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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. Warings "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; Saulnieret 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 (Koohang & Paliszkiewicz, 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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