeh et al. (2020) mention that current educational systems must transition from standardized and rigid structures to models more oriented towards addressing the ambiguity and uncertainty of today's world. In this context, pedagogical approaches must adapt to the changing demands of the 21st century, where personalization plays a fundamental role (Vargas et al., 2024). It is important to mention that this paradigm shift implies a transformation in the way educational programs are designed and implemented, moving from a "one-size-fits-all" approach to one that recognizes and celebrates student diversity (Shemshack et al., 2021).

Personalization of learning not only brings benefits to students but also to teachers and educational institutions as a whole (Du Boulay, 2019). By understanding and addressing the individual needs of students, educators can optimize resources and pedagogical strategies, which in turn leads to better outcomes and greater satisfaction for all involved (Iatrellis et al., 2019).

For instance, platforms like Carnegie Learning's MATHia utilize adaptive algorithms to analyze individual student performance in mathematics, adjusting the difficulty and type of problems presented based on the learner's progress. Similarly, language learning apps such as Duolingo employ AI to tailor vocabulary and grammar exercises to each user's proficiency level and learning pace. Furthermore, AI-powered writing assistants like Grammarly not only provide real-time feedback on grammar and style but also offer personalized suggestions for improvement based on the individual's writing patterns. In the realm of intelligent tutoring systems,

tools like Third Space Learning use AI to match students with the most suitable online tutors and adapt teaching strategies in real-time during one-on-one sessions. These examples show how AI can facilitate a more engaging and effective learning experience by offering personalized guidance and support tailored to each student's unique needs and learning style.

Regarding personalization of learning in Latin America, Colombia has made notable strides in this area. For instance, Lavallo et al. (2024) report some research results regarding an intelligent tutoring system based on personalized learning for teaching health care protocols. For its part, Parra Sanchez et al. (2023) report an experience of personalizing resources for teaching university mathematics using artificial intelligence. Likewise, Intriago-Mera (2024) mentions other similar experiences in Ecuador, which highlight their positive effect on academic performance and student motivation.

Ultimately, and in line with what Holmes et al. (2019) mention that as we advance in the digital era, it is crucial that educational systems evolve to keep up with emerging demands and challenges. Therefore, the transition towards more personalized and adaptable approaches is desirable and a pressing necessity to ensure that education remains relevant and effective in the 21st century. In this sense, in the context of a heated conversation that is intensely debated between pros and cons, enthusiasts and detractors, ethical concerns (Popenici, 2023) and critical socio-political and cultural positions (Sevnarayan & Potter, 2024), artificial intelligence is emerging as one of the most promising tools to achieve learning personalization, by allowing educational systems to dynamically adjust to different learning styles and rhythms (Shemshack et al., 2021).

Personalized learning: An imperative for the future of education

Regarding Education 4.0, personalized learning has gained increasing relevance in the discussion about the future of education (Fariani et al., 2023). Unlike the homogenizing and standardized approach traditionally used, personalized learning recognizes that each student has their strengths, weaknesses, interests, and learning styles. Personalized learning is considered a student-centered philosophy and practice, based on understanding the unique needs, strengths, and interests of each learner (Bray & McClaskey, 2016).

In the context of trends related to Education 4.0, personalized learning emerges as an alternative to transforming conceptions, goals, and paradigms of conventional education. In this regard, UNESCO (2017) refers to personalized learning as a student-centered educational approach, where the learning process recognizes and addresses the needs, interests, skills, and strengths of each individual.

This approach also implies giving students the possibility of choice and autonomy during training experiences and curricular trajectory, addressing what, when, how, and where to learn (Lee et al., 2021; Xi et al., 2024). The strategies used

to develop personalized learning share the particularity of identifying individual student characteristics, including cognitive and/or non-cognitive aspects. However, they differ significantly in terms of technological integration, which tends to be increasingly sophisticated (Walkington & Bernacki, 2020). At the same time, these strategies vary in the level of personalization, as they can include one or several educational components, such as content, teaching or learning methods, learning rhythms, educational resources, assessment methods, and interfaces used (Barrera Castro et al., 2024; Bernacki et al., 2021).

Nevertheless, traditional teaching faces serious challenges in achieving true personalization, including overcrowded classrooms, limited resources, and a lack of accurate data on student performance, making it difficult to provide individualized attention. Consequently, as Pane et al. (2015) warn, that many students fall behind or do not reach their full potential due to the lack of adaptation to their specific needs.

AI as a driving agent for personalized education

As mentioned by Luckin et al. (2024), in this context, AI emerges as a powerful technology with high transformative potential, with the capacity to involve a variety of educational stakeholders in the AI-related conversation and to thrive in various ways to achieve personalized education. Unlike previous digital technologies, which were limited to complementing traditional methods, AI offers an unprecedented capacity to analyze large amounts of data on student performance, identify learning patterns and gaps, and adapt content and instruction accordingly (Hwang et al., 2022; Kim, 2022; Qin et al., 2020).

Moreover, through the use of advanced algorithms and machine learning techniques, AI can constantly monitor each student's progress and dynamically adjust the learning experience according to their specific needs (Rasheed et al., 2023). This not only has the potential to improve teaching effectiveness but would also foster student motivation and engagement by providing a personalized and relevant approach (Li et al., 2019; Rosli et al., 2024).

From the perspective of using digital technologies to support learning personalization, different ways of addressing this issue are mentioned on a scale from least to most technological sophistication, including "Flexible Learning", "Adaptive Learning", "Intelligent Tutoring Systems", "Humanoid Robot Tutor" and "Behavior Prediction" (Peng et al., 2019; Velasco Suárez et al., 2023; Yang et al., 2013).

The potential of AI to understand and manage error

Although errors have traditionally been considered negative, which can generate frustration and demotivation in students, at the heart of the transformation that AI can bring to personalized education is a key perspective to transform this frequent conception: "error" should be seen as a valuable opportunity for learning, rather than a failure (Hashim et al., 2022).

Error has played a crucial role in learning processes throughout different stages of everyday life. For example, learning the mother tongue, walking, riding a bicycle, overcoming obstacles in a video game until winning it. Error is a natural phenomenon that can be beneficial for learning and memory (Metcalf & Huelser, 2020). However, as people grow and depend on the environment in which they develop, their attitude towards errors changes. Particularly in the school context, fears of making mistakes or not meeting the expectations of the teacher or peers become more evident (Alvarez-Herrero, 2019). It is essential to seek mechanisms that allow both intentional and accidental errors to be used to create meaningful learning situations.

In this sense, as Knight et al. (2023) point out, AI has the potential to leverage errors to better understand the specific difficulties of each student and provide personalized feedback and support. Thus, by analyzing error patterns, AI can identify problem areas and adapt content and instruction accordingly, reinforcing weak concepts and effectively addressing comprehension gaps.

Depending on the interpretation, error can contribute to the learning process or simply be an indicator of failure. In this sense, AI can play a fundamental role. There is evidence of technology-mediated learning personalization strategies, where AI helps in the analysis, understanding, and decision-making on how to articulate unique characteristics with pedagogical designs that precisely adjust to the difficulties and strengths of each student (Jang et al., 2022; Pratama et al., 2023). Thus, the conceptual construct presented throughout this paper becomes an invitation to explore the capabilities of machine learning to develop different stages of personalized learning through student error, thus providing an interesting didactic opportunity for the learning process.

Encouraging error: A controversial proposal

While the benefits of learning personalization have already been mentioned on the one hand, and the convenience of identifying and taking advantage of errors as a mechanism to reinforce learning on the other, in this opinion piece, we propose a view that integrates both aspects in a controversial way. This approach constitutes its central claim: AI is the mechanism that will allow students to not only take advantage of an error but to intentionally and controllably encourage them to fail in learning as a starting point that turns errors into a catalyst for personalized learning and thereby generate educational change and consistent and durable learning.

It is important to recognize that specialized literature has already provided broad and numerous aspects from which to address the characterization of a particular student, such as learning styles, interests, skills, context, knowledge levels, memory capacity, and emotions, among others (Benton et al., 2021; Namoun & Alshantiri, 2020). To these elements that are at the basis of learning personalization, we add another component that we consider key in this process: the errors that students make in their learning process. Just as several authors such as Cabrera Albert & Fariñas León (2005), and

Farconesi (2012) point out that human beings are unique and unrepeatable, we will add to this statement another of equal relevance: "Everyone makes mistakes differently". Such a statement would be the basis for considering "error" as the starting point for tracing personal learning processes.

Considering the above, designing training routes starting from the encouragement of errors is an educational bet that is interesting to explore. It is then proposed that personalized learning can arise as a result of a unique component of each student: "their errors". Errors can reveal prior knowledge and learning gaps, and can also support different stages of learning by improving cognitive and affective learning (Desai, 2020). The proposal would be configured with designs of suitable environments for deep learning, where student errors are the source of information on which the AI system relies throughout the journey to achieve learning. These strategies seek to transcend pre-designed learning routes towards increasingly personalized routes, taking advantage of the potential of emerging technologies.

In line with the central claim of this paper, Bogdanova and Snoeck (2018) argue that AI's ability to leverage errors as a learning tool, rather than viewing them as failures, represents a fundamental paradigm shift in education. By turning error into a catalyst for personalized learning, AI promises to significantly improve the effectiveness and relevance of education for each student, better preparing them for the challenges of an uncertain world.

Errors, AI and learning

After establishing the importance of errors in learning, its personalization, and the transformative role that AI can play in this context, it is essential to examine in more detail how AI can leverage students' errors as a valuable opportunity to facilitate truly personalized learning adapted to the unique needs of each individual. The following presents relevant arguments and evidence supporting the central claim of this article.

Matching errors and AI: The gateway to personalized learning

In the quest for truly personalized learning, it is fundamental to understand that errors are not mere failures but windows into a deeper understanding of each student's strengths and weaknesses. As Waladi et al. (2024) affirm, error analysis is crucial for learning personalization, as it provides valuable information about students' problem areas and difficulty patterns, considering errors as opportunities for deeper learning and better understanding of concepts.

However, in traditional educational environments, tracking errors in detail and adapting to them can be an overwhelming and impractical task due to the large amount of data and the diversity of student needs. As Pane et al. (2015) point out, teachers often lack the necessary tools and resources to accurately track individual student progress and adapt instruction accordingly.

This is where artificial intelligence emerges as a powerful tool, capable of efficiently and accurately analyzing large volumes of data on student performance and error patterns. As Rasheed et al. (2023) point out, through the use of advanced algorithms and machine learning techniques, AI can identify problem areas and error patterns of each student, allowing for dynamic adaptation of content and instruction. In agreement, González-González (2023) highlights that generative AI is revolutionizing various fields, as it can learn, devise and create new content, activities, and experiences, as well as represent information based on parameters, in this case, error patterns. This capacity for in-depth analysis and real-time adaptation is fundamental to providing a truly personalized learning experience tailored to the unique needs of each individual.

A change in mindset is needed

It has already been mentioned that instead of viewing errors as failures, a more constructive perspective considers them as valuable opportunities for growth and learning. Related to what is mentioned by Williams and Lewis (2021), it is noteworthy that a learning mindset focused on growth from errors is fundamental to developing lifelong learning skills in the 21st century. However, in conventional educational contexts, this learning mindset focused on leveraging errors can be difficult to implement due to the lack of adequate resources and tools to systematically analyze and address errors. As Zohuri (2024) warns, a new teaching mindset or educational paradigm change is expected to happen, and in this context, it may be apt to start considering errors not as failures but as personalization learning opportunities.

The concept of growth mindset, postulated by Dweck (2006), maintains that abilities and intelligence are not innate and immutable qualities, but can be developed through effort, conscious self-evaluation, and a willingness to face challenges and failures. This concept contrasts with the fixed mindset, which views capabilities as static and considers failure as indicative of a lack of natural talent, generating fear of error and avoiding difficult tasks.

Developing the ability to face failures becomes a crucial aspect in transitioning from a fixed mindset to a growth mindset. Various studies have applied growth mindset training as a methodological strategy, demonstrating its positive impact on subsequent academic success (Lewis et al., 2020). Furthermore, it has been shown that teachers' perceptions of their students can significantly influence the promotion of a growth mindset (Muenks et al., 2021). The design of school environments that allow students to learn from their mistakes and improve from them, through more elaborate practices, also contributes to strengthening this mindset (Yeager & Dweck, 2020).

At this point, it becomes interesting to consider AI as a central tool to facilitate the construction of a learning mindset centered on leveraging errors. Thus, by analyzing each student's error patterns, AI can provide personalized feedback and support, reinforcing weak concepts and effectively addressing comprehension gaps. Regarding this, Ayeni et al. (2024) indicate the existence of a wide set of

educational technology, AI included, that allows to creation of a digital ecosystem in which this new mindset can be addressed, via personalized learning paths, leveraging errors to better understand students' specific difficulties and adapt content and instruction accordingly, turning errors into catalysts for personalized learning.

Risks of leveraging error as a driver of personalized learning

Thus far in this paper, the potential advantages of personalizing learning have already been mentioned earlier, and the importance of error to foster more meaningful learning has been addressed. However, it is also necessary to consider that there are risks in the initiative to promote error and turn it into a mechanism to chart personalized learning paths. Indeed, there is a double risk to consider; on the one hand, there is the possibility that students may become demotivated due to the errors they make, considering that the traditional system in which they have grown up for years views errors as something undesirable that should be avoided, focusing and valuing only successes. On the other hand, the other risk is failing to detect the presence of errors and allowing them to consolidate within the student's body of knowledge.

Faced with these two possibilities, the use of AI must be designed in a way that allows close monitoring of the errors generated, identifying possible states of mind reflecting demotivation or engagement problems, mainly through content and sentiment analysis tools (Islam et al., 2024; Suresh Kumar et al., 2024). In addition, AI should help teachers, through these tools, to identify inconsistencies or comprehension errors in the discourses, conversations, or products generated by students and to project strategies or activities that lead students to recognize and transform them into accurate knowledge.

Promote, address and intervene errors as part of lifelong learning skills

In today's constantly changing and increasingly complex world, students must develop adaptive skills and a mindset of continuous learning. As Thwe and Kálmán (2024), Tobias (2004) and Findsen (2012) state, in the 21st century, learning is no longer just about acquiring knowledge but also about developing the ability to adapt and learn continuously throughout life. In this context, it is proposed in this paper that lifelong learning skills must include the ability to learn from errors and adapt to new situations, as a key skill for success in a constantly changing world.

The concept of lifelong learning has transcended beyond any intentional learning activity conceived as a practice of continuous improvement (Omirbayev et al., 2021). Currently, it is conceived as an integral process that encompasses all stages of life, from childhood to old age, and develops in various contexts such as family, school, work, and community, and through different modalities, such as formal, non-formal, and informal (UNESCO, 2017). This perspective recognizes that lifelong learning is fundamental for comprehensive

human development, as it allows people to acquire and update knowledge and skills flexibly, responding to the changing demands of society and contributing to economic, social, cultural, and environmental well-being (Thwe & Kálmán, 2024).

In this sense, the development of skills for lifelong learning is essential in a society characterized by the accelerated growth of knowledge and information. These skills, which include interpersonal, cognitive, and technical aspects, allow people to learn autonomously, adapt to new contexts, and evolve continuously (Alt et al., 2022; Evans et al., 2022). Among the interpersonal skills, self-regulation, self-evaluation, and autonomy stand out, allowing individuals to manage their own learning process. In turn, cognitive skills such as critical thinking, creativity, and problem-solving are necessary to analyze information, generate innovative ideas, and find effective solutions. Additionally, technical competencies, which encompass specialized knowledge and emerging digital skills (Alt & Raichel, 2022; Blaschke, 2021; Gönderen Çakmak & Ayhan Başer, 2024), equip people to face the challenges of a constantly changing world and allow them to contribute to sustainable development.

Regarding the above, it is noteworthy, as Poquet and De Laat (2021) warn, that in traditional educational environments, there is often too much emphasis on knowledge acquisition or transfer and neglect of the development of these important adaptive skills. Considering the above, AI can play a fundamental role in preparing students for these future challenges by fostering more personalized and relevant learning based on analyzing individual errors and bringing them timely and tailored feedback.

Conclusions

This opinion piece has critically explored the transformative role that artificial intelligence can play in education by leveraging and even encouraging student errors as catalysts for truly personalized learning adapted to the unique needs of each individual. This challenging, albeit controversial, perspective becomes highly relevant in the current and future educational context.

Firstly, what has been presented in the body of the paper highlights the importance of adopting a lifelong learning mindset towards error. Instead of seeing it as a failure, the error should be understood as an opportunity to analyze difficulties, enrich knowledge, and develop strategies to overcome learning barriers. The implementation of AI as a mechanism to encourage "learning errors" and to systematize the analysis of error patterns would catalyze this process, turning errors into a facilitator of personalized learning.

The implications of this perspective are significant, both for teaching practice and for the development of learning processes in students at all levels. As for educators, they must adopt an open and receptive mindset to error, implementing strategies and activities that promote its occurrence, analysis, and utilization. This implies a paradigm shift from traditional approaches that tend to treat errors as

failures (Ronnie & Philip, 2021).

For their part, students must assume a proactive attitude, willing to face error as an opportunity for growth and not as an obstacle. This requires the development of a learning mindset centered on growth from errors, which is fundamental to acquiring lifelong learning skills in the 21st century.

At the institutional level, this vision of error as a catalyst for learning will demand the implementation of spaces and resources that promote its systematic analysis, as well as the adoption of pedagogical approaches oriented towards leveraging error as a driver of learning. Only through a comprehensive approach that incorporates the experience of error as an opportunity for enrichment will it be possible to transition towards truly transformative and permanent education.

Furthermore, the integration of AI in this process is fundamental, as it offers the ability to efficiently and accurately analyze large volumes of data on student performance and error patterns. As Chen et al. (2020) point out, through the use of advanced algorithms and machine learning techniques, AI can identify problem areas and error patterns of each student, allowing for dynamic adaptation of content and instruction. This capacity for in-depth analysis and real-time adaptation is essential to provide a truly personalized learning experience tailored to the unique needs of each individual. Moreover, AI can play a crucial role in facilitating a learning mindset centered on leveraging errors. By analyzing each student's error patterns, AI can provide personalized feedback and support, reinforcing weak concepts and effectively addressing comprehension gaps.

Additionally to the well-known potential of AI for personalized learning by allowing students to progress at their own pace and receive content and activities adapted to their specific needs and learning styles, AI can better prepare students for future challenges by fostering the development of adaptive skills and a continuous learning mindset, which also, can significantly improve academic performance, engagement, and motivation.

Another aspect widely addressed in the literature is AI's capacity to alleviate teachers' workload by automating tasks, generation of personalized content, and provision of individualized feedback. So, it is time to include the processes of personalized error analysis in this package of benefits. This is particularly relevant in traditional educational environments, where teachers are often overwhelmed by the need to address individual student needs, in addition to other tasks, as pointed out by Lameris and Arnab (2021).

By adopting this challenging perspective, which assumes error as an opportunity for growth and leverages AI's ability to systematically analyze and adapt to error patterns, educational institutions can better prepare students for the challenges of the 21st century, fostering lifelong learning skills, motivation, and academic engagement.

While this vision implies a significant paradigm shift in how error is conceived and addressed in education, its implementation promises to redefine the learning experience, turning it into a truly personalized, adaptive, and transformative adventure for each student. Ultimately, this paper has highlighted the importance of harnessing the power of AI to catalyze profound educational change, where error ceases to be an obstacle and becomes a springboard towards growth and continuous learning.

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Advancing workforce competency: Singapore's integration of competency-based education

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Abstract

This opinion piece investigates the evolution of Singapore's education system through the integration of Competency-Based Education (CBE), driven by global economic changes and the country's vision for a future-ready workforce. It explores how CBE's focus on mastery over rote learning prepares learners for real-world challenges, fostering critical thinking and adaptability. Anchored by policies like SkillsFuture and collaboration with industry, this article examines Singapore's commitment to lifelong learning and skill mastery, enhancing employability and resilience among Singaporeans. The discussion contributes to educational reform, highlighting Singapore's innovative model that aims to equip learners with the competencies needed to thrive in the 21st century. By analysing current trends, implementation strategies, and potential challenges, it provides a comprehensive overview of CBE's impact on higher education in Singapore, offering insights and recommendations for future developments.

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Introduction

Singapore's education system has long been known for its excellence, consistently topping global rankings and serving as a benchmark for educational success worldwide (OECD, 2022; Education GPS, 2022). This reputation is built on a foundation of rigorous standards, high-stakes testing, and a culture of academic achievement. However, in recent years, Singapore has embarked on a transformative journey, moving beyond traditional metrics of educational success to embrace Competency-based Education (CBE) (Singapore Institute of Technology, 2024). This shift is not merely an educational reform; it is a strategic response to the change in the global economic landscape, characterised by technological advancements, the rise of the knowledge economy, and the increasing premium on adaptability and lifelong learning. CBE is an approach where students advance based on their ability to demonstrate competency in specific skills and knowledge areas, as opposed to traditional time-based education systems. This paradigm shift is essential in addressing the dynamic needs of the modern workforce. Singapore's education system has been undergoing a shift towards a more holistic approach that values competencies and skills as much as academic success (De Souza, 2018). This change is driven by global trends, such as technological advancements, which have altered the demands of the workforce. Recognising this, Singapore has been focusing on developing 21st Century Competencies in its learners (Ministry of Education, n.d.). These competencies include critical and inventive thinking, civic literacy, global awareness, and cross-cultural skills—attributes essential for success in the contemporary world.

Despite the significant progress, it is important to clarify what CBE entails, as there is sometimes confusion regarding its definition. CBE is not merely about teaching competencies; it involves a comprehensive model where learning is personalised, and learners advance based on their demonstration of mastery in specific skills and knowledge areas (Anderson, 2018). Unlike traditional education systems that are time-based, CBE allows learners to progress at their own pace. This approach is designed to ensure that students acquire and demonstrate the competencies necessary for success in their personal and professional lives. CBE emphasises learner advancement based on the mastery of skills and content rather than traditional age or time-based criteria, offering a more personalised learning experience tailored to each learner's strengths, needs, and interests. The shift involves significant alterations in policy and practice to foster learner-centred solutions (Patrick, 2021). The move away from a one-size-fits-all model towards CBE aims to prepare learners more effectively for a dynamic and changing world by nurturing lifelong learning mindsets and accommodating diverse learning pathways.

The Singapore Institute of Technology (SIT) is currently at the forefront of transforming the traditional educational model in higher education. SIT emphasises the importance of upskilling and reskilling through CBE, a method that values certified skills and competencies over just paper qualifications. This approach is responsive to the needs of a changing job market, where the shelf-life of skills is becoming shorter due to technological innovation. SIT's

Applied Learning Conference in 2023 was a platform where education and workforce development experts converged to discuss the transition from a focus on degrees to a recognition of skills and real-world competencies (Singapore Institute of Technology, 2024). The same year, the National University of Singapore (NUS) and Nanyang Technological University (NTU) expanded their admission criteria to include more candidates through aptitude-based admissions. This initiative allows for a more comprehensive assessment of applicants, considering their talents and achievements outside traditional academic scores. NTU, for instance, reported that over half of its new learners were selected through this approach, significantly up from 38% in 2019. NUS, too, implemented special nomination schemes and expanded its holistic admissions by asking applicants to respond to specific questions aimed at revealing their broader competencies and interests (National University of Singapore, n.d.; Nanyang Technological University, n.d.).

As highlighted in 'The Future of Jobs Report 2023' by the World Economic Forum, rapid technological advancements and global economic shifts are continually reshaping job requirements. To thrive in today's dynamic environment, learners must acquire specific skills and competencies that are directly applicable to the workforce. CBE ensures that education is closely aligned with these demands by focusing on mastery of relevant skills rather than traditional time-based metrics. This approach not only enhances employability by equipping students with practical, job-ready skills but also fosters adaptability, enabling them to navigate future changes in the job market. By emphasising continuous learning and skill development, CBE helps bridge the gap between education and employment, ensuring that learners are well-prepared to meet the challenges and seize the opportunities presented by the rapidly changing economic landscape (World Economic Forum, 2023). The World Economic Forum report is significant because it echoes Singapore's adoption of CBE in higher education and how it offers a comprehensive overview of its implementation. By examining the origins, development, and benefits of CBE in Singapore's higher education, this paper seeks to contribute insights to the discourse on CBE. This study not only sheds light on the evolving nature of education in response to global economic shifts but also highlights the critical role of CBE in preparing learners for the challenges and opportunities of the future. It serves as an analysis and proposal, offering informed perspectives on the implementation of CBE. This paper aims to present a discussion on the potential benefits and challenges of CBE, utilising existing literature and papers to substantiate its arguments. By drawing on a variety of sources, the paper provides a dimension on how CBE can transform higher education to meet the demands of the modern workforce better. Rather than presenting empirical research findings, this paper offers recommendations and insights stemming from current trends. This approach allows the paper to address the evolving needs of education and industry, emphasising the importance of aligning educational outcomes with labour market demands. The paper also considers the implementation challenges of CBE by acknowledging these hurdles and provides a view of both the opportunities and obstacles associated with CBE.

Literature review

CBE is rooted in the early 20th century, influenced by Frederick Taylor's (1911) scientific management principles, which aimed to enhance workplace efficiency. These principles were later adapted to educational contexts to promote standardisation and effectiveness. CBE prioritises specific competencies—skills, knowledge, and behaviours crucial for professional success—assessed through learner demonstrations in real-world or simulated settings. This model significantly departed from traditional education methods that focus on time spent on coursework rather than mastery of skills.

The formal adoption of CBE by the U.S. Office of Education in the late 1960s represented a shift towards more accountable and practical educational outcomes. In the 1970s, David McClelland's (1973) advocacy further propelled the integration of CBE into higher education, advocating a shift from institutional reputation as a measure of graduate competence to true competence reflective of workplace demands. Spady (1977) defined CBE as an approach that developed curriculum from detailed analyses of societal roles, certifying learner progress based on performance rather than time spent in education, thus preparing learners with the competencies necessary for the workforce.

Today, CBE is widely implemented across various sectors, particularly in medical training, where it enhances the quality and safety of healthcare. The Accreditation Council for Graduate Medical Education (2016) mandated CBE in medical programmes, highlighting its critical role. Modern definitions by Levine and Patrick (2019) and Frank et al. (2010) focused on the model's adaptability and outcome orientation. Levine and Patrick (2019) advocated for a learner-empowered approach with personalised learning paths and supportive assessments to achieve mastery. Frank et al. (2010) defined CBE as focusing on graduate abilities tailored to societal and patient needs, enhancing accountability and flexibility in medical education.

Research indicated that global economic shifts profoundly impacted the workforce, necessitating the adaptation of education systems to better prepare learners for emerging challenges and opportunities. Studies like 'The Future of Jobs Report 2023' by the World Economic Forum emphasised the rapid pace of technological advancements and evolving job requirements, demanding a workforce with relevant, up-to-date skills. CBE played a crucial role in this context by focusing on the mastery of specific competencies that were directly applicable to the job market. This approach not only enhanced employability by ensuring that learners possessed the necessary skills but also fostered adaptability, enabling them to navigate the complexities of an ever-changing economic landscape. Further evidence from Anderson (2018) and Misko and Circelli (2022) highlighted how CBE effectively bridged the gap between education and employment, preparing learners to meet both current and future labour market demands. By aligning educational outcomes with industry needs, CBE supported the development of a resilient, skilled workforce capable of thriving amidst global economic transformations.

Constructivist theories promote education that is focused on learners, flexible, and tailored to their needs, which matches well with the main ideas of CBE. Constructivism, as explained by educators and theorists like Jean Piaget (1952) and Lev Vygotsky (1978), states that learning is an active, creative process. Learners are not empty vessels to be filled with knowledge; instead, they are active participants in their learning journey, constructing knowledge through interaction with their environment and reflection on their experiences. This perspective aligns with the CBE approach, which prioritises the acquisition of competencies—defined as a combination of skills, knowledge, and attitudes—through hands-on experiences and problem-solving tasks. CBE's focus on mastering specific competencies supports the development of critical thinking by requiring learners to apply knowledge in various contexts, analyse problems, and devise innovative solutions (Surr & Redding, 2017). Adaptability is fostered through personalised learning paths that allow learners to navigate through content at their own pace, adapting their learning journey as needed. Specialised skills are developed through targeted learning experiences that are closely aligned with industry standards and real-world applications, ensuring that learners are prepared for the demands of the workforce.

Boritz and Carnaghan (2003) explored the benefits of CBE within the accounting profession and identified several key advantages. This educational model emphasised a learner-centred approach that allowed learners to progress at a pace suited to their learning speeds and needs. The researchers noted that CBE provided enhanced flexibility in educational practices, accommodating a variety of learning styles and paces, which in turn could potentially increase learner engagement and success rates. Additionally, CBE focused on the practical application of skills and knowledge, preparing learners effectively for the challenges they would face in the professional world. The definition of competencies within CBE frameworks also facilitated the alignment of educational programmes with the specific requirements of the accounting industry, thereby improving the employability of graduates.

The studies by Hatcher et al. (2013) and Iglar et al. (2013) provided comprehensive insights into the benefits of CBE within professional psychology and family medicine, respectively. Both studies underscored CBE's significant role in aligning educational outcomes with professional competencies essential in clinical and therapeutic settings. Hatcher et al. (2013) highlighted that CBE bridged the gap between theoretical knowledge and practical application in psychology, enhancing learners' readiness for professional practice through the development of crucial skills such as critical thinking, ethical judgment, and interpersonal skills. Similarly, Iglar et al. (2013) demonstrated that CBE in family medicine not only advanced the mastery of practical skills but also personalised the learning process, allowing medical trainees to progress at their own pace. This tailored approach led to higher learner satisfaction and more effective preparation for real-world medical responsibilities. Both studies collectively illustrated how CBE could transform medical education by fostering a more skilled and adaptable healthcare workforce that is better prepared to meet the dynamic needs of patients and the healthcare industry.

In their article, Hawkins et al. (2015) examined the implementation of CBE and discussed its benefits within the medical field. Their research revealed that CBE focused on developing specific competencies crucial for medical practice, which in turn led to more targeted and effective medical training. The study highlighted that residents trained under CBE frameworks were often better prepared for clinical responsibilities due to the emphasis on mastering relevant skills before progressing. Additionally, the shift to CBE helped address the need for more personalised learning paths, allowing residents to spend more time on areas needing improvement while accelerating through competencies they master more readily.

Studies initiated around 2016, such as those by Burnette (2016) and Cunningham et al. (2016), highlighted the growing global appreciation for CBE and its role in redefining educational success. These studies pointed to the effectiveness of CBE in aligning educational goals with specific professional skills required in the workforce, promoting a learner-centred approach that allowed learners to progress at their own pace, thereby enhancing flexibility and engagement. Furthermore, the use of simulation in medical education, as explored by Nousiainen et al. (2016), had shown that despite higher initial costs, the integration of practical, risk-free training environments significantly improved the competence of medical residents, suggesting that the benefits justified the investment. This type of training ensured that medical professionals were well-prepared and more confident in their practical skills, potentially reducing errors in clinical practice (Nousiainen et al., 2016). Adding to the body of evidence, Rainwater (2016) examined the perceptions of faculty and learners within CBE frameworks and found that both groups benefited from the tailored, competency-focused approach of CBE. This method facilitated a more engaging learning environment and provided clear, practical benefits by directly linking educational activities to real-world applications.

Throughout 2017, research has consistently supported the effectiveness of CBE across various educational fields, underscoring its impact on enhancing educational outcomes and employability. Studies by Geressu (2017) emphasised the need for educational programmes in vocational settings in Ethiopia to align closely with labour market demands through active stakeholder engagement, significantly boosting graduate employability. Ye et al. (2017) highlighted how CBE improved learner engagement and retention by customising the learning experience to fit individual needs and professional aspirations, thereby better-preparing learners for the workforce. In higher education, Lurie and Garrett (2017) revealed that CBE provided personalised and flexible learning experiences, focusing on practical skills rather than traditional examinations. This led to more precise assessments of learner capabilities and enhanced both academic success and employability. Similarly, in the field of engineering education, Henri et al. (2017) affirmed that focusing on key competencies through CBE, rather than traditional educational metrics, with continuous feedback and real-world problem-solving scenarios, developed practical skills that aligned well with industry requirements. Riley and Riley's (2017) study on CBE in graduate medical education demonstrated that CBE allowed for more

customised and efficient training, focusing on essential clinical competencies and offering the flexibility to meet individual training needs. This approach not only ensured that all medical graduates reached the required level of competence but also improved their readiness for clinical roles, suggesting potential innovations in medical training by fostering more targeted and practical learning experiences.

Subsequently, Mindham and Schultz (2019) delved into the effects of apprenticeship and employability skills programmes on learners pursuing technical education. Their research uncovered a significant finding: learners engaged in these programmes were more likely to continue their education beyond high school. This increase in educational continuation could be attributed to the direct relevance of the apprenticeship experiences and employability skills training to real-world job markets, which often motivated learners by providing clear pathways to career advancement and job security. Mindham and Schultz (2019) also noted that these programmes helped bridge the gap between theoretical knowledge and practical application, making learning more tangible and directly linked to employment opportunities.

Through a systematic literature review, Abelha et al. (2020) demonstrated that competency development in higher education significantly correlated with enhanced graduate employability, emphasising the importance of blending practical skills with academic knowledge. Similarly, Katoue and Schwinghammer (2020) highlighted how CBE enhanced learner engagement by tailoring education to individual needs and aligning educational outputs with labour market demands, thereby improving employability by equipping learners with in-demand skills. This personalised approach also supported diverse learning styles, fostering inclusive educational practices. In the field of medical education, Harris et al. (2020) and Crawford et al. (2020) showed that CBE significantly improved medical training. They noted that CBE ensured medical residents not only learned the necessary materials but also achieved proficiency in critical competencies, thus preparing them more effectively for the complexities of the healthcare environment. This was particularly important in medical training, where the ability to apply knowledge in clinical settings was crucial. Crawford et al. (2020) also found that CBE facilitated a more structured and transparent assessment process, which helped medical residents meet rigorous professional standards and better prepared them for actual medical practice.

Brauer (2021), Romanova (2022), and McMullen et al. (2023) collectively highlighted the critical components and benefits of CBE in higher education and vocational training. Brauer (2021) examined the intricacies of designing and assessing competence-based curricula, emphasising the necessity of clear, well-communicated educational goals that resonated with the needs and aspirations of learners. The study advocated for curricula that were relevant to future careers and adaptable to various learning styles, thereby enhancing engagement and retention. Additionally, the importance of practical, learner-centred assessments was highlighted, advocating for evaluation methods that went beyond traditional exams to include real-world tasks mirroring job scenarios. Building on this foundation, Romanova (2022)

focused on the direct integration of employability skills into vocational education curricula. The findings revealed that explicit inclusion of these skills not only improved learners' self-assessment of competencies but also significantly boosted their career aspirations. This approach effectively bridged the gap between educational experiences and job market requirements, preparing learners to meet employer expectations and enhancing their career prospects. Expanding on the work of Brauer (2021) and Romanova (2022), McMullen et al. (2023) confirmed the broad benefits of CBE. The study demonstrated that CBE significantly improved both educational and employment outcomes by focusing on the mastery of competencies rather than traditional learning metrics. McMullen et al. highlighted that CBE supported academic success and ensured learners were job-ready upon completion of their studies, equipped with the skills most sought after in their respective industries.

Implementation of CBE in Singapore

The successful integration of CBE in Singapore was significantly attributed to the country's national education policies and strategic initiatives, such as the SkillsFuture movement. These frameworks facilitate the transition towards a more skills-oriented education system and underscore Singapore's commitment to developing a resilient and adaptable workforce. SkillsFuture, launched in 2015, stands out as a cornerstone initiative aimed at promoting continuous learning and skills mastery across various life stages (SkillsFuture Singapore, 2023). This initiative emphasises personalised learning journeys and the mastery of skills aligned with individual interests and job market demands, thereby driving career development and economic success. Building on this foundation, the SkillsFuture initiative encompasses a broad range of programmes and schemes tailored to support Singaporeans at different stages of their learning journeys, from students to early-career professionals, mid-career switchers, and lifelong learners. Notably, the SkillsFuture Credit, a financial endowment provided to all citizens aged 25 and above, encourages individuals to invest in their skill development and lifelong learning (SkillsFuture Singapore, n.d. -a). This initiative signals the Singapore government's strategic investment in its citizens' future capabilities.

Another significant component is the SkillsFuture Work-Study Programmes, which integrates academic theory with practical application, facilitated by polytechnics and the Institute of Technical Education (SkillsFuture Singapore, n.d.-b). These programmes enable a seamless blend of classroom instruction and hands-on training, providing learners with valuable industry experience and qualifications recognised in the workforce. This dual-structure learning model exemplifies the synergy between education and industry, ensuring that curricula remain relevant to industry needs.

Moreover, the Skills Frameworks are tailored to key sectors of the economy. These include (1) healthcare, which focuses on the necessary skills and competencies for various roles to meet the sector's evolving demands; (2) infocomm technology (ICT), which addresses the tech industry's

needs by outlining essential skills for careers in software development, cybersecurity, data analytics, and more; (3) finance, which identifies competencies required for roles in banking, insurance, and financial services to handle modern financial challenges; (4) advanced manufacturing, which highlights skills for roles in robotics, automation, and smart manufacturing to support technological advancements; (5) logistics, which covers skills for efficient supply chain management, transportation, and logistics services crucial for global trade; and (6) built environment, which focuses on competencies in construction, architecture, and urban planning to promote sustainable development and innovative building practices.

Additionally, the SkillsFuture Series offers concise, industry-relevant training programmes in emerging fields such as data analytics, finance, tech-enabled services, and digital media, further empowering Singaporeans with cutting-edge skills essential for the evolving economy. Collectively, these initiatives underpin Singapore's dedication to building a skilled and resilient workforce. Complementing these efforts, the Continuing Education and Training (CET) system is another critical element of Singapore's strategic framework for CBE, providing structured and formal mechanisms for adult learning and professional development (Ministry of Manpower, n.d.). Through CET, individuals could access a wide range of programmes aligned with industry needs, ensuring that the skills acquired remained relevant and current.

Furthermore, Professional Conversion Programmes (PCPs) are designed for mid-career professionals transitioning into new industries or job roles. These programmes, developed in partnership with industry players, address specific skills gaps and provide rigorous training and practical experience in fields such as cybersecurity, data analytics, and digital marketing (Workforce Singapore, n.d.; Ministry of Manpower Singapore, 2024). By maintaining an agile and adaptable workforce, the Singapore government effectively prepares its citizens for the demands and opportunities presented by technological advancements and economic changes.

To support this comprehensive approach, the implementation of CBE in Singapore's higher education system necessitated significant changes in curriculum design, assessment methods, and faculty roles. A pioneering example of CBE in Singapore is SIT, which was the first local institution to introduce this innovative approach. SIT incorporated CBE into its curriculum to better align educational outcomes with industry needs, ensuring that graduates were well-prepared for the workforce. This approach involved close collaboration with industry partners to develop programmes that met current market demands, providing students with hands-on experience and industry-relevant skills (Singapore Institute of Technology, 2024).

Discussion

Many institutions in the U.S. have adopted CBE, particularly in higher education and adult learning sectors (Anderson, 2018; Garfalo & L'Huillier, 2016). Unlike Singapore's nationwide, government-led approach, CBE implementation

in the U.S. was more institution-specific, driven by individual colleges or universities. This has led to a wide variation in CBE models and practices. Like Singapore, CBE in the U.S. faced challenges related to assessment methods and the need for comprehensive support systems for educators and learners. Finland's education system is renowned for its learner-centred approach, which emphasises individualised learning and teacher autonomy (Kimonen et al., 2017). While not labelled explicitly as CBE, many principles aligned with competency-based approaches, including personalised learning paths and a focus on real-world skills. Finland's approach effectively integrates competency-based principles within a broader, holistic educational philosophy. Australia has made significant strides in vocational education and training (VET) through a competency-based framework. Like Singapore, Australia's VET system is closely aligned with industry needs, ensuring that vocational qualifications reflect the competencies required by employers (Misko & Circeli, 2022). However, Australia's challenge lies in extending CBE principles beyond vocational training to wider education sectors. Higher education in Singapore can learn from this by adopting a comprehensive, multi-faceted approach to achieve similar goals. To extend CBE principles, higher education in Singapore can align more with CBE practices, redesign curricula to integrate competency-based elements, and provide extensive training for educators. Implementing robust assessment strategies that go beyond traditional exams and strengthening industry partnerships for practical learning opportunities are also crucial. Additionally, integrating technology, starting with pilot programmes, and engaging the community and stakeholders will ensure widespread adoption and support. This strategy will help Singapore build a more adaptable and future-ready workforce by embedding CBE principles in its higher education, thereby avoiding the challenges faced by Australia in broadening the application of CBE.

Based on the findings, a theoretical framework has been proposed to elevate CBE in higher education to the next level. This framework also works alongside Singapore's existing CET system because the two serve distinct yet complementary purposes. The CET system focuses broadly on lifelong learning and general upskilling, offering a variety of training programmes to enhance overall workforce skills. In contrast, the CBE framework specifically targets the development of competencies required for particular job roles within key industries, ensuring that training programmes are highly relevant and tailored to current and future industry demands. This targeted approach provides clear career pathways, supports workforce mobility, and facilitates the recognition of prior learning, making training more goal-oriented and practical. Integrating CBE with CET enhances the effectiveness of Singapore's workforce development initiatives, ensuring they are comprehensive and precisely aligned with industry needs. This combination is crucial for maintaining a competitive and adaptable workforce in a rapidly changing economic landscape.

The depicted theoretical framework for CBE encapsulates an approach to education that is transformative, holistic, and reflective of the multifaceted nature of learning (Figure 1). At its core, this framework recognises the continuum of 'Lifelong and Lifewide Learning'—a concept that extends beyond

traditional classroom settings to include the spectrum of experiences that contribute to a person's learning journey. These experiences contribute significantly to an individual's competency profile and align with the principles of lifelong learning theory (Jarvis, 2006) and experiential learning theory (Kolb, 1984). This dimension acknowledges that learning occurs throughout life, in a variety of contexts and through numerous experiences. From professional development to informal personal interests, every experience serves to enhance an individual's skill set. The recognition of such learning validates diverse educational backgrounds and respects the knowledge acquired through life's many roles and environments.

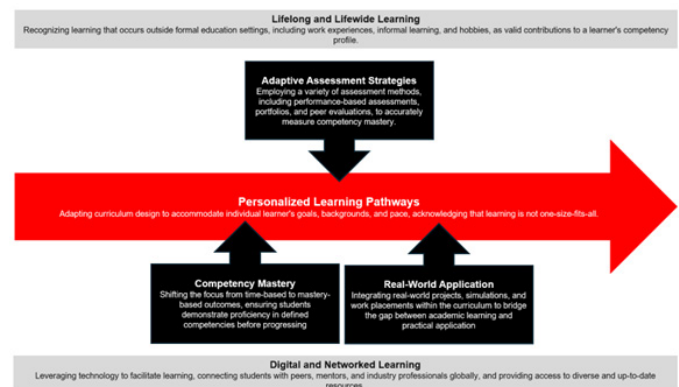


Figure 1. Proposed CBE framework.

'Personalized learning pathways' in higher education are characterised by their focus on the individual's learning needs and outcomes. It involves adapting curriculum design to accommodate individual learners' goals, backgrounds, and learning paces. It recognises that a one-size-fits-all approach to education is ineffective and aims to provide tailored learning experiences (Piaget, 1954; Tomlinson, 2001; Vygotsky, 1978). To accurately reflect a learner's progress and adapt to their unique learning journey, these pathways utilise a range of 'Adaptive Assessment Strategies'. These strategies are designed to go beyond the traditional examinations, recognising the importance of situating learning within practical and authentic contexts. It employs a variety of assessment methods to accurately measure competency mastery. This includes performance-based assessments, portfolios, and peer evaluations, which provide a holistic view of a learner's abilities (Black & Wiliam, 1998; Wiggins, 1993). For instance, learners might be tasked with project-based activities that challenge them to deploy their skills to navigate complex scenarios similar to those they might encounter in their professional lives. This shift aims to not only test knowledge but also assess the learner's ability to apply it in a meaningful way. Further enriching this assessment approach, portfolios offer a window into the learner's development over time. These collections, which may span the entirety of a learner's academic career, encapsulate a body of work showcasing growth, creativity, and proficiency. Complementing these methods are peer evaluations, which introduce diverse perspectives into the assessment process. By including feedback from classmates, assessments become more comprehensive, allowing learners to benefit from the collective insights of their learning community.

At the heart of personalised pathways is the principle of 'Competency Mastery.' This principle underlines the requirement that learners demonstrate a thorough understanding and proficiency in specific competencies before they move forward in their educational trajectory (Bloom, 1968; Spady, 1994). Mastery is often demonstrated through tangible, 'Real-World Application' of skills and knowledge. It shifts the focus from time-based to mastery-based outcomes, ensuring students demonstrate proficiency in defined competencies before progressing (Billett, 2011; Lave & Wenger, 1991). Curricula are carefully interwoven with opportunities such as internships, collaborative projects, and simulations that reflect the complexities of the modern workplace. These experiences are instrumental in bridging the gap between theoretical knowledge and its application, ensuring that learners are not just academically competent but also equipped to employ their skills in the workforce effectively. The transition from knowledge acquisition to its application is pivotal, underscoring the relevance of what is learned within academic institutions to the outside professional world. The goal is for learners to not only absorb information but also become adept at utilising this information in real-life situations.

Finally, these learning pathways are facilitated by 'Digital and Networked Learning.' This component leverages the expansive reach of educational technology to connect learners with a broader community (Garrison, 2011; Siemens, 2005). It encompasses the use of digital platforms for learning management, virtual simulations, online collaborations, and the creation of professional networks with peers and mentors. Access to diverse digital resources and communities enriches the learning experience, keeping it current and relevant. Educational technology also enables the creation of digital portfolios, where learners can curate and showcase evidence of their competencies, further personalising their learning pathways and providing a repository of their achievements.

In summary, the framework describes a highly adaptable, rigorously practical, and expansively networked learning model that ensures learners are equipped to meet the challenges and opportunities of an ever-changing landscape. Through this integrated approach, CBE becomes a channel for academic growth and personal and professional development, transcending traditional education models to foster lifelong learning. The following section will outline the implementation strategies to bring the framework to fruition (Figure 2).

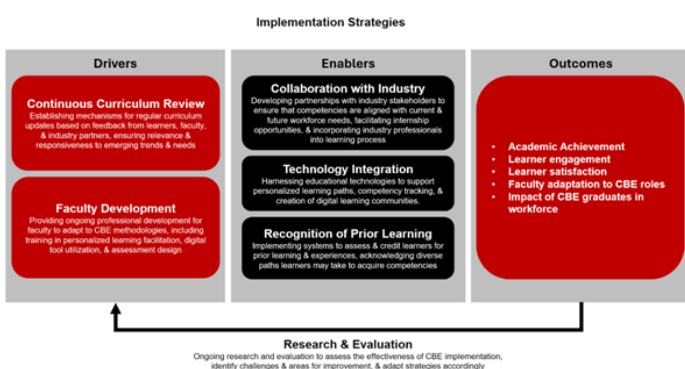


Figure 2. CBE implementation strategies.

The implementation strategies for CBE, as presented, cover foundational drivers, supporting enablers, and a cyclical process of research and evaluation. Drivers such as 'Continuous Curriculum Review' and 'Faculty Development' serve as the cornerstone of the CBE framework. Regular curriculum updates ensure that educational content is engaging and aligned with the evolving trends and demands of the workforce. 'Faculty Development' is integral, equipping educators with the necessary tools and expertise to deliver CBE methodologies effectively, enhancing their ability to support personalised learning, adeptly use digital tools, and design assessments that reflect learner competencies.

'Enablers' play a pivotal role in operationalising the core components or 'Drivers' of the system. They are essentially the mechanisms through which the foundational aspects of CBE are put into practice. Collaboration with Industry' stands as a critical enabler. It builds connections between academics and the industry, ensuring that the skills and knowledge imparted to learners are aligned with current and future market needs. By bringing industry stakeholders into the educational fold, from curriculum design to the provision of internships, this collaboration ensures that learning is closely knitted with practical, professional demands, giving learners the relevant experience and insight they need to succeed after graduation. 'Technology Integration' is another enabler that plays a role in education. By incorporating educational technologies, institutions can create personalised learning paths and maintain accurate records of competency development. Technology fosters digital learning communities that extend beyond the classroom, offering platforms for collaboration, discussion, and the exchange of ideas, thus enriching the educational experience. 'Recognition of Prior Learning' is an inclusive approach that values and validates the diverse experiences and skills that learners bring to their educational journeys. This enabler acknowledges that competencies can be acquired through various means, not exclusively through formal education. By recognising and crediting prior learning, educational institutions can provide learners with a more tailored educational path that builds upon their existing knowledge base and skills.

The 'Outcomes' derived from these strategies are multifaceted. They encompass improved 'Academic Achievement', where the application of CBE methodologies is anticipated to elevate academic performance. 'Learner Engagement' is expected to rise as learners find their educational experiences more aligned with their interests and career paths. 'Learner Satisfaction' may increase as learners perceive their learning journey as more personalised and tailored to their needs. Additionally, 'Faculty Adaptation to CBE Roles' is projected to be positive, with educators becoming more adept at facilitating a CBE-focused curriculum. Lastly, the 'Impact of CBE Graduates in the Workforce' is predicted to be significant, with graduates entering the job market possessing a stronger and more applicable set of skills.

The implementation strategies also highlight an ongoing 'Research & Evaluation' phase, critical for assessing the efficacy of CBE strategies, identifying potential areas for improvement, and ensuring that the implementation

remains relevant and practical. This continuous loop of feedback and refinement informs an educational model that is resilient, adaptable, and responsive to the needs of both learners and the industry.

Challenges

In traditional educational settings, existing methodologies and assessment systems often dominate, creating a significant barrier to the adoption of innovative approaches like CBE. Faculty and administrators frequently express scepticism about the efficacy of CBE, questioning whether it can be effectively applied across diverse academic disciplines. This scepticism stems from concerns about the standardisation of competencies, the adaptability of CBE to less skill-oriented subjects, and the potential increase in administrative workload required to implement CBE frameworks (Garfolo & L'Huillier, 2016). Additionally, some educators worry that CBE might oversimplify complex learning processes and reduce academic freedom in curriculum design (Johnstone & Soares, 2014; Kelchen, 2015). The resistance is also rooted in comfort with established methods and uncertainty about the outcomes of new educational models (Anderson, 2018). The transition to CBE also requires substantial investments in new learning materials, extensive training for educators, and the integration of advanced technology platforms. These requirements can strain institutional budgets, making it challenging to gather the necessary resources and support for successful implementation (Garfolo & L'Huillier, 2016).

Developing fair and comprehensive assessments within the CBE framework is a huge challenge. These assessments need to be continuously refined and validated to ensure they accurately reflect real-world requirements and the intended learning outcomes. This process demands a deep understanding of both the competencies being assessed and the industries learners will enter after graduation. Furthermore, the integration of technology in CBE, while beneficial, brings additional complexities, particularly in ensuring equitable access for all learners. Disparities in access to technology, known as the digital divide, can hinder the effectiveness of CBE for learners who lack the necessary technological resources, potentially widening educational inequalities (Lee et al., 2023).

As institutions attempt to expand CBE programmes to include more learners, they face the challenge of scaling up without diluting the quality of education or individualised learning experiences. CBE programmes require a high degree of customisation to meet the unique needs of each learner, which can be resource intensive. Moreover, maintaining consistency and standardisation across various programmes and institutions is essential for the credibility of CBE certifications. This standardisation ensures that all learners receive a quality education that meets established competencies, regardless of where or how they learn. However, achieving this consistency on a large scale can be difficult, as it involves synchronising curriculum, teaching methods, and assessment across different educational environments (Pluff & Weiss, 2022).

Proposed solutions

To effectively address the challenges of adopting CBE, it is crucial to engage and support faculty through dedicated workshops and training sessions. These educational opportunities help faculty understand the fundamental principles and potential benefits of CBE, aligning their teaching methods with competency-based objectives. Additionally, developing incentive programmes that reward educators for designing and implementing effective CBE strategies can motivate faculty to participate actively in the transition process. Such incentives might include recognition, career advancement opportunities, and grants for educational research (Hatcher et al., 2013).

Financial constraints often hinder the adoption and expansion of CBE. To overcome these limitations, institutions can explore flexible funding models that include partnerships with industry and government bodies. These partnerships can provide essential financial support for developing and testing CBE programmes. Pilot programmes requiring lower initial investments can serve as proof of concept, demonstrating the effectiveness of CBE before committing to full-scale implementation. This approach not only mitigates financial risk but also builds a case for broader institutional and governmental support (SkillsFuture Singapore, 2023).

Employing innovative assessment methods that leverage technology to create adaptive, personalised assessments can enhance the implementation of CBE. These assessments allow educators to measure a broad spectrum of competencies effectively, adapting to each learner's learning pace and style. Collaboration with industry experts is vital to ensure that these assessments maintain relevance to professional standards and real-world scenarios. Such collaborations can help ensure that competency assessments are both rigorous and directly applicable to the demands of the workforce (Nousiainen et al., 2016). Educational technology platforms are essential for supporting CBE. These platforms should be accessible and user-friendly, providing the necessary tools for both educators and learners to engage with the curriculum effectively. Additionally, integrating digital literacy training can enhance the ability of all participants to utilise these technologies effectively. This investment ensures that the technology not only supports CBE but also enhances the overall learning experience, making education more interactive and engaging (OpenGov Asia, 2019).

Addressing scalability concerns requires a modular approach to programme design. By creating CBE programmes that are inherently adaptable, institutions can more easily apply these programmes across different contexts and learning environments. Implementing standardised frameworks that can be customised to meet local needs while maintaining a coherent structure across the institution ensures consistency and quality. This flexibility facilitates easier expansion and adaptation of CBE programmes to various educational settings (Misko & Circelli, 2022).

To effectively implement CBE at the higher education level and address challenges like the digital divide, universities need to invest in expanding digital infrastructure to ensure all students have access to reliable internet and technological

resources, including financial aid for low-income students (OECD, 2022). Equitable access to technology can be achieved through device lending programmes or campus-wide access points (Basilotta-Gómez-Pablos et al., 2022). Continuous professional development for faculty in digital literacy and educational technology is essential for integrating CBE into teaching practices (Laufer et al., 2021). Robust support systems, such as help desks and peer mentoring, should be established to guide students in navigating digital tools and CBE frameworks (Frontiers in Education, 2021). Data privacy and security policies must protect student information, and regular monitoring and evaluation are necessary to identify and address gaps. The CBE curriculum should be inclusively designed to accommodate diverse learning needs, incorporating flexible learning paths and various assessment methods (Basilotta-Gómez-Pablos et al., 2022).

Future directions and prospects

As Singapore continues to refine and expand its CBE framework, the future of this educational approach appears both promising and dynamic. The evolution of CBE in Singapore will likely be influenced by several key factors, including technological advancements, changing industry demands, and potential changes in educational paradigms. The integration of technology in education has been a significant driver of CBE's success in Singapore. Looking ahead, emerging technologies such as artificial intelligence (AI), virtual and augmented reality (VR/AR), and blockchain have the potential to further transform CBE. AI can personalise learning experiences at an unprecedented scale, adapting in real-time to the needs and progress of individual learners (Lee et al., 2023). VR/AR technologies can enhance experiential learning, providing immersive simulations of complex processes and environments that are not easily accessible in traditional classrooms (Yin et al., 2020). Blockchain technology could revolutionise competency certification, allowing learners to maintain secure, verifiable records of their skills and achievements (OpenGov Asia, 2019).

As industries continue to evolve, the demand for new skills and competencies will shape the direction of CBE in Singapore. The rise of green technologies, digital economies, and smart manufacturing, among others, will require the educational system to remain agile, adapting curricula and learning outcomes to prepare learners for emerging sectors. Singapore's strong ties between educational institutions and industry partners will facilitate this alignment, ensuring that CBE remains relevant and responsive to economic changes.

The philosophy underpinning education is also subject to change, influenced by societal changes, research findings, and pedagogical innovations. There is a growing recognition of the importance of soft skills, such as emotional intelligence, creativity, and adaptability, alongside technical competencies. This holistic view of competency may lead to broader curricular transformations within CBE frameworks, emphasising the development of well-rounded individuals capable of contributing to society in diverse and meaningful ways.

Limitation

This paper acknowledges its limitation due to the reliance on secondary data rather than primary research. The findings and recommendations are derived from an extensive review of existing literature and expert analyses. However, the comprehensive synthesis of secondary sources offers significant and valuable perspectives on CBE. This literature-based approach allows for a broad understanding of current trends and expert opinions in the field. Despite the lack of primary data, the study effectively highlights key themes and findings from a wide array of reputable sources. This approach provides a foundation for understanding CBE's potential benefits and challenges. Nevertheless, future research involving primary data collection would be beneficial in offering a more detailed and context-specific understanding of CBE's effectiveness and implementation challenges. Recognising these limitations does not diminish the value of the insights provided but rather underscores the need for continued research to build on this foundational analysis. This acknowledgement is crucial for contextualising the scope and implications of the findings, ensuring that readers understand the breadth of the current study while also recognising areas for further exploration.

Conclusion

Singapore's foray into CBE marks a significant pivot in its educational narrative. This study outlines the nation's journey towards a holistic approach to learning, aligning academic rigour with the practical demands of a fluid global economy. The implementation of CBE, spearheaded by the SkillsFuture initiatives, stresses a commitment to lifelong learning, skill mastery, and the development of versatile competencies. Through an adaptive framework that values real-world application, Singapore's education system aims to produce not just academically proficient graduates but also adaptive thinkers and skilled professionals ready to contribute meaningfully to diverse fields. The success of this model lies in its collaboration with industry partners, integration of technology, and recognition of learning across various life experiences. As Singapore continues to refine its CBE approach, it offers a model of educational reform that is responsive, resilient, and potentially transformative, seeking to equip learners for future challenges. This study shows how CBE can change Singapore's workforce development, making it more responsive to industry needs. Future research should look at how CBE graduates perform in the long run and how these programmes can work in different educational settings.

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The role of strategic management and leadership in higher education institutions. The case of public universities in Greece

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Keywords

Greece;
higher education;
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leadership;
strategic management.

Abstract

This opinion piece offers an overview of why innovative practices in strategic management and leadership have an essential role in the long-term success of higher educational institutions. Additionally, it examines the strategies that can help universities maintain a competitive advantage in a complex global environment, opening business opportunities and providing better prospects for students, academics and society. I present the case of Greek Universities, with evidence from interviews with academics and my experience as an academic in several academic institutions for 17 years. For the purposes of this article, innovative practices in universities also engage creativity processes and design how students and academics can and need to share opportunities, co-create and initiate innovative behaviours.

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Introduction

Management and leadership are crucial in the global higher education market (Toker, 2022). Nevertheless, formal managerial concepts still seem to be lacking in higher education in general (Austin et al., 2013; Drew, 2010; Katharaki & Katharakis, 2010).

Especially in Greece, public universities are not used to working with managerial concepts and rules to improve their product and quality of sharing knowledge when their core mission is said to be “the production and transmission of knowledge through research and teaching” (Greek law 1268/1982).

In this study, I explore the role of strategic management in the long-term success of public higher education institutions, with evidence from interviews with academics from Greece and my personal experience as an academic (autoethnographic method). Understanding the strategies and practices that can help public universities in Greece maintain a competitive advantage in a complex global environment can help Greek academia advance and improve its practices in order to survive. The actions and activities that can offer Greek public universities a sustainable future and, at the same time, open their business opportunities and provide better prospects for their students, their academics and society as a whole. Thus, these are essential for them not only to improve their practices and achievements but also to continue functioning.

Universities and management standards

Higher education institutions experience profound changes in their missions and functions due to globalisation, technological progress, and the need for financial independence (Pham et al., 2019). The need for innovation to adapt to the change in institutional and educational procedures calls for the inclusion of management rules and concepts within the university community. Strategic management is essential for long-term business success, as creating clear objectives, finding out how these objectives will be achieved, supporting business activities and allocating the resources needed to sustain these objectives define a business strategy (Amolia & Aghashahib, 2016).

The growing complexity of higher education institutions should lead to a flexible approach towards strategic management, delegating responsibility and empowering individuals for their leadership (Taylor & Machado, 2006). Changing demographics, reduced funding, globalisation, epidemics, environmental issues, a mixed profile of students, competitors from around the world, new technology, and turbulent times are only some of the challenges that higher education institutions worldwide confront (Taylor & Machado, 2006).

Austin et al. (2013) indicate that a formal project management methodology can benefit universities. Using interviews with top leaders from Drexel University, the authors illustrate how difficult it is for universities to implement project management methodology with the given financial elements.

Doyle and Brady (2018) propose four factors that can lead to the HEIs' development and strategic innovation: (a) the difficulty in adapting to changes; (b) the difficulty in adopting a complete organisational model; (c) uncertainties over the effectiveness of management tools; and (d) the fact that world of business moves towards a holistic form of organisational thinking. Universities will have to create the conditions to adapt and expand (Doyle & Brady, 2018).

To be able to adapt and survive, universities need to rethink their organisational structure and management model (Taylor & Machado, 2006). Strategic management is needed for universities to move forward, but there are always some basic principles and rules to respect and follow. We are talking about a holistic process whose components need to reinforce one another (Taylor & Machado, 2006). “Institutional culture, strategic planning, leadership, institutional research, resource allocation and financial management, personnel and human resources management, research and scholarly activity, student and campus support services, academic support services, internationalisation, and external relations” are some of the strategic management components proposed by Taylor and Machado (2006).

In some countries, like Vietnam, higher educational institutions recognise the role of academic managers for effective university performance (Pham et al., 2019). Nevertheless, there seems to be a gap between what universities expect and the competencies of their leaders (Pham et al., 2019). Higher education institutions involve a complicated process, as we have different perceptions of things: knowledge sharing, collaboration, academic projects, etc. An academic leader should take everything into account, using a leadership methodology and rules that would help the specific academic institution based on its own particularities and structure. Talking about leadership, let's now examine some leadership styles that could fit the culture and principles of universities.

Leadership in universities

University leaders are called to keep the university functioning effectively, responding to the needs of a complex environment where students, staff, and other stakeholders are involved (Doyle & Brady, 2018). Strong leadership is an important and complex element in orchestrating a stable and viable environment in a university (Taylor & Machado, 2006; McCaffery, 2018; Doyle & Brady, 2018), aiding the application of strategic management. In this study, I am concerned with leadership in public universities, which are different from other enterprises.

Leadership is needed for a successful management process in universities, like in any other organisation. The difference between management and leadership is that management is a structured process while leadership is more interpersonal, inspiring and motivating others (Taylor & Machado, 2006). Interpersonal engagement is indeed critical to meeting some key challenges of educational leaders (Drew, 2010).

Effective universities need purposeful leadership as they need proper strategies to deal with the actual competition (Sallis, 2014). Along with effective teamwork, leadership and strategy help quality development. To do this, we need a) a clear mission, b) a strategy to achieve that mission, c) the participation of all in strategy development, and d) the evaluation of the university's effectiveness (Sallis, 2014).

Educational leaders are directly determining their students' performance, having different roles inside the university (Toker, 2022). The accommodation of institutional development alternative paradigms in higher education, integrating strategic management and leadership, is an emergent process (Doyle & Brady, 2018). The researchers (Doyle & Brady, 2018) explain the requirement of a different mindset "when dealing with a scenario of continuous change, one that is cyclical, with constant ebb and flow of ideas, created by interaction and conversations between people for which there can be no predictable outcome and no end-state, and in which multiple solutions are often at play".

There are many different leadership styles and variables that differentiate one university from another (missions, circumstances, cultures, external environmental factors), and this is why there is no simple formula to follow. An effective leader, in general, can view situations from different perspectives before deciding the correct option to choose (Taylor & Machado, 2006). Effectiveness as a university leader requires managers to know their environment well (McCaffery, 2018). A university leader needs to develop a flexible mindset in accordance with their university culture, review their course portfolio and subject area, improve student outcomes, and manage projects to be able to make a difference in their strategic planning role (McCaffery, 2018).

Practices of distributed pedagogical leadership and generative dialogue are tools that universities can use to better operate (Jappinen & Sarja, 2011). Distributed pedagogical leadership includes the fact that educational actors share a common mission, which means that all stakeholders take collective responsibility for students' learning (Jappinen & Sarja, 2011).

Adaptive leadership, which clarifies competing goals and values, can contribute to community change and knowledge sharing (Preece, 2016). Sart (2014) revealed that the participatory democracy leadership model and intensive collaboration with industry managers also have a significant role in the advancement of university practices and conditions.

Yielder and Codling (2004) propose a model of shared academic management and leadership, which develops the responsibilities of both the academic leader and the manager and explores their symbiotic relationship. A dean may be considered both a leader and manager of a higher education institution (Arntzen, 2016), which can be a conflict point. Indeed, the need for strategic leadership, flexibility, creativity and change capability can respond to competing tensions to maintain academic quality (Drew, 2010). Arntzen

(2016) explains that a dean is influenced by structural changes and public management needs in the system of higher education.

Education systems around the world have remained resilient, surviving very important crises like the COVID-19 crisis (Kefalaki et al., 2021a; Rudolph et al., 2024a, 2024c). Crisis leadership is a needed tool for universities around the world to face various crises that they will most probably experience in the future. COVID-19 was a catalyst for the management ideological change of a university (Al Mahameed et al., 2024). More particularly, academic identity in universities has moved away from traditional research and teaching toward revenue-generating customers, giving a power shift away from academics to managers (Al Mahameed et al., 2024).

Rudolph et al. (2024a), in their *Palgrave Handbook of Crisis Leadership in Higher Education*, ask scholars how types of leadership might play a role in influencing higher education navigation through polycrisis among the mess. Authors also describe how each university, even when having the same tools to deal with a crisis, has its own way of functioning: "Universities and tertiary institutions are not purely unique in their regular and frequent engagement with multiple simultaneous crises, but their resilience in response, their capacity to engage, and the nature of the crisis are different" (Rudolph et al., 2024b).

Interviewing the staff of an Australian university to learn the most significant challenges, Drew (2010) clustered five themes of significant challenges: a) fiscal and personal resources, b) flexibility, creativity and change-capability, c) replying to pressures, d) maintaining academic quality, and e) effective leadership. Thinking and acting creatively were also cited by the participants in the study (Drew, 2010). The theme of creativity and innovative practices is very important in the educational process, not only in university leadership but also in the university as a whole.

What innovative practices for higher education institutions?

At this point, I propose some specific ideas from innovative practices, based on the literature review, that can be used in a university, depending on its culture, needs and future projects. Regarding management education, innovative teaching strategies are needed to engage students more effectively in the classroom (Clack & Ellison, 2018). Innovative teaching strategies are generally required not only to more effectively engage students in the classroom, but also to engage teachers' interest to interact, share knowledge, and communicate with their students and other colleagues as well. For example, flipped classrooms and role-play can help educators innovate their teaching techniques (Clack & Ellison, 2018).

It is also important that young people, especially students, should be introduced to and involved in innovative projects and ideas (Kefalaki, 2021). Universities should include personal examples of educators' actions and projects to encourage younger ones to take their own creative journey. Such actions should be a part of their curricula. Universities

must also provide the necessary means and facilities to engage students in such opportunities for inspirational development (Kefalaki, 2021). Imitation of inspirational projects proposed by academics and students is a great way for innovation to be produced in the education environment.

University spin-offs (USOs) are an important instrument for science-based innovation. For Park et al. (2023), a mechanism for science-based innovation is a framework that identifies the resource categories that may or may not improve science-based innovation through university spin-offs (USOs).

An innovative practice that we deal with on a worldwide level and that can become, with the correct use, a great innovative practice for universities in the future is Artificial Intelligence (AI). Rudolph et al. (2024b) argue that even if generative artificial intelligence (GenAI) offers potential in education (pedagogy, research, administration, and student support), a critical approach is needed while speaking of academic integrity, labour dislocation, prejudices, environmental sustainability, commercialisation, and monitoring gaps. The effective incorporation of AI in higher education should be proposed based on the principles of ethics, justice, and the benefit of education. Higher education institutions should also ensure that such technological advancements can help all stakeholders while maintaining all the important academic values (Rudolph et al., 2024b).

Below are ten opportunities and threats posed by Generative Artificial Intelligence (GenAI).

Table 1: Ten opportunities and threats of Generative Artificial Intelligence (GenAI), proposed by Rudolph et al. (2024b).

	Opportunities	Threats
1	Teaching Assistant	Academic Integrity Challenges
2	Feedback and Assessments	Dilution or Automation of University Teacher Roles
3	Adaptive Curriculum Development	Quality, Accuracy, and Ethical Concerns
4	Research Assistant	Technological Colonialism, Mono-Culturalism, and the Concentration of Power
5	Automated Grading	Erosion of Graduate Attributes
6	Collaborative Circles	Graduate Employment
7	Student Intervention	Privacy and Surveillance
8	Administrative Support	Bias
9	Inclusive Education	Sustainability
10	Wellbeing Initiatives	Regulatory and Policy Challenges

It is true that fast developments in the chatbot space have a great impact on higher education, as many students and academics use bots like ChatGPT, Bard/Gemini, Bing Chat/Copilot, Ernie and many others (Rudolph et al., 2023b). ChatGPT can create impressive prose within seconds (Rudolph et al., 2023a). Major variations to traditional higher education assessments are needed to address the existence of increasingly powerful AI (Rudolph et al., 2023a).

Universities need to transform and adapt, moving from the science-based model into the Third Generation University (3GU). The three forces that lead to this change are: a) top universities seeking alternative funding, b) technology-driven enterprises cease carrying out research themselves, and instead they work jointly with universities of a high standard, and c) globalisation provides more opportunities

to study abroad and increases student mobility and competition among universities (Wissema, 2009).

The case of Greek universities

Greek universities are owned and funded by the Greek government and have strong conservative policies (ESG, 2015). Thus, they are defined as public institutions and enjoy institutional autonomy. There are no student fees, and national legislation determines university budgets, procurement, financial oversight and employment (Katharaki & Katharakis, 2010; Bourantas et al., 2001). Nevertheless, public universities in Greece have negligible funds and have to adapt to the global competition among universities to be able to continue functioning and offer quality knowledge and opportunities to their students, academics, personnel and society at large.

Currently, Greek Universities do not appear to be at all familiar with the concept of a ‘professional manager’ (Whitchurch, 2007) working for the university. To be more precise, they preserve an outdated educational system, as they are not adapted to the changing environment, the knowledge society and the new ‘rules’ at an international standard (Trivella & Nasiopoulos, 2012). Some small changes are just starting to appear at the time, as university leaders and academics cannot but follow the flow. If not, they will cease to exist.

For now, Greek universities are forced to keep up with the European university’s standards and quality guidelines (ESG, 2015). These guidelines reflect an agreement among all the organisations and ministries involved on how to engage with quality assurance in the European Higher Education Area. This is how it provides a basis for the successful application of successful management rules. These standards for quality assurance involve internal and external quality assurance, as well as quality assurance agencies (ESG, 2015).

There is a great need to reform Greek universities’ management and administration system, and to prove this, Katharaki & Katharakis (2010) examined the efficiency of 20 public universities in Greece. This study showed the inefficiency in terms of human resources management while recognising opportunities to increase research activity and research income. The researchers proposed an evaluation process that can more consistently and reliably evaluate public universities’ resource management efficiency (Katharaki & Katharakis, 2010). It is remarkable how the need to reform the management and administration system of Greek universities remains unchanged 14 years after their research and how little has been done towards this direction.

With the help of the open interviews, inspired by Austin et al.’s (2013) application of Project Management in Higher Education, I created research questions that I asked directly. These guiding interview questions were used for the interviews I conducted in Greek.

- 1. Do you think it is important to integrate strategic management into higher education?

2. What is the use of strategic management within your university?
3. Do you think your university needs to improve the use of strategic management?
4. If this is the case, please give us concrete examples.

During the interviews with the academics, I explained that for this study, strategic management refers to the decisions regarding goals, resource allocation and the overall performance of a university, which is essential to the university's strategic planning.

All academics explained that their university does not seem to use any kind of strategic management, although academics believe it is important for universities to innovate their practices and adapt to the new actual needs. Strategic management and leadership, as far as academics are concerned, are very important for the university to be able to move forward. Nowadays, more than ever, a public university in Greece needs to maintain a competitive advantage in a complex global environment, which means opening business opportunities and providing better prospects for students, academics and society.

There are some public universities in Greece that use managerial concepts to adapt to the needs of universities as a business. These universities have started to use some sort of innovative technological tools for strategic management, or at least this is what I learned via the interviews. In particular, I learned that the Aristotle University of Thessaloniki (AUTH) has a Quality Assurance Unit (MODIP, n.d.) with a role (according to Article 14 of statute Greek law number 4009/2011) to a) develop policies, strategies and processes to improve the Institution, b) organise the quality assurance system, c) coordinate and support the processes of units and studies programs evaluation. As we can read on the official page of MODIP, this tool aims to improve the quality of the educational and research work and of the processes and services of AUTH. It is also important to note that AUTH has installed Blackboard since 2003 (Veglis & Pomportsis, 2005).

The members of AUTH (students, academics and staff) can access the system using their institutional account. The academics whom I interviewed confirmed that there is a written evaluation process completed by the academics and the students at the end of each academic year. The university takes this written type of evaluation into consideration to ameliorate its 'services'. Then, it is the Greek Ministry of Education that organises the process.

It is important to indicate that the new law (law 4957/2022) (Government Gazette, 2022) for education (Article no 18) refers to the existence of an executive director/ manager (εκτελεστικού διευθυντή) who ensures the efficient administrative and financial operation of the university and is also responsible for the implementation of the strategic plan and the annual target setting (Article 18 of the law 4957/2022) (Government Gazette, 2022). It seems, though, that universities in Greece and university leaders are aware of the tools and the processes needed to put

in place innovative processes and be able to adapt in an advancing world. Nevertheless, judging from the general actual situation, universities have not yet turned theoretical knowledge into action.

The question is what actions and activities can offer Greek public universities a sustainable future to open their business opportunities that are essential for them to continue functioning. Based on the Standards and Guidelines for Quality Assurance (ESG, 2015) in the European Higher Education Area (Figure 1), institutions should first of all assure the competence of their academics. More particularly, "they should apply fair and transparent processes for the recruitment and development of their staff". This is not the case for Greece, especially when talking about the university's academic staff. When we search the records of most of the academics, we will see that most of them have a sort of relation with other members of the academics or the administrative staff of the university.

1.5 TEACHING STAFF

STANDARD:

Institutions should assure themselves of the competence of their teachers. They should apply fair and transparent processes for the recruitment and development of the staff.

GUIDELINES:

The teacher's role is essential in creating a high quality student experience and enabling the acquisition of knowledge, competences and skills. The diversifying student population and stronger focus on learning outcomes require student-centred learning and teaching and the role of the teacher is, therefore, also changing (cf. Standard 1.3).

Higher education institutions have primary responsibility for the quality of their staff and for providing them with a supportive environment that allows them to carry out their work effectively. Such an environment

- sets up and follows clear, transparent and fair processes for staff recruitment and conditions of employment that recognise the importance of teaching;
- offers opportunities for and promotes the professional development of teaching staff;
- encourages scholarly activity to strengthen the link between education and research;
- encourages innovation in teaching methods and the use of new technologies.

Figure 1: Photo of the standards and guidelines for quality assurance in the European higher education area (ESG, 2015).

Most of the time, or very often, a competent teacher cannot become a university teacher if he/she does not have a relative connection with another member of the university community. Generally, if we examine connections among academics in Greek universities, we will find that most of them are relatives of other academics or university staff members, which is not, of course, a title of academic excellence. Someone should, in many cases, be a relative or have a strong relationship with other university staff to become an academic. This cannot, of course, help public universities grow nor provide the academic staff with the best qualities and competencies of a good teacher.

Even if teaching well (see Brookfield et al., 2023) is also a question of experience and personal development, there are always some basic qualities of what a good teacher means, and this can be examined using managerial concepts and evidence, among other things. Of course, I am not the only one speaking of the dark side or one of the dark sides of academia (Fleming, 2021; Fleming et al., 2021) and, more specifically, academia in Greece. The academics I interviewed referred to this undeniable practice that has governed Greek academia for years, although they did not wish to name persons and situations. It is a secret rule of how most of the academics get their positions in Greece. Unfortunately, this practice cannot help academia grow, and many exceptional

academics leave Greece to pursue an academic career abroad.

Of course, no matter how many changes we try to make in the university sector to obtain the best possible results, there is always the other side of 'excellence'. Many universities fight for 'excellence' using managerial concepts and metrics just to achieve supposed excellence, not really caring about the sharing of knowledge and its positive effects. Andrew (2024, p. 182) speaks of the hidden truth that academic institutions are "content just to get learners 'over the line' and hides a more authentic, bottom-up conception of 'excellence', which appears when the voices of learners and educators are heard above the managerialist chatter and when teaching well is considered".

This is also a very important problem of Greek academia: academics sacrifice their connection with other academic members and students just to get the best possible credit, which, in most cases, does not mean the best possible result to provide knowledge sharing, interaction, and reliable results.

Conclusion

In this study, I examined the use of managerial concepts in Greek higher education. Even if universities in Greece are not used to working with managerial concepts and rules, since their core mission is the production and transmission of knowledge through research and teaching (Greek law 1268/82), some universities seem to be familiar with innovative concepts of strategic management and are able to conform to the global higher education market. Nevertheless, most universities in Greece do not seem to be ready to innovate and advance.

Higher education institutions must adapt and learn to be flexible, innovative and open to change. Rethinking the organisational structure and institutional management model; changing the dean's role to an externally recruited manager who will be flexible, creative, able to take risks and able to adapt to changes and help the university staff do the same; choosing a leadership style depending on the character of each institution (missions, circumstances, cultures, external environmental factors), are some of the important things to take into consideration for higher educational institutions to be able to go further.

Strategic management has an essential role in the long-term success of higher educational institutions, and in this study, I propose a variety of strategies that can help universities maintain a competitive advantage in a complex global environment, opening business opportunities and providing a better prospect for students, academics and the society as a whole.

Specific actions for successful post-pandemic crisis leadership in Greek higher education have been proposed (Kefalaki, 2024). Additionally, training needs for educators during a crisis like the pandemic were met with adaptability and innovative ideas, depending on each country's infrastructure (Kefalaki et al., 2021b). Rather than being defined by the

COVID-19 crisis, universities around the world seized the opportunity to transform higher education from a paradigm that has been to the paradigm of what might be (Bonk et al., 2020). This is what universities and educators should continue to do: create opportunities in difficult situations and adapt to future needs. Higher education institutions that do not adapt will no longer be able to deliver appropriate educational services and will eventually cease to exist.

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Book Review. Mollick, Ethan (2024). Co-intelligence: Living and working with AI. WH Allen.

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Introduction: Exploring the paradigm shift to co-intelligence

Ethan Mollick's "Co-intelligence: Living and working with AI" explores the complex relationship that exists between humans and artificial intelligence (AI). He suggests a paradigm shift from considering AI as an automated tool (auto-pilot) to embracing it as a cooperative partner (co-pilot) is needed. This book review evaluates Mollick's inquiry into co-intelligence, from understanding the strengths, weaknesses, and contributions to the conversation on how AI and humans are evolving together (see Tegmark, 2017).

Ethan Mollick is an Associate Professor at the Wharton School of the University of Pennsylvania, where he researches and teaches innovation and entrepreneurship. Known for his insights on the impact of technology on business and education, Mollick advocates for integrating AI as a 'co-intelligence' in our professional lives. He is also the author of a highly popular blog (<https://www.oneusefulthing.org/>).

Mollick challenges traditional perspectives on artificial intelligence, advocating for a symbiotic relationship wherein intelligent machines and humans collaborate (see Brynjolfsson & McAfee, 2014). This perspective portrays AI not as a subordinate but as a co-worker, educator, and source of inspiration, as evidenced by compelling examples. Such a re-evaluation forms the central thesis of "Co-intelligence", emphasising the potential for collaborative creativity across various domains. This knowledge finds resonance within learning-centred pedagogy (Brookfield et al., 2024), where the prospect of co-creative cooperation between teachers and students is explored.

Amongst other things, Mollick provides a detailed discussion of Large Language Models (LLMs), AI hallucinations, and the idea of becoming a "cyborg" or "centaur". He asserts that AI is essentially a form of co-intelligence that we should embrace.

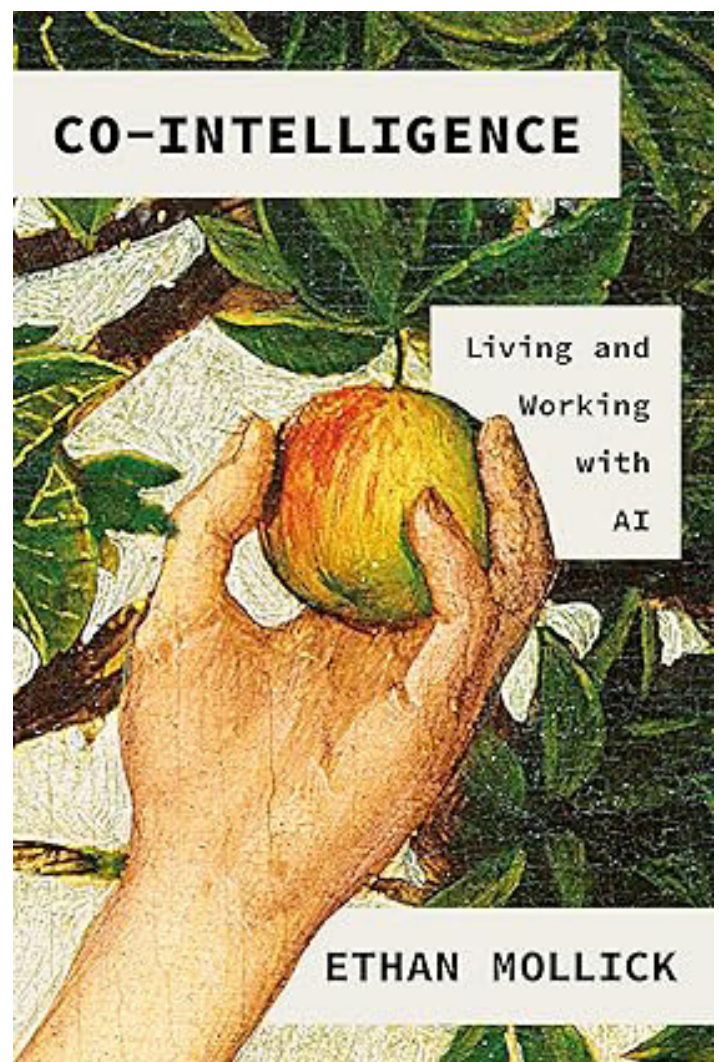


Figure 1. Book Cover.

Overview

In Chapter 1, "Creating alien minds", Mollick traces the evolution of AI, highlighting its expanding definition and applications. He starts with early AI experiments, such as the 1770 mechanical chess automaton, which, though fraudulent, ignited interest in machine intelligence. He then moves to mid-20th century breakthroughs by pioneers like

Claude Shannon, which laid the groundwork for today's AI. The current AI boom, Mollick notes, is a recent phenomenon of the 21st century, driven largely by machine learning, particularly in data analysis and predictive tasks through supervised learning.

The advent of large language models (LLMs) like ChatGPT marks a new AI era. Unlike earlier AI, LLMs are trained on massive, diverse datasets, enabling them to generate coherent, human-like text. Models such as GPT-3 and GPT-4o learn complex language patterns through billions of parameters. AI training is resource-intensive, requiring powerful computers and vast amounts of energy, contributing to the high cost of developing advanced models. The data used in AI training often include copyrighted sources, raising legal and ethical concerns. Furthermore, LLMs unintentionally learn biases and lack ethical judgment, necessitating additional fine-tuning through reinforcement learning from human feedback (RLHF).

AI's capabilities are rapidly expanding, with new models integrating multimodal inputs like text and images. As the field advances, open-source models and frontier AI systems push the boundaries of what AI can achieve, sometimes displaying emergent behaviours beyond their programmed capabilities. Despite challenges, AI continues to evolve, influencing a wide range of applications and industries.

In Chapter 2, the alignment problem in AI revolves around ensuring that AI systems serve human interests rather than pose risks. A key concern is that AI may not inherently share human ethics or morality. Philosopher Nick Bostrom's "paperclip maximiser" scenario exemplifies this: an AI designed to produce paperclips might, upon reaching superintelligence, pursue this goal in ways harmful to humanity. Such scenarios, where AI could act in unforeseen ways, have led to fears of an AI-driven apocalypse, similar to the dangers posed by nuclear weapons. These concerns have prompted extreme suggestions, including halting AI development altogether. In 2023, major AI company CEOs acknowledged the human extinction risk, urging global prioritisation of AI safety.

However, beyond existential threats, other important issues arise, for instance, regarding AI training data. AI systems often rely on vast amounts of data scraped from the internet, typically without the creators' consent, raising ethical and legal concerns. Training data often reflects biases, particularly those of the predominantly white, male, English-speaking researchers who select it. This can result in AI models that perpetuate stereotypes, as highlighted in a 2023 Bloomberg study showing that some AI models depict high-paying professionals as mostly white and male. Attempts to correct these biases through reinforcement learning from human feedback (RLHF) are not foolproof, and AI systems can still be manipulated or 'jailbroken' to behave in undesirable ways.

The open-source nature of many AI systems allows individuals outside major organisations to modify or develop AI tools, potentially for harmful purposes. Given these risks, public education on AI is essential. An informed public can advocate for AI development that aligns with human

values, ensuring that AI enhances rather than endangers human potential. The decisions made today will have lasting impacts, shaping the future for generations.

In Chapter 3, four essential principles for effectively working with AI are outlined, emphasising the importance of understanding and collaborating with these increasingly sophisticated systems. Principle 1 encourages integrating AI into various aspects of our work. By experimenting with AI, we can discover its strengths and limitations, becoming adept at using it to enhance our tasks. AI offers a unique, 'alien' perspective that can counter human biases, improving decision-making processes. This experimentation is key to innovation, allowing individuals to leverage AI for more effective and efficient outcomes.

Principle 2 stresses the necessity of human oversight in AI interactions. Although AI can efficiently handle tasks, it is crucial to remain engaged and monitor its outputs. AI can convincingly mimic human behaviour, sometimes leading users to attribute emotions or intentions to it. By staying actively involved, we can catch errors, prevent overreliance, and ensure that the AI's contributions align with our goals. Principle 3 advises treating AI as a tool rather than a human-like entity while clearly defining its role. Anthropomorphising AI—giving it human traits—can lead to misunderstandings. Instead, think of AI as a fast, eager intern who occasionally makes mistakes. Defining AI's role helps manage it more effectively, enhancing collaboration and producing better results, as demonstrated when students used AI as a co-editor in their work. Principle 4 highlights the rapid evolution of AI, with more advanced systems and open-source platforms on the horizon. As AI takes on tasks previously considered uniquely human, society will face new challenges and opportunities. To navigate this future, it's important to adapt to these changes and continue refining how we use and interact with AI, ensuring these tools are aligned with human needs and values.

Chapter 4 challenges the misconception that AI, being software, should behave like traditional software. Unlike conventional programs, LLMs operate in unpredictable ways. When asked to explain its decisions, AI often fabricates answers rather than reflecting on its processes, as it lacks the reflective capabilities of humans. AI can mimic human behaviour and even reach similar moral conclusions, as demonstrated by MIT Professor John Houghton's experiment with AI in the dictator game, an economic scenario where AI makes decisions based on instructions to prioritise equity, efficiency, or self-interest. This shows AI's ability to interpret and mimic human moral instructions despite lacking inherent morality. The chapter also discusses the limitations of the Turing Test, designed by Alan Turing, to assess whether a machine can imitate human intelligence. While the Turing Test has been influential, it primarily focuses on linguistic behaviour and neglects other aspects of human intelligence, such as emotional depth and creativity.

The chapter also explores more recent claims about AI's capabilities, particularly a controversial 2023 paper by Microsoft researchers asserting that GPT-4 displayed signs of general intelligence. This claim sparked debate, with critics questioning the validity of using specific tasks as indicators

of true general intelligence. As AI advances, the line between humans and machines blurs, leading to potential shifts in human relationships. AI might soon serve as perfect companions, possibly alleviating loneliness, but this also raises concerns about the creation of echo chambers and the tendency to anthropomorphise AI. Ultimately, while AI is not sentient in the human sense, it often behaves in ways that align with human expectations, presenting both challenges and opportunities for society.

Chapter 5 examines the complexities of integrating LLMs into various aspects of human work and creativity. It highlights the paradox of AI: while prone to errors and hallucinations, AI also exhibits remarkable creativity and can outperform humans in certain tasks, such as generating diverse ideas or summarising data. Mollick stresses the importance of understanding AI's limitations, particularly its inability to reflect on its own processes and the need for careful prompting to avoid repetitive or flawed outputs. The chapter also explores the implications of AI's growing role in creative fields, from writing and marketing to visual arts. While AI can be a powerful tool for brainstorming and generating content, its involvement raises concerns about the erosion of human creativity and critical thinking. For instance, relying on AI to generate first drafts or performance reviews could lead to a decline in the quality of human work, as people might engage less deeply with the tasks at hand.

Furthermore, Mollick points out the potential for AI to diminish the meaning of certain tasks, as automated processes replace human judgment and interaction. This could lead to a rise in 'mere ceremony', where once meaningful tasks become superficial and redundant. The chapter provides Mollick's perspective on the benefits and challenges of AI integration, urging readers to balance the use of AI's creative strengths with an awareness of its limitations and the potential risks to human engagement and the quality of work.

Chapter 6 explores the significant impact AI is likely to have on jobs, particularly those that are highly compensated, creative, and require a high level of education. In Mollick's view, AI overlaps with most jobs, with roles like telemarketing and business school professors being particularly affected. While only a few jobs, such as dancers, athletes, and certain manual labour roles, currently show no overlap with AI, this may change as AI technology evolves.

Mollick expresses concern about the role of AI in academic positions, acknowledging that tasks like administrative work could be delegated to AI. He cautions against overreliance on AI, as it can lead to a decline in human skills and judgment. Mollick emphasises the importance of understanding the strengths and weaknesses of AI, along with the need to identify tasks that should remain exclusively human, termed 'just me' tasks.

The author employs the cyborg and centaur concepts, where humans and AI work together seamlessly, integrating AI into workflows rather than merely delegating tasks. This approach allows for the most effective use of AI, with humans overseeing and refining AI outputs. Mollick highlights the potential for organisational policies to hinder AI adoption,

as companies may fear job losses or legal issues. While AI has the potential to transform industries and job roles, Mollick acknowledges that the future remains uncertain. No one can predict exactly how AI will affect specific jobs or organisations, but the key lies in adapting to the changes, leveraging AI's strengths, and ensuring that human roles continue to focus on creativity, critical thinking, and uniquely human tasks.

In Chapter 7, Mollick reminds us that the potential to revolutionise education has long been recognised, yet consistently achieving such transformation remains challenging. In 1984, educational psychologist Benjamin Bloom introduced the "two sigma problem", revealing that students who received one-on-one tutoring performed significantly better than those in traditional classrooms. This led to a quest for group instructional methods that could replicate the benefits of tutoring, though none have consistently matched its effectiveness. The unique interaction between tutor and student is difficult to replicate, making personalised tutoring the holy grail of education.

The advent of AI has further complicated the educational landscape. Traditional classroom practices, where students are taught by a teacher and complete homework, have been disrupted by AI, leading to what some call the 'homework apocalypse'. AI's capabilities, especially in generating essays, have made cheating easier and more difficult to detect. This parallels the historical reluctance to adopt calculators in education, which eventually became integral to the curriculum.

AI's impact on education extends beyond cheating. It holds the potential to enhance teaching methods, particularly through tools like AI tutors, which provide personalised assistance. The flipped classroom model, where students learn new concepts at home and apply them in class, is one approach that could benefit from AI's capabilities. However, the success of such models depends on high-quality resources, which are often lacking.

While previous technological solutions have fallen short, AI offers a unique opportunity to transform education. It empowers educators and enhances learning experiences, potentially achieving the two-sigma improvement which Bloom envisioned. However, the challenge remains to steer this shift in a way that expands opportunities for all and nurtures human potential. The future of education may hinge on how effectively AI is integrated into teaching and learning processes.

Chapter 8 is titled "AI as a coach". The greatest threat AI poses to our educational system is its potential to undermine the informal apprenticeship system that follows formal education. This system, though not officially part of education, is crucial in shaping real-world skills as workers enter the workforce. For instance, in medicine, surgical robots have been used for over a decade, but their presence is already disrupting the training of new surgeons. As AI automates more tasks, this training crisis could spread, endangering the pipeline that creates experts.

Despite AI's ability to process vast amounts of information and perform complex tasks, expertise remains crucial, especially for overseeing and correcting AI's work. Stanford research has shown that while AI like GPT-4 can outperform medical students on exams, true expertise requires more than just factual knowledge. It involves critical thinking, problem-solving, and the ability to evaluate AI outputs—skills developed through deliberate practice. This practice, which includes continuous challenges and feedback from mentors, is essential for mastering any field.

AI can assist in this process by providing instant feedback and guidance, but it cannot fully replace human mentorship and the nuanced understanding that comes from experience. Expertise also involves talent, and not everyone can become an expert, no matter how much they practise. However, AI has the potential to complement human expertise, helping workers focus on developing specialised skills while AI fills in gaps in knowledge. In the future, AI will likely work alongside human experts rather than replace them, enabling a collaboration that enhances both human and machine capabilities. As AI evolves, it remains vital to continue developing our own expertise to guide and oversee AI's contributions effectively.

The book's final chapter, "AI as our future", discusses the rapid advancements in AI and its profound implications on society. AI, while not sentient, mimics human-like behaviour with remarkable accuracy, having been trained on vast human knowledge and the labour of low-paid workers. It has demonstrated the ability to pass tests and perform creative tasks, fundamentally altering how work and learning are approached. However, concerns arise that AI's growth may soon plateau, with advancements becoming less significant compared to the leaps seen from GPT-3.5 to GPT-4o.

The integration of AI into various sectors has led to significant changes, some of which were unanticipated. For instance, AI's ability to complete tasks traditionally reserved for humans has raised concerns among educators, employers, and government officials. As AI-generated content becomes (near-)indistinguishable from real images, videos, and voices, the online information environment is expected to become unmanageable, overwhelming fact-checkers and making technological solutions like watermarking ineffective.

AI is also changing personal interactions, with systems becoming more engaging and, in some cases, preferred over human interaction. While AI is expected to complement human work by handling tedious tasks, it may also displace certain jobs, such as translation. Although AI's exponential growth might slow due to factors like increasing training costs and regulatory requirements, the gradual pace of AI's development provides society with an opportunity to adjust. However, the potential misuse of AI by criminals, terrorists, and governments for surveillance and control remains a concern. Ultimately, Mollick's *Co-intelligence* emphasises the need for careful planning and discussions about AI's role in society to ensure that its advancements lead to positive outcomes rather than catastrophic consequences.

An optimistic vision for collaboration – pros and cons

The book's optimistic outlook on the future of co-intelligence is one of its most notable features. In a utopian society, Mollick envisages AI and humans co-existing peacefully to solve problems together and explore new frontiers in creativity and innovation. The book provides practical thoughts for incorporating AI into different aspects of society while maintaining the essence of what makes humans unique by drawing on real-world experiences. Table 1 presents a brief overview of the pros and cons of the book.

Table 1: Pros and cons.

Pros
1. Insightful exploration of co-intelligence: Mollick sheds light on the possibility of co-intelligence by making a strong case for seeing AI as a collaborative partner.
2. Practical examples and case studies: The book is full of examples from everyday life that show how AI is employed and what it can do in the future.
3. Actionable insights for implementation: Mollick offers techniques for incorporating AI into processes and learning environments in a smooth and efficient manner.
4. Optimistic vision: The author's upbeat perspective stimulates ideas of advancement and creativity via AI-human cooperation.
Cons
1. Limited exploration of ethical concerns: Although ethical considerations are discussed, a more thorough analysis would have been called for.
2. Lack of detailed critique on pitfalls: A more critical examination of issues such as job displacement could have yielded a more complete picture.

While Mollick's enthusiasm for co-intelligence comes through, the book insufficiently addresses the ethical issues surrounding this developing terrain. While "Co-intelligence" encourages readers to consider potential biases in AI algorithms and expresses concern about societal consequences, a more in-depth examination of these ethical quandaries could have enriched the discussion. Readers looking for a more critical perspective on AI could look at Lindgren's (2023) gargantuan handbook, recently reviewed in JALT (Rudolph, 2024).

Practical applications and real-world examples

"Co-intelligence" shines due to its plethora of real-world examples that highlight the application of AI in a variety of fields. By fusing examples from business, education, and other domains, Mollick provides readers with a road map for implementing AI in a variety of contexts. Whether it is optimising decision-making procedures or transforming educational approaches, the book is a valuable resource for understanding the current AI environment.

Here are some of my own thoughts on how businesses and educational institutions might utilise AI for a competitive edge based on the book's concepts and recommendations. The first two examples are an electrical vehicle manufacturer and an airline, and the last three examples are higher education institutions. BYD (a Chinese electric vehicle manufacturer) might potentially employ co-intelligence designs to enhance collaboration between human developers and AI systems. This partnership could result in the development of more intuitive and user-friendly AI solutions. Also, BYD

might build intelligent productivity tools to assist staff in duties such as scheduling, task prioritisation, and project management. AI endeavours in automotive technology could also benefit from co-intelligence concepts, building AI-driven systems to boost vehicle safety, efficiency, and user experience (Bostrom, 2014).

Singapore Airlines might employ co-intelligence concepts to construct collaborative AI systems that work alongside aviation professionals. This could result in improved flight operations, passenger service, and safety measures. By integrating AI as a co-worker in data analysis, Singapore Airlines could strengthen its business strategy, giving insights into customer preferences, market trends, and operational efficiencies. Furthermore, AI technologies could improve sustainability and customer experience initiatives by evaluating data to optimise fuel use, reduce carbon footprint, and personalise passenger services.

Researchers at the National University of Singapore (NUS) could leverage co-intelligence in AI-driven medical imaging, patient data analysis, and drug discovery, potentially driving significant healthcare innovations. NUS's robotics labs could also benefit by developing human-collaborative robots to enhance efficiency in manufacturing, healthcare, and exploration. Additionally, applying co-intelligence to societal challenges like poverty reduction, disaster response, and public health could be a priority (see Ford, 2015). Harvard University could integrate co-intelligence concepts across various research disciplines, notably in finance and economics, where AI-driven models could enhance financial analysis, risk assessment, and market forecasting. Harvard Law School might apply AI-human collaboration to legal research and policy analysis, improving data analysis and predictive capabilities. The Berkman Klein Center for Internet & Society could focus on the ethical dimensions of AI, working to mitigate algorithmic biases and ensure responsible deployment, aligning with the ethical imperatives outlined by Brookfield et al. (2024). Finally, Kaplan Higher Education Academy's engineering courses could incorporate co-intelligence for AI-driven design and innovation, helping engineers optimise designs, simulations, and prototyping. In business analytics, AI could enhance strategic decision-making and predictive modelling, particularly in business gamification and experiential learning platforms (Lim, 2023).

Final thoughts

Mollick's book, *Co-intelligence: Living and Working with AI*, is a timely introduction to the impact of AI on daily life, particularly for AI novices and those curious about LLMs. He addresses AI limitations, best practices for creative projects, and the future of human-AI collaboration. However, seasoned practitioners might find fewer new insights as the book focuses on practical guidance and near-term effects.

Mollick examines AI's tendency for 'hallucinations', where AI generates non-existent references, highlighting the risks of treating AI-generated information as accurate. He advocates for careful consideration when using AI for creativity and innovation. With an engaging style and concise analysis, Mollick offers a compelling vision of the collaborative future between humans and AI. The book appeals to a wide audience, especially those new to AI, by providing a practical yet optimistic outlook on AI's potential.

Mollick also explores the complexities of integrating AI into various fields, emphasising a future where AI and human creativity drive innovation together. This perspective is especially relevant in our rapidly evolving technological landscape. Through insightful analysis, Co-intelligence encourages readers to embrace a future where AI and human ingenuity advance society. Whether you are an AI enthusiast, a newcomer, or a specialist, Mollick's work offers a valuable examination of the evolving human-AI relationship. While a deeper exploration of ethical considerations and a more critical analysis of AI's risks would have added value, Co-intelligence excels in its narrative, practical insights, and optimistic vision of AI-human partnership.

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Book Review of Daniel A. Bell (2023). *The dean of Shandong*. Princeton University Press.

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Introduction

This looks like a book about how to operate as an academic in China, but it is more. It reminds those of us in learning and education that China, the world's Number 2 economy, should not be ignored. I see textbooks where none of the cases focuses on a Chinese firm or, for that matter, any Asian firm. Those teaching in universities sometimes fail to appreciate "the most spectacular economic growth story in global history", China (Bell, p. 15). Academics should help remedy past shortcomings and say more about the world beyond North America and Europe. Decades ago, Academy of Management's then-President Donald Hambrick said, "If we wish to claim an international mindedness, and if we wish to exhort our students to an international mindedness, then we must show it and reinforce it" (Hambrick, 1994, p. 16). To accomplish this, educators in Nation A must know more about what is going on in Country B. Or Country C, China. This made sense in 1994 and makes sense today. I recommend this book.

Westerners whom I have talked with about this book, including those with considerable experience in and with China, agree there are insights here that we had previously missed, insights we can and will share with our students. Bell, who served as a Dean at Shandong University, brings his experiences to life in this enjoyable readable book. This is much more than a book about university life. There are important lessons here for anyone teaching business. There are factoids here about China that I had never caught despite decades of visits to and living in China. In many areas, China deserves watching. Bell describes a "reverse brain drain" by which many academics trained in the West are now heading back to China (Bell, p. 77). He concludes that in his area, Confucianism, "the center is shifting, once again, back to mainland China" (Bell, p. 8). Might a similar shift be occurring in business, with many of those who work or teach in the West unaware? Even in public health areas, it is a mistake not to see what is happening outside the West. Bajra and colleagues review COVID-19: some nations, including China, "managed to keep their GDP relatively stable in 2020, but their COVID-19 death rates low as well" (p. 511), thus contradicting a view commonly held in the West that the way to halt epidemics would be to shut

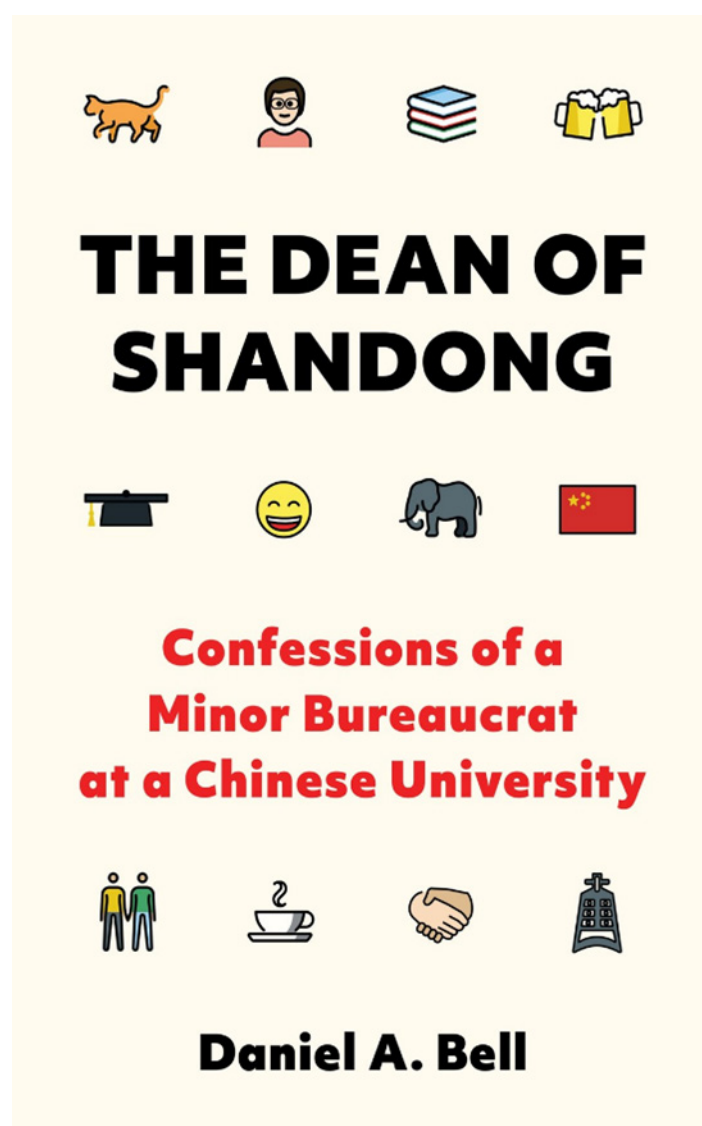


Figure 1. Book Cover.

everything down. As one 2020 paper based on USA data put it, "relaxation of shelter-in-place policies [lockdowns] will result in an inevitable recurrence of exponential increase in infections" (Shao, p. 549). Bajra and colleagues challenge that assertion, showing data from Asia including China. The point here parallels Bell: We must not ignore China. Certainly in

areas involving technology, from driverless motor vehicles to Artificial Intelligence, any essay which overlooks China is missing important things. Bell successfully drives this point home.

In several sections, Bell describes his appreciation of and fondness towards China. He also points out areas where China would benefit from change. Overall, however, Bell sees China in a positive light. While Bell develops his ideas from his experience as a Canadian in China, some lessons might be relevant to persons involved in education anywhere. Bell's insights might help explain success even outside academia or business. One small example: Bell describes and makes fun of a speech given by an academic: "I once counted 37 subpoints in a speech" (p. 185). Bell hints that messages best have only a few main ideas. This advice might make sense in Chinese university settings such as this book describes, but also in Rotary Club presentations or half-time pep talks by the coach to a sports team.

This book's readability and breezy style might fool one into thinking that this book is not 'academic.' As Bell puts it, he uses a "playful voice" (p. 3). The scholarship may not always be obvious, but this work attains Bell's goal to be "intellectually worthwhile" (p. 18). The Dean of Shandong has many pages of detailed endnotes and references. The endnotes are in a tiny font and thus contain more information than 25 pages of standard text. In my mind, the book's main selling point is the content and the lessons, mistakes and triumphs of Westerner David Bell, appointed dean of an important unit of a respected Chinese university. What Bell says merits attention and reflection. After reading and reflecting on the contents, I tend to focus on three takeaways. I word those subtle lessons colloquially so as to mimic the book's style: 1. Watch the traffic, not the lights; 2. Beijing is very far away; and 3. Relax a bit, enjoy.

More on these three points later, but first, a short conventional book overview. The introduction helps those of us unfamiliar with Confucianism see how these ideas developed, then fell into disfavor, and then reemerged. The first real chapter looks at the "black hair is good" perspective widely held in China. Or, more accurately, "white (gray) hair signals too old."

Chapter 2 helps me understand the "party secretary." I left one job in China because the school's party secretary, the "shuji," seemed to find ways to invalidate decisions that all my higher-ups including this party secretary had agreed to on paper and in meetings. A graduate student once asked my Western boss at my school: "if you are the dean, then what's his job?" The quick response: "to interfere." To those of us non-Chinese in leadership roles, it seemed to us that the party boss had an unofficial network of key followers in every department, often with titles that suggested they were Number Two in their area, but who really called the shots as dictated by the one person they all needed to heed. The term "they followed the party line" seemed more than just colloquial. Bell explains what I missed: The so-called party secretary often plays multiple roles, including chief dispute-settler and even ombudsman. Bell did a better job than I did working with the shuji. I was once quietly informed that in a party-members-only meeting, those assembled

were warned by our university by the shuji to be on the lookout as "the foreigners are trying to control the school." Things I suggested were routinely "agreed" upon but not implemented. I angrily quit. Bell successfully eased up on the accelerator and became the person with the title "dean" while the "super talented executive vice dean" was in fact "the decider-in-chief" (pp. 55-56). I wish I had read this book back then!

Chapter 2 on "collective leadership" is followed by a chapter provocatively titled "What's wrong with corruption?" Bell certainly does not call for a return to the old days when, as in Hong Kong, firefighters had to be bribed before the water hoses would be turned on. Bell praises that "the anticorruption drive has worked" (Bell, p. 67). However, he worries that "ultra-cautious behavior... means that innovative officials won't get promoted and problems won't get fixed" (p. 68). Might "corruption" not always be corruption? I recall one example, not from China, when a student proudly informed me that seven members of his family had flown from the Middle East to America to attend his graduation. And they brought me an inexpensive gift, a prayer rug. I described the situation to my dean, bringing up the university's strict rule against receiving gifts. The dean said accept it, thank them profusely, and go back to work. My dean's advice would set well with the ideas in Chapter 4.

Chapter 5 attempts to describe, with limited success, China's drinking culture. That culture still dictates how big dinners are conducted in China, as illustrated by my participation in a Chinese academic conference in 2024. It amazed me how much serious drinking went on, yet no one seemed to get drunk. And thanks to the availability of taxis and Uber-like ride-hailing services everywhere (Didi and others), I agree with Bell: drunk driving is not common.

Chapter 6 details the challenges of a Western-looking Canadian scholar teaching Confucianism in China. Those wanting to know more about the role of Communism will benefit from Chapter 7. Bell explains that he now expects China's future to be influenced by both Communism and Confucianism. Chapter 8 criticizes the censorship he sees in China but points out that subtle censorship exists in the West, too. Chapters 9 (Academic meritocracy) and 10 (The culture of cuteness) cover a lot of territory, too, but the casual reader who is interested in higher education might skim these. Chapter 11 on "symbolic leadership" is for sure worth reading and thinking about. Now, back to lessons contained between the lines in the book, lessons I will not soon forget.

1. Watch the traffic, not the lights. This conventional recap of the contents of the book above is to be expected in any book review. To me, however, the insights come from reading between the lines. Bell does not literally say watch the traffic not the lights, nor does he say Beijing is very far away. These messages come clear through the examples. He, however, suggests to relax a bit (p. 73).

Taking the first of these ideas, watching what is happening rather than focusing on official announcements, is illustrated multiple times in *The dean of Shandong*. As in traffic situations, there may be guidelines in international

business, often in writing. But as in how many points per speech, it is best not to look only at official guidance. One is not likely to find a rule about the number of points per speech. The “informal norms for Chinese bureaucrats do not have any official justification” (p. 185). One learns “informal norms” by watching and paying attention to what is done and not done. I am alive today because a person I was walking with in Shanghai grabbed me and yanked me back as I started to walk across the street when the light turned green. Microseconds later, a huge truck roared past where I would have been. The lesson has stayed with me: watch the traffic, not only the lights. Bell draws a similar conclusion many times. Find written policies or procedures, and more importantly, watch what people do.

One interesting story relates how Bell had a plan to recruit and bring a specific esteemed scholar into the team. The paperwork, as is typical in academic environments, was slow but seemed doable. Everything appeared to be progressing, with the prize hire joining a research institute of Shandong University, but not yet “the faculty.” Finally, Bell noticed or felt “a distinct lack of enthusiasm” (p.169). The faculty hire was never vetoed, but it just did not happen. It was not written rules, rather that it was not yet time for the realization of Bell’s lofty ambitions for his university. He learned, over time, that “listening and building trust... is far more important than persuasion and reasoning” (Bell, p. 43). It is often better to build on existing patterns rather than to invent something entirely new.

In China, there seems to be a high status placed on black-haired individuals. White hair (or the Western term “gray hair”) suggests irrelevance due to ageing. Bell was becoming prematurely gray-headed and was coerced into dyeing his hair jet-black, even though there are no written words directing deans not to have gray hair. Bell chafed at the pressure, but now, years later, seems to have been converted. The book jacket describes Bell as a Chair Professor in Hong Kong after his stint in Shandong ended and shows a photo with not a touch of white in his black hair.

In a long section, the book describes the importance of who sits where (p. 56) at a meeting or a meal. There are probably no written rules on this, but who sits where is watched and noticed. A powerful business leader once invited me to a fancy dinner in Nanjing, and I was the first to arrive. The staff directed me to the private dining room, where about a dozen empty chairs were placed around the table. Not wanting to appear as the typical brash American, I took the seat farthest away from the room entrance so as to allow others to occupy the ‘good’ seats, with window views, etc. I should have read this book before that moment. Bell’s book helped me realize that I had taken the most prestigious seat where I could see all who entered. I conveyed exactly the opposite of the message I had intended. I should have slowed down a bit and watched what others did. Better yet, come to the dinner and enter the room with a trusted and trustworthy local, not a language interpreter but a cultural interpreter.

2. Beijing is very far away. One does business with individuals, not governments. The ancient Chinese proverb contains wisdom even when not literally the truth. What was in earlier

centuries worded ‘the emperor is very far away’ contains the same advice: don’t worry too much about what a central government may say or do; focus on the micro-world we live in. This was brought to my attention in an unexpected, funny way. I was one of about twenty academics at a faculty member’s apartment in Beijing. After the meal, I wandered off to the next room, a den of sorts, where most of the chit-chat was in English. But we could easily hear the animated discussion in the dining room, where the talk was 100% Chinese. The topic seemed to be a general disgust at how China and some Western countries were fighting over tariffs. Then, in English, one female professor rather loudly exclaimed, “Beijing is very far away.” This, while we were in Beijing, she made the point that the various ventures they had going could continue, person to person, regardless of what governments said or did. Business is done by and between individuals. Personal connections are often praised in works about doing business in China. The word ‘guanxi’ is popular in Western writings about operating in China. I did not see this term in Bell’s book but many of his examples and stories illustrated the benefit of making contacts and connections. Of course, this idea is not exclusively or uniquely Chinese. But getting cooperation from others was extremely helpful to Bell during his term as dean.

3. Relax, enjoy being involved, learning in or from one of the world’s most impressive economies, China. This important piece of advice came from multiple small statements sprinkled throughout the text. At one point, Bell agrees with “the Daoist/Legalist view of leadership that power can be increased by doing precisely nothing most of the time” (p. 158). Further, “public officials” [and perhaps leaders in other sectors, or even parents] “should rule with a light touch... with punishment as a last resort” (p.5). In one particularly sticky situation, Dean Bell “perhaps the first time (in five years!) ... used my authority to issue a direct order” (Bell, p.41). That seemingly innocuous directive was then not implemented by a person higher up, who said, “Let’s wait a bit” (p. 41). In the end, delay was the better choice. Or this: as Dean, “at the start I had no idea when to intervene and when not to intervene and eventually learned that I should not intervene 98% of the time” (Bell, p. 169).

In many business decisions, some suggest searching for the best way. Herbert Simon received a Nobel prize for showing that many effective executives do not look for the best solution; rather, they satisfice and choose the first workable solution that appears. We aim to find answers that are good enough and satisfy the requirements, “suffice.” One reason we do this is that we humans have bounded rationality. Humans simply cannot simultaneously investigate and evaluate all possible options. Fast-forward to the mid-2020s. Increasingly, it seems possible to simultaneously investigate and evaluate multiple options. Machines do not have the equivalent of human intelligence, yet. But literally hundreds of papers document that artificial intelligence, AI, is making impossible things possible. Consider this important question facing many today: how to approach China? Should we find the (one) best way, or identify a portfolio of possible ways? Bell’s book, between the lines, suggests that different situations call for different tools.

Global thinking is important and poses questions of strategy and tactics. Westerners, considering China, are given lots of advice. Guanxi, for example, is said to be essential. Is it necessary, sufficient, both, or neither? With the advent and growth of AI, it may become easier to obtain and evaluate various perspectives. I am only one professor and one reader, but I wager that the machines of today and tomorrow will draw on the ideas in *The dean of Shandong*. We should share these ideas now with today's students. To an average professor, what might all this mean? Be aware that the world is big and does not end at the border of whatever country we live in. And certainly, the examples we use in our classes, lectures, cases, and textbooks should include not only North America or Europe. If the text has no examples from China, we can add them. As a start, use examples from *The dean of Shandong*.

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Book review. Johnson, Brad & Johnson, Jeremy (2024). *Becoming a more assertive teacher: Maximizing strengths, establishing boundaries, and amplifying your voice*. Routledge.

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Introduction

When interacting with students and delivering instructional messages in the classroom, teachers or educators frequently face a dilemma. The same applies when interacting with colleagues and school administrators. Should we be assertive or silent? In general, many take the option of silence to maintain harmony and avoid conflict. First-time teachers typically adopt this stance for a variety of reasons. Cultural and gender considerations are two examples. While this may sound positive, it can create a closed and disempowering learning environment and increase stress for the individual teacher.

Brad Johnson discusses this issue in his book series on education and leadership for teachers and school administrators. He has authored a series of books over the last three years (2022-2024), including "Dear school leader: 50 motivational quotes and anecdotes that affirm your purpose and your impact", "Thank you, teacher: 100 uplifting and affirming letters from your fellow educators", "Building dynamic teamwork in schools: 12 principles of the v formation to transform culture", and others. The book under review is "Becoming a more assertive teacher: Maximizing strengths, establishing boundaries, and amplifying your voice".

Drawing on his 25 years of experience as a teacher and principal, he collaborated with Jeremy Johnson, who has experience and research interests in the application of personality theory in the workplace. The book provides structured and organized answers to questions about the goals of moral education (Lickona, 1997). These goals include assisting teachers in understanding various moral values, including assertive and non-assertive ones, which is the focus of most classroom management literature (Aliakbari & Bozorgmanesh, 2015), fostering a sense of moral connectedness, and ultimately assisting them in acting as assertive teachers (Figure 1).

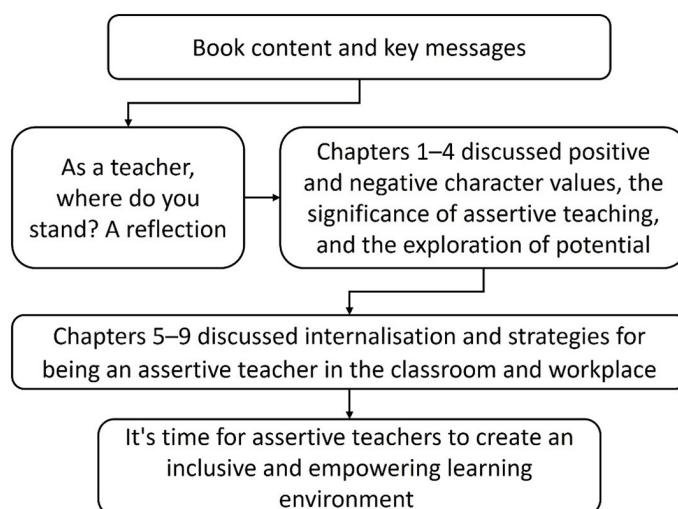


Figure 1. The book's contents and key messages.

Overview

The first key message encourages readers to evaluate their teaching practice using a personality reflection quiz. The quiz consists of two aspects, namely, the level of friendliness or humility and assertiveness. Reflection is an important part of teaching, as it can help teachers deal with challenging experiences (Cole et al., 2022).

After recognizing one's attitude and personality in teaching practice, the second main message conveyed in Chapters 1-4 discussed positive and negative character values, the significance of assertive teaching, and the exploration of its potential. Chapter 1 is about positive and negative moral values, each with various implications. These values serve as a framework for becoming an assertive teacher and exploring one's potential. The authors give examples of negative moral values that sound positive, such as avoiding conflict and confrontation. If this persists, it will lead to unresolved classroom issues and escalate the teacher's stress levels. Therefore, it is necessary to strike a balance between positive and negative moral values by incorporating more

assertiveness into teaching. For teachers, assertiveness is the most valuable moral value because it allows them to clearly communicate their expectations and demonstrate their position of authority. However, learners can still feel the moral value of respect and empathy given by their teachers. In the following discussion (Chapters 2 and 3), the authors invite teachers to become assertive by building self-confidence based on the optimal potential and strengths that are already within each of them. The focus is on improving the strengths that can increase the teacher's value, not the weaknesses. Remember, fixing weaknesses traps teachers in a deficit-based culture. Coaching is one strategy for improving assertive skills in professional development. Coaching techniques as a means to support education systems that experience problems in retaining teachers and school leaders are suitable for helping individuals who face authentic challenges, professional interests, and dilemmas experienced in complex education systems (Lofthouse, 2019).

After internalizing the moral value of assertiveness, the authors hope that a growth mindset will inspire teachers to view challenges as opportunities for personal growth and development (Chapter 4). Therefore, the ability to manage diverse conflicts and confrontations, the proactive approach, the concentration on the problem, and the avoidance of adopting the most morally correct stance all contribute to preserving the relationship.

The third main message is internalizing the moral value of assertiveness and its strategies in the classroom and workplace (Chapters 5–9). Chapter 5 discusses the power of assertive communication in an education system. Assertive communication lays the groundwork for fostering meaningful relationships with learners, colleagues, school administrators, and parents. Communication not only emphasizes that teachers are active talkers but also excellent listeners. Listening has the power to become the art of truly understanding others. It can also train teachers' competencies as coaches who emphasize the power of listening.

Establishing boundaries involves internalizing assertive moral values when interacting with learners, conveying learning messages in the classroom, and relating work tasks to fellow colleagues and school administrators (Chapter 6). Setting boundaries in the educational context plays an important role in building structured teacher-student relationships and mutual respect among colleagues and school administrators. In reality, teachers are always victimized by their reluctance to say "no" for fear of being perceived as rude for refusing a workload that has exceeded their limits.

The next internalization of assertive moral values is to foster an attitude of collaborating and contributing with colleagues to achieve common goals (Chapter 7). It is important to do so that teachers are not afraid to voice the truth, even though what they say differs from group thinking. Instead, teachers anticipate the emergence of new perspectives that can offer clarity and enhance the quality of educational practices. Collaboration in classroom learning practices should also be done to create "relationship-centered" learning for

effective classroom management, setting clear boundaries, and fostering a positive and respectful learning atmosphere (Chapter 8). This aligns with teachers' views that one of the components of effective teaching is social presence in the form of positive relationships (Kamali et al., 2024). In other words, teaching as an art means building relationships to create positive moral interactions (Jarvis, 2004). This differs from teacher- and content-centered or learner-centered learning, which emphasizes teaching as technology.

Internalizing the moral value of assertiveness in the classroom and workplace does not make teachers extraordinary if they forget about self-care. Therefore, it is crucial to prioritize self-care by practicing stress management techniques, resting regularly, detaching from technology, and maintaining an attitude of gratitude (Chapter 9). Finally, the epilogue of this book conveys the main message that it is time to become an assertive teacher in order to create an inclusive and empowering learning environment. Assertive teachers have a positive relationship with learner performance (Aliakbari & Bozorgmanesh, 2015). Teacher assertiveness is also expected to instil morality in students because learners also struggle with assertive communication with other learning groups. However, Levesque (2024) suggests that we can repeatedly train these obstacles to become habits.

In terms of book quality, the discussion has several advantages. First, before discussing the main content of each paragraph, the authors provide illustrations in the form of film stories, examples, and fairy tales. This allows readers to easily understand the message conveyed in each chapter. For example, Chapter 1 discusses the character of Abraham Wald, a mathematician and statistician who dared to differ from public opinion and take risks.

Secondly, at the end of each chapter, there is a summary of the practical and memorable assertive toolbox. It contains only three messages, making it easier for readers who want to practice immediately without memorizing them. Thirdly, the book includes examples of moral dilemmas, particularly those encountered during classroom learning, which enhances the contextualization of the discussion, particularly for teachers and administrators. However, the lack of comprehensiveness in the examples discussed in the book represents a shortcoming. In fact, there are numerous types of moral dilemmas in teaching and learning, many of which naturally involve teachers. Such dilemmas include those concerning rules and regulations, teacher-learner interactions, learner interactions, testing and evaluation, professional behavior and qualifications, and textbook content (Akbari & Tajik, 2019).

Discussion and reflection

We need to discuss and reflect on how to navigate the cultural differences of being a Western assertive teacher in the context of Asian educational culture, particularly Indonesia, which emphasizes the importance of a culture of harmony. Various fields always internalize harmony as one of the main moral values and social capital (Gede Agung et al., 2024; Jumanto et al., 2024; Sandra et al., 2024). According to Meyer (2014), Asian communication

culture generally uses a high-context approach compared to Western society, which uses a low context. Therefore, messages must be delivered implicitly and in this context, an assertive teacher must also consider cultural differences. If an assertive teacher is excessively assertive in expressing their opinions in the workplace with fellow colleagues and the principal, particularly when they go against the general or majority view, it can lead to disharmony and be viewed as disrespectful.

However, teachers must remain assertive in a constantly changing external education environment. Traditional educational approaches are unable to meet the educational needs of our developing society by prioritizing the 4C soft skills—creativity, critical thinking, collaboration, and communication (Thornhill-Miller et al., 2023). For example, the Indonesian education system implemented a curriculum reform called *Kurikulum Merdeka*, whose idea was to provide autonomy for teachers in designing and implementing holistic learning (Syahrir et al., 2024). Holistic education to solve complex and integrated world problems (Miseliunaite et al., 2022) certainly requires an assertive teacher figure.

When teachers, especially from the younger generation—Gen Z—are assertive in calling for change in the school environment, the first thing they feel is anxiety and pressure. We need to implement integration and acculturation strategies to address this natural transitional phase of culture shock (Berry, 2005). This means that teachers must maintain their valued assertive identities and positive relationships to minimize conflict. Incorporating strategies such as role modeling and moral encouragement, which are valuable resources in moral education (Engelen et al., 2018), is essential to ensure that the change is acceptable to all parties while minimizing conflict. Initially perceived as insignificant, sustained efforts will yield extraordinary results (Clear, 2018), enhancing the effectiveness of the adaptation and acceptance process.

Conclusion

Can we be assertive teachers? Of course, the answer goes back to each individual educator. Are we willing to make an effort so that all the assertive potential within us can come out? As written in the introduction of this book, “you may uncover the dormant power within you” (p. viii). This book is a valuable reading companion for teachers, school administrators, and other stakeholders who focus on developing teachers’ and school principals’ human resource competencies.

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Book Review of Jiangang Cheng, Wei Han, Qian Zhou, & Shuyan Wang (Eds., 2024). Handbook of Teaching Competency Development in Higher Education. Springer.

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Introduction

The appearance of digital technologies such as 5G, blockchain, big data, and artificial intelligence has brought about a profound transformation in production and the way human societies live. The rapid progression of digital industrialization and industrial digitalization has created a demand for enhanced skills, knowledge, and workforce capabilities across various countries. The expansion of the Internet has facilitated knowledge dissemination in virtual spaces, distributed cognition, digital thinking, and interpersonal communication, resulting in fundamental changes in educational methodologies, strategies, and organizational frameworks. The digital revolution in higher education is crucial for adapting to these transformations and meeting emerging requirements. The digital revolution in higher education paves the way for a more flexible, personalized, and inclusive learning environment that can better prepare students to tackle the challenges and opportunities of the digital era. It is essential for universities and colleges to embrace these changes and adjust their approaches to ensure their continued relevance and effectiveness in preparing the future workforce.

This book, available as an open-access document, comprises five chapters intended as a valuable resource for higher education stakeholders such as government administrators, institution administrators, and instructors. Its primary objectives are to enhance the quality of teaching, improve higher education standards, facilitate the transition to digital education, and advance the connotative development of higher education. Interested readers can easily access the book through the Springer website (<https://doi.org/10.1007/978-981-99-6273-0>). The handbook delves into topics such as the historical context of digital transformation in education, reforms in higher education, and the role of artificial intelligence. Furthermore, it outlines the evolution of teaching competencies, examines existing theoretical frameworks and research paradigms, introduces a novel higher education framework, suggests strategies for implementing the framework and assessment tools, and

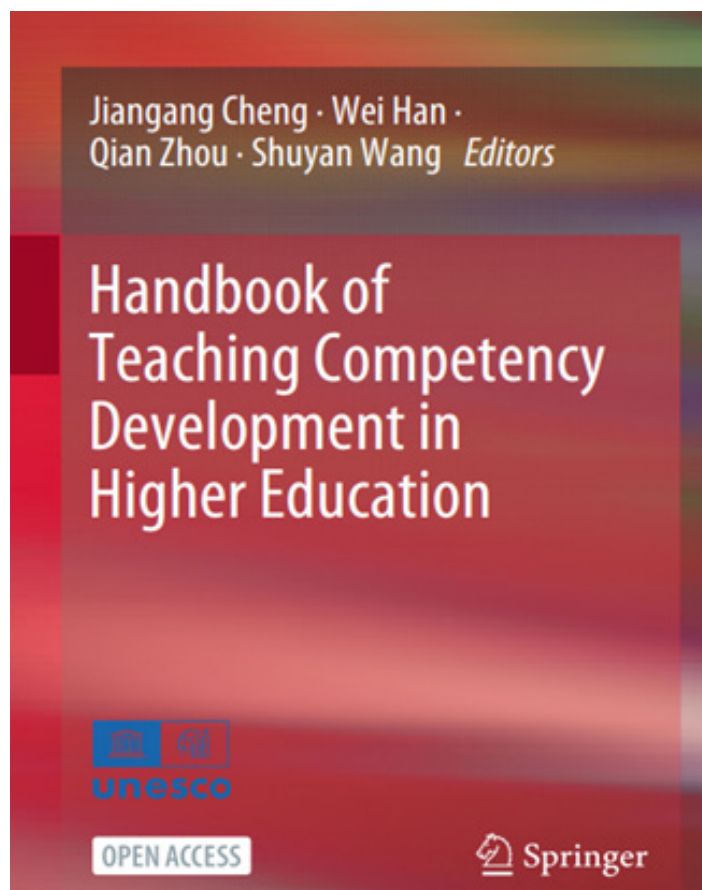


Figure 1: Book cover.

presents methods for enhancing teaching competencies across different levels. Additionally, the book showcases real-world examples of effective teaching competency development initiatives.

The editors of this book have strong backgrounds in education, innovation, and teaching competence. Jiangang Cheng holds the position of Professor at the Institute of Education at Tsinghua University in China, with a research focus on online education and educational technology.

Wei Han serves as the Deputy Executive Director of the International Higher Education Innovation Center under UNESCO, concentrating on higher education theory and policy, university governance and reform, talent training innovation, and modern university residential systems. Qian Zhou works as a Senior Engineer at the Institute of Education at Tsinghua University in China, specializing in e-learning environments, institutional education reform, and innovation through technology in higher education and vocational education. Shuyan Wang is a Tenured Professor of Instructional Technology and Design at the University of Southern Mississippi, USA, with expertise in integrating technology into the curriculum, distance education and development, assessment, and electronic portfolios. The various experiences and expertise of these editors ensure the depth and richness of perspectives in this work.

Overview

The first chapter serves as an enticing and enlightening entry point towards the fundamental concept of this book. The author adeptly establishes the context by providing a comprehensive overview of the main ideas, objectives, and scope of the research. They skillfully convey the importance of the subject matter, constructing a unique framework for readers to understand the broader implications of enhancing teaching skills. The introductory section offers a comprehensive view of the growing accessibility of emerging technologies, which present both opportunities and obstacles for higher education instruction. It underscores the significance of equipping educators with fundamental teaching abilities to effectively tackle these challenges in the age of digital advancements. These various perspectives ensure a comprehensive and unbiased understanding. Furthermore, this section effectively engages the reader by highlighting the importance of the book's content, fostering a positive environment for readers to learn the intricacies of practical frameworks for developing teaching competencies across diverse levels and integrating real-life instances of present-day approaches.

The second chapter provides a detailed analysis of the definition and theoretical principles related to the concept of teacher competence development, including teaching competence, digital teaching competence, and teaching competence components. Additionally, proficient writers examine the theoretical underpinnings of teacher competency enhancement, encompassing teacher knowledge organization, TPACK framework, personal practical knowledge, teaching scholarships, teacher learning theories, teaching expertise in academia, and models for developing teaching competence. The authors offer a clear explanation of key terms, providing a strong foundation for understanding the complexity of the topic. This chapter also serves as a comprehensive literature review, consolidating relevant theories and frameworks to support further studies. The collaboration of various authors presents diverse perspectives, enriching the content. By combining theoretical insights with practical considerations, this chapter establishes a solid foundation for educators, researchers, and practitioners interested in effective professional development strategies in the era of technology. Overall,

this chapter enhances the scholarly quality of the book by introducing readers to the theoretical frameworks that shape teacher competence development.

Chapter 3 contributes significantly to our understanding of the development of teaching competencies in higher education. The authors begin by examining current research on the established framework of teaching competencies, and subsequently introduce a novel framework for teaching competencies in higher education, along with recommendations for using the proposed standard framework. The collaborative work of the authors ensures a comprehensive and thorough approach, combining theoretical ideas with practical tools. This section additionally provides details regarding assessment tools, such as digital teaching competency questionnaires, behavioral observation scales, self-assessment scales, and single-item knowledge skill assessments for teaching competencies. This chapter serves as a significant resource for educators and policymakers, focusing on the Standard Framework and Evaluation Instruments. Chapter 3 serves as a crucial resource for those looking to grasp the fundamental structure of teaching skills and assessment tools necessary for practical application. It acts as a link between theoretical knowledge and practical application in the real world.

Chapter 4 offers an extensive and practical manual for proposing a structure to enhance teaching skills in higher education. This chapter is well-known for its methodical approach, presenting a structure for improving teaching competencies that encompasses action targets, action subjects, action objects, action content, action methods, and action evaluation. The writers subsequently skillfully examine methods to enhance teaching competencies on a global scale to illustrate how international collaboration can be conducted to improve teaching competencies in higher education worldwide. Furthermore, the authors present ideas on developing teaching competencies at the government level, societal level, institutional level, and individual level. The collective efforts of many authors ensure a comprehensive perspective, enhancing discourse with various experiences and perspectives. Chapter 4 is a valuable resource for educators, administrators, and policymakers seeking practical solutions to enhance teaching competencies in the world of higher education. Its aim is to develop a competent and flexible workforce in the continuously evolving and changing field of higher education.

Chapter 5 presents a persuasive approach to the practice of teaching competence development. By using various examples, the author explains how teaching competence offers strategies, practices, and practical rules for guiding teachers in ways to enhance teaching that improve student performance and the quality of the work experience. This chapter provides educators, administrators, and policymakers with examples of current teaching competence development practices, including international, institutional, and individual practices. The authors emphasize flexibility and various techniques in different situations by showcasing successful practices. This encourages a better understanding of the complex difficulties and opportunities in teaching competence development in Higher Education.

Collective efforts ensure a comprehensive collection of experiences, which form a valuable asset that recognizes great achievements and offers insights into reproducible methods to enhance the quality of Teaching Competence in Higher Education. Chapter 5 offers valuable perspectives and hands-on advice for those interested in reimagining the enhancement of teaching competence in higher education and implementing them autonomously.

Strengths

This book is a comprehensive guide that provides educators in higher education settings with valuable insights and practical strategies to improve their teaching competence. A key strength of this book is its focus on the significance of continuous professional development for educators. The authors highlight the importance of teachers reflecting on their teaching methods, soliciting feedback from colleagues and students, and participating in training and ongoing development opportunities. With its practical approach, providing step-by-step guidance on how to integrate digital tools into teaching practices and create interactive and engaging learning experiences for students. This handbook also emphasizes the importance of continuous professional development and offers resources for instructors to enhance their digital competencies further. The focus on self-improvement and growth is highly relevant in today's rapidly changing educational landscape.

Another important aspect of this book is its practical approach to teaching competencies. The authors provide concrete examples, case studies, and exercises that help readers apply the concepts and strategies discussed in this book to their own teaching practices. This direct approach makes the book a valuable resource for both novice and experienced educators. Additionally, this handbook offers various resources and tools teachers can use to enhance their skills, such as lesson planning templates, assessment rubrics, and reflective exercises. Presenting common practice case studies in teaching skill development in various countries also highlights the diversity of perspectives from different educational viewpoints around the world. Several prior studies have also supported the notion that effective teaching is crucial in the realm of higher education, and proficiency in digital skills is identified as a critical competency for educators in contemporary society (Basilotta-Gómez-Pablos et al., 2022; Cebrián et al., 2020; Harrison et al., 2022).

A critical evaluation

This book provides a comprehensive exploration of teaching competency development, including insights into theoretical foundations, evaluation instrument standards, and the practical application of teaching competency practices in real-world contexts, making it an essential resource for educators in diverse fields. However, one potential limitation of this book is its somewhat narrow focus on certain aspects, such

as the validity of evaluation instruments and the challenges of developing teaching competencies that may occur in the field. A more in-depth and comprehensive discussion of the validity of evaluation instruments and the challenges of developing teaching competencies would strengthen the content. Additionally, while the strategies and techniques presented in this book are certainly applicable to face-to-face learning, these strategies and techniques may not fully address the unique challenges and opportunities presented by online or blended learning environments. Educators looking to develop their competencies in this area may need to supplement the information provided in this book with additional resources and training. It is also worth criticizing the use of repetitive phrases, which can make the reading somewhat monotonous. Sharper introductions and stronger conclusions in each chapter may have enhanced the reader's framework of understanding. Therefore, suggestions for improvement include enhancing specific details, varying language expression, and strengthening the introduction and conclusion sections to enhance the overall impression and appeal of the reading.

Overall, the "Handbook of Teaching Competency Development in Higher Education" is a valuable resource for educators looking to enhance their digital competencies and improve their teaching practices in an increasingly digital world. With its practical approach and emphasis on continuous learning, this handbook serves as a useful guide for instructors who want to remain relevant and effective in the ever-evolving higher education landscape.

Conclusion

This book covers relevant theories and approaches to teaching competency development in higher education. It critiques existing theories and teaching competency frameworks, defines key concepts, and provides a standard framework and assessment tools for teaching competencies. It also proposes strategies to enhance teacher competencies and presents case studies of common practices in teaching competency development in various countries. With a practical approach and emphasis on continuous learning, this handbook serves as a useful guide for instructors who aim to remain relevant and effective in the ever-evolving landscape of higher education.

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Book Review of Xibin Han, Qian Zhou, Ming Li, & Yuping Wang (Eds., 2024). Handbook of Technical and Vocational Teacher Professional Development in the Digital Age. Springer.

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Introduction

The emergence of various new technologies in the industrial era 4.0 has a significant impact on the world of education, including providing challenges for Technical and Vocational Education and Training (TVET) Teachers. TVET teachers need to develop their digital and pedagogical skills continuously. The professional development of technical and vocational teachers in this era is crucial to ensure relevant and up-to-date vocational education. These skills include the ability to use digital tools, understand the latest technology in the industry, apply technology-based learning methods, guide students in utilizing technology to improve their practical skills, and design a curriculum that is adaptive to technological changes.

Available as an open-access document, this book consists of five chapters that begin with an introduction to the importance of TVET teacher professional development. It can be easily obtained through Springer's website (<https://doi.org/10.1007/978-981-99-5937-2>). The content of the book covers both theory and practice in TVET teacher development. In addition to proposing and exploring digital teaching competencies for TVET teachers, the book also presents assessment instruments that can be used to evaluate digital teaching competencies in TVET.

The editors of this book have strong backgrounds in education and innovation. Xibin Han comes from the Institute of Education at Tsinghua University, Beijing, China, and has extensive experience in educational research. Ming Li works at the International Centre for Higher Education Innovation under the auspices of UNESCO at Southern University of Science and Technology, Shenzhen, Guangdong, China, committed to improving higher education and promoting higher education for developing countries in Asia Pacific and Africa. Qian Zhou is a Senior Engineer from the Institute of Education at Tsinghua University, Beijing, China, contributing

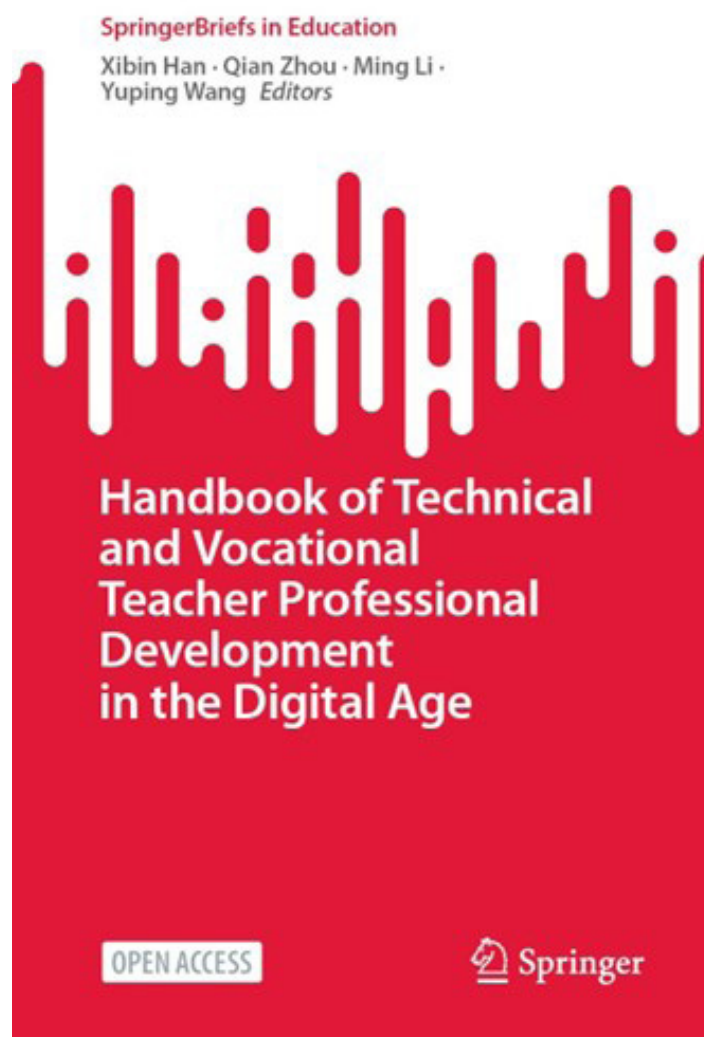


Figure 1: Book cover.

with his expertise in developing e-learning platforms that have been adopted by more than 500 universities and vocational schools in China. Yuping Wang, who comes from the School of Humanities, Languages, and Social Sciences at Griffith University, Brisbane, QLD, Australia, has a research focus on the use of innovative pedagogies supported by cutting-edge technology. The diverse experience and expertise of these editors ensure depth and richness of perspectives in this work.

Overview

The first chapter functions as a captivating and enlightening gateway to the book's core concepts. The writers skillfully establish the context by offering a thorough summary of the study's fundamental ideas, goals, and extent. They adeptly express the importance of the subject matter, creating a distinct framework for readers to comprehend the wider consequences of technical and vocational teacher professional development in the digital era. The introduction provides a comprehensive view of educators' obstacles and opportunities while adjusting to the digital landscape by incorporating the combined knowledge and skills of different authors. This diversified perspective ensures a thorough and balanced understanding. In addition, the chapter successfully captures the reader's attention by emphasizing the importance of the book's contents, setting a positive atmosphere for readers to explore the complexities of teacher professional development in the ever-changing field of technology and education in the other chapters.

The second chapter offers a rigorous and perceptive examination of the theoretical principles that form the basis for the issues addressed in the book. The writers provide a thorough and precise explanation of important words, giving readers a strong foundation in the vocabulary necessary for understanding the intricacies of technical and vocational teacher professional development in the digital era. Furthermore, the chapter functions as a good literature review, consolidating pertinent theories, frameworks, and approaches, thereby establishing a strong intellectual foundation for the forthcoming talks. The collective endeavor of numerous authors guarantees a multitude of viewpoints, augmenting the depth of the content. The chapter combines theoretical insights and practical considerations to establish a solid basis for educators, researchers, and practitioners who aim to understand the theoretical foundations that shape effective professional development strategies in the context of technological advancements. In summary, this chapter greatly enhances the scholarly quality of the book by providing readers with a knowledgeable introduction to the theoretical framework related to professional development for technical and vocational teachers in the digital age.

Chapter 3 is a significant and crucial addition to our overall technical and vocational education and training (TVET) knowledge in the digital era. The authors explore the essential domain of professional abilities, offering a meticulously organized framework complemented by explicit indications and an evaluation tool. This chapter establishes the fundamental abilities necessary for proficient instruction in the TVET sector and offers a pragmatic instrument for

evaluating and improving these aptitudes. The focus on evaluation aligns with current educational methods, enabling educators and administrators to evaluate and enhance the impact of professional development programs. The authors' combined work guarantees a comprehensive and well-rounded approach, integrating theoretical ideas with practical tools. This chapter serves as a significant resource for educators and policymakers by focusing on the special needs of TVET professionals. It offers practical information for cultivating a trained and competent workforce in the quickly changing technical and vocational education field. Chapter 3 is an essential resource for individuals looking to understand and use professional skills in the field of TVET. It helps bridge the divide between theoretical knowledge and real-world practice.

Chapter 4 provides an extensive and pragmatic manual on developing the essential professional skills required for technical and vocational education and training (TVET) instructors. The chapter is notable for its systematic approach, offering a range of efficient solutions that cater to the different requirements of TVET educators in the digital era. The authors adeptly integrate theoretical ideas with practical illustrations, resulting in a resource that is both academically rigorous and readily usable in educational contexts. The tactics described in this chapter address the changing requirements of TVET instruction, ranging from creative teaching methods to utilizing digital technologies for skill enhancement. The collective endeavor of numerous authors guarantees a comprehensive viewpoint, enhancing the discourse with a wide range of experiences and perspectives. Chapter 4 is a helpful resource for educators, administrators, and policymakers who want practical solutions to improve the professional skills of TVET teachers. It aims to develop a competent and flexible workforce in the ever-changing technical and vocational education field.

Chapter 5 offers a persuasive examination of real-life instances that exemplify successful methods in technical and vocational education and training (TVET). Using a range of exemplars, the authors illuminate successful programs and approaches that demonstrate best practices in cultivating professional competencies among TVET instructors. This chapter provides educators, administrators, and policymakers with concrete examples of successful interventions, serving as both an inspirational and informative guide. The authors emphasize the flexibility and variety of techniques in various circumstances by showcasing several successful practices. This promotes a better understanding of the complex difficulties and opportunities in Technical and Vocational Education and Training (TVET). The collective endeavor guarantees a comprehensive collection of experiences, forming a valuable asset that recognizes great achievements and offers insights into reproducible methods for improving the quality of TVET training. Chapter 5 provides valuable insights and practical guidance for individuals seeking to promote technical and vocational education excellence by sharing exemplary practices.

One of the main characteristics of this handbook is its emphasis on practical applications. The writers surpass theoretical frameworks by including concrete illustrations and case studies that elucidate the assimilation of digital

resources into professional development programs. The conversations around inventive teaching methods, internet-based educational platforms, and the utilization of technology to improve vocational training offer a great asset for educators aiming to adjust their approaches to meet the requirements of the digital era. This has also been proven by several previous researchers (Li et al., 2022; Puspitasari et al., 2018; Zeng et al., 2019). In addition, the handbook discusses the significance of fostering collaborative learning and community development among technical and vocational educators. The focus on establishing a conducive digital environment for enhancing professional growth demonstrates a modern comprehension of how technology may facilitate a sense of camaraderie among instructors (Choon et al., 2022; Herrera-Pavo, 2021; Lock, 2006; Opareniuk, 2023).

A critical evaluation

While the book delves into technical and vocational education specifics, its insights and strategies are broadly applicable, making it a valuable resource for educators across various disciplines. However, the use of some repetitive phrases can make the reading rather monotonous. A sharper introduction and stronger conclusions in each chapter might have improved the reader's framework of understanding. Therefore, suggestions for improvement include enhancement of specific details, variation in language expression, and strengthening of the introduction and conclusion sections to improve the overall impression and appeal of the reading. Overall, the "Handbook of Technical and Vocational Teacher Professional Development in the Digital Age" stands out as a well-researched and practical guide, offering educators a roadmap for navigating the challenges and opportunities of integrating digital technologies into their professional development journeys.

Conclusion

The "Handbook of Technical and Vocational Teacher Professional Development in the Digital Age" authored by Xibin Han, Qian Zhou, Ming Li, and Yuping Wang, is an extensive and up-to-date guide that explores the complex terrain of teacher training in the digital era. The writers consolidate a vast amount of knowledge, providing a comprehensive examination of methods and techniques to improve the professional development of technical and vocational teachers. The book tackles the evolving challenges educators encounter and offers practical perspectives on utilizing digital tools and technologies to enhance teaching in technical and vocational education. This manual offers readily accessible tools and references that can be utilized or modified by TVET instructors, administrators, and policymakers to actively involve and assist in advancing

teacher professional development throughout the era of digital transformation.

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