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The double-edged sword: Open educational resources in the era of Generative Artificial Intelligence

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Abstract

The integration of Generative Artificial Intelligence (GenAI) into the Open Educational Resources (OER) landscape represents a paradigmatic shift, transforming OER from static content into a dynamic, algorithmic infrastructure. While GenAI promises to democratize content creation and accelerate localization, it simultaneously introduces profound ethical and epistemic risks. This commentary, in this regard, adopts a speculative-critical methodological approach to interrogate the "double-edged" nature of this transition. We analyze several emerging tensions: the ontological crisis of human authorship, which challenges traditional copyright frameworks; the risk of "openwashing" where proprietary models appropriate the language of the open movement; the potential for automated translation to amplify Global North epistemic biases; and the paradox of hallucination where OER serves as both a corrective ground truth and a potential casualty of remix culture. By comparing and contrasting the optimistic imaginaries of AI-enhanced access against critical perspectives on data surveillance and commodification, this paper argues that the binary definition of "openness" is no longer sufficient. We conclude that ensuring equity in the AI era requires a transition from open content creation to the stewardship of "white box" technologies and transparent digital public goods.

Introduction

The term "open educational resources" was first coined in 2002 at the UNESCO Forum on the Impact of Open Courseware for Higher Education in Developing Countries. The notion of Open Educational Resources (OER) then gained global traction through the UNESCO 2012 Paris OER Declaration, which laid the normative foundation for the movement. That 2012 Declaration called on governments to encourage the release of publicly funded educational materials under open licenses, promote ICT-enabled learning environments, support capacity building, and foster multilingual and culturally contextualized resources. The Paris Declaration laid the normative and philosophical foundation of the OER movement, linking open education to human rights, including the right to education, cultural participation, and lifelong learning.

The UNESCO Recommendation on OER (UNESCO, 2019) was adopted at UNESCO's General Conference. For the first time, OER gained status through an international normative instrument. The 2019 Recommendation established five strategic pillars: capacity building, policy, access, sustainability, and international cooperation. Though it explicitly mentions the potential contributions of artificial intelligence, the Recommendation was drafted before the proliferation of Large Language Models (LLMs) and Generative AI (GenAI). As such, this framework largely addresses a landscape of static content and could not anticipate the algorithmic disruption that was to follow.

The rapid development of Artificial Intelligence (AI) has triggered several debates about how AI and OER could work together (Bozkurt, 2023; Tlili & Burgos, 2024). GenAI has been the subject of substantial hype. Particularly, it has the potential to significantly transform how OER are created, distributed, customized, and accessed, reshaping the entire open education workflow. In terms of content creation, GenAI can automate or accelerate the production of draft materials, generate multimodal versions of resources, create examples and assessments, and support educators with rapid prototyping. For distribution, AI-driven tools such as automated tagging, metadata generation, and content summarization can increase the discoverability and interoperability of OER across platforms and repositories. Customization is perhaps the most transformative domain: GenAI can potentially adapt resources to different reading levels, cultural contexts, or disciplinary needs; translate high-quality content across multiple languages; and convert materials into accessible formats such as audio, simplified text, or alternative modalities. Additional applications could include accessibility support and personalization of learning.

Thus, the UNESCO Dubai Declaration (UNESCO, 2024) attempts to respond to how AI and emerging technologies will transform content creation, distribution, customization, and access. The Declaration acknowledges that the landscape of content creation, dissemination, and use has changed rapidly; that GenAI, machine translation, automated indexing, content adaptation, and other digital tools now shape how educational resources are produced and circulated. One of the Declaration's central conceptual moves is to frame OER as digital public goods, resources with a public mission, and part of a global commons governed with principles of equity, inclusion, transparency, and collective stewardship. By pushing for open infrastructures, open-source software, interoperable metadata standards, and transparent, auditable AI tools, the Declaration connects OER policy to the broader terrain of digital sovereignty, data governance, and rights-based digital public infrastructure.

Rather than inventing new categories, the Dubai Declaration (UNESCO, 2024) revisits the five pillars of the 2019 Recommendation for the era of AI and other emerging technologies. Capacity building emphasizes developing the skills and digital confidence of educators, learners, and content creators, including ethical and responsible use of AI in OER. Policy and governance focus on establishing supportive legal, institutional, and licensing frameworks to facilitate open practices. Inclusive access prioritizes the intrinsic qualities of OER for adaptation into culturally and linguistically relevant resources, ensuring that OER reach underserved populations and support diversity. Sustainability highlights the importance of long-term economic models, but also infrastructure and community stewardship to maintain OER quality and availability over time. International cooperation encourages cross-border collaboration and knowledge exchange, leveraging collective expertise to strengthen the global OER commons.

Despite this aspirational vision, the integration of GenAI into open education illuminates profound tensions that policy alone cannot resolve. These frictions arise, most clearly, where the efficiency of automation clashes with t-

-he ethics of openness. This commentary interrogates some of the major tensions (summarized in Table 1) and explores whether the intersection of OER and AI, particularly GenAI, represents a democratization of knowledge or a new form of epistemic enclosure.

Table 1. Key tensions associated with GenAI and OER.

Framing Question	GenAI and OER-In Favor Interpretation	GenAI and OER-Critical Interpretation
Do OER have to be human-created?	AI-generated content can expand access, speed up resource creation, and lower barriers for educators with limited time or resources.	OER should be created by humans to preserve, among others, pedagogical intentionality, contextual sensitivity, and ethical accountability.
Do OER have to be copyrighted?	Open licenses can apply to AI-generated resources, making content available through the public domain; flexible IP models encourage sharing and remixing, including AI-assisted outputs	Copyright and licensing become ambiguous or meaningless with AI outputs, undermining the current foundations of openness and attribution in scholarship and authorship.
Is "open" being misused in relation to AI?	AI can extend openness by supporting creation, translation, adaptation, and accessibility of resources, broadening participation in the OER movement.	Corporate AI systems falsely appropriate the language of openness while relying on closed data, opaque code and models, and restrictive terms with the ultimate aim of commercialization.
Will AI reproduce linguistic, cultural, and epistemic biases?	AI can be fine-tuned or regionally trained to reduce bias and increase representation in OER, especially for under-resourced languages.	AI inevitably amplifies Global North biases and epistemic dominance, embedding them deeper into OER ecosystems at scale.
Will OER reduce AI hallucination or increase it?	Quality OER can be used as a reliable knowledge base so that the educational output provided by AI/GenAI is more accurate and reliable, particularly in specialized areas.	The quality issues associated with overall content available on the internet, including OER, and the reuse of poor AI-generated content might influence the model and make it even worse.

Method

To interrogate the intersection of OER and GenAI, this commentary adopts a speculative–critical mode of inquiry (Bayne & Ross, 2024; Bozkurt et al., 2023). This approach is increasingly vital in educational research during periods of rapid transformation, where the velocity of technological diffusion often renders conventional empirical cycles reactive rather than anticipatory. The speculative–critical tradition combines conceptual analysis with imaginative extrapolation to interrogate how emerging technologies reshape educational values, practices, and relations of power. Our approach forgoes empirical validation in order to engage critically with discourses, i-

-maginaries, and normative assumptions that underpin current debates about open education and artificial intelligence.

This method is particularly suited to the study of GenAI, whose pace of development and social diffusion outstrips conventional modes of empirical inquiry. Many of the most significant questions and controversies are unfolding in real time and demand anticipatory forms of reasoning. Speculative inquiry allows researchers to explore these issues conceptually, mapping possible trajectories and tensions without presupposing stable outcomes. The critical dimension of our framework situates these explorations within the established pedagogy of questioning the ethical, social, and political consequences of educational technology (Freire, 1970; Giroux, 2011; Farrow, 2017).

Procedurally, we structure the commentary as a series of thematic explorations. For each domain, we present two contrasting provocations (summarized in Table 1). These function as heuristic devices, representing the opposite poles of a conceptual spectrum: the techno-optimist imaginary of AI-enhanced openness versus the critical-realist perspective of surveillance and enclosure. By framing GenAI as a “double-edged sword” (Selwyn, 2019), this dialectical approach foregrounds the productive tension between opportunity and risk. It invites plural interpretations, positioning speculation not as mere guesswork, but as a critical practice that expands the horizon of what "openness" might mean in an algorithmic age.

Do OER have to be human-created?

GenAI tools have made creating resources easy and accessible to millions of people, which has raised questions about whether these resources can be copyrighted, attributed an open license, or even considered OER. In January 2025, the U.S. Copyright Office published a part of its Copyright and Artificial Intelligence report (U.S. Copyright Office, 2025), mentioning that AI-generated resources cannot be copyrighted. The report stated that "given current generally available technology, prompts alone do not provide sufficient human control to make users of an AI system the authors of the output" (p.18). The report further argues that “prompts essentially function as instructions that convey unprotectible ideas" and "do not control how the AI system processes them in generating the output" (p.18). It concludes that GenAI outputs created with little or no human creative involvement (including in automatic response to most text prompts) are not copyrightable.

The above legal framework, albeit from one country, is reflected in international approaches. This view highlights that content created by AI cannot be copyrighted, and we typically think of OER as being in the public domain, or copyrighted with an open license. Thus, from the legal perspective, all AI-generated resources are OER, since their being ineligible for copyright protection places them immediately into the public domain. However, from another perspective, either (purely) AI-generated content is not OER, or we need to rethink our common understanding of OER, as current OER definitions do not specify human involvement in the OER creation and do not exclude machines.

Some might argue that the AI era could be more about hybrid intelligence (i.e., the combined artificial intelligence and human intelligence) and hybrid knowledge (i.e., the knowledge is created by both humans and machines). It is therefore important to keep machines within the process of knowledge creation, including OER. On the other hand, others might argue that what counts as human creation is difficult to define. They might question the true meaning of education and our involvement as humans in the knowledge creation and transfer within a society if the educational process, including creating educational resources and teaching, is delegated to machines.

Does OER have to be copyrighted?

The language of “in the public domain” present in many definitions of OER would suggest that OER do not need to be copyrighted. However, it can be argued that copyright is important for OER, as they are a testament to provenance, resulting in the possibility of identifying authorship and as a proxy for quality or accuracy. On the other hand, given that the work of hundreds, or even thousands, of authors forms the basis for each decision or generated sentence by an AI, how can we select from them in order to attribute sources? If we opt for OER with-

-out copyright (i.e., in the public domain), some might argue about how we can then protect intellectual property. This would also support "power to the strongest", where companies, with the financial advantage, would benefit the most by using what is available to train their models and increase their profits. Others, on the other hand, might argue the necessity of copyright, but this also comes with several legal and technological challenges.

For instance, courts have begun to acknowledge that the act of training GenAI models on copyrighted material is a “fair use,” meaning that no permissions are needed from rightsholders before copyrighted material (whether traditionally or openly licensed) can be used for training. For example, the judge in Bartz v. Anthropic wrote, “the purpose and character of using copyrighted works to train LLMs to generate new text was quintessentially transformative” (Bartz v Anthropic, 2025). If this is the case, how can we update the current legal frameworks to protect the intellectual property of OER authors from being abused (as the author may see it) by GenAI tools? Should current open licenses be updated to address such issues? How can we develop machines (including GenAI tools) that can read the open licenses attributed to OER and act within what that open license or other contract mechanisms specify (For example: https://github.com/creativecommons/cc-signals)? And if training is a fair use and happens outside the realm of copyright, would changes to open licenses even matter from a legal perspective?

Is open being misused?

While the term “openness” is constantly evolving and renewing, there is a longstanding tension regarding its authentic use (Weller, 2014). A new front has emerged in relation to the risk of "open-washing" when it comes to GenAI, where something is labelled as open but is actually rooted in proprietorship, private profit, and restricted access to knowledge (Wiley & Hilton, 2018; Tlili et al., 2024). The indeterminacy of defining “open” can be understood as a flexibility which enables new perspectives and behaviors, but this same lack of agreed definition means that those who do not necessarily share the progressive values of the open education movement may freely brand themselves with the term. OpenAI (2025) produces ChatGPT, which is perhaps the AI tool with the highest profile. However, their systems are among the lowest ranked in terms of indicators which could be used to determine the “openness” of AI systems according to factors such as availability of AI models, parameters, model weights, training data, documentation and availability to application programming interfaces (Liesenfeld & Dingemanse, 2024).

The basis of OpenAI’s claim to openness is open-source code, which is commonly used in almost all software (Langenkamp & Yue, 2022). This is arguably too low a standard for authentic “openness”, particularly in GenAI (Widder et al., 2024). Furthermore, the Open Source Initiative (n.d.) has published a definition of open source AI, which requires a much higher standard of transparency that would enable others to reconstruct models in full through having access to all relevant elements (models, code, parameters, weights, and information about data sources). Generally speaking, most AI models exhibit differing degrees of openness in these respects, and, while more “open” models are being released (Lin et al., 2025), they are competing for attention and adoption with increasingly well-established, heavily funded commercial, proprietary or restrictive models.

On one reading, AI offers pragmatic benefits to the OER ecosystem: automation, personalization, and analytics can reduce costs, improve scalability, and enable new forms of partnership that strengthen the long-term viability of OER without eroding open licenses or public values. On a more critical note, the same technologies intensify phantomization, drawing OER into proprietary infrastructures controlled by large technology firms, where value extraction, data capture, and paywalled services undermine openness and reframe digital public goods as commercial assets. The dichotomy is therefore not about AI per se, but about whether its integration reinforces open, commons-based governance or deepens dependency on closed, market-driven systems.

At a minimum, those involved with education must be aware of the difference between systems that are “free of charge” (gratis or “available” online for use, such as Perplexity and ChatGPT in their introductory offerings), and those that are “open” in the wider sense discussed here. By thinking of AI as simple tools to be used, educators ignore how many GenAI tools are part of an ecosystem of big tech platforms with clear business models and commercial interests that can have significant negative consequences for education as a public good (Amiel, 2024).

Will AI reproduce linguistic, cultural, and epistemic biases?

A long-standing concern of the OER movement is that most content produced originates in the Global North. Due to their legal and technical flexibility, OER are more easily adapted - increasing the support for localization and translation (Amiel et al., 2011). But disparities in the sheer capacity to produce quality content (technical resources as well as associated costs), linguistic limitations as well as biases, have led to a one-way road. Content from richer and more spoken languages is usually translated and sometimes localized to lesser spoken languages and the Global South.

Powerful GenAI tools for content creation and adaptation (e.g., videos, images, software) are currently offered in great part by private corporations through paid services. Financial resources needed to engage in the more sophisticated aspects of OER adaptation and localization will likely disfavor those who need it most. Moreover, the capability to easily create content by those with more resources, could potentially decrease the interest in reusing, remixing and adapting existing resources. This could be due to issues in findability or quality OER, or the low time cost in 'prompting' for new resources.

Will OER reduce AI hallucination or increase it?

Hallucination (errors or mistakes) is a major issue in AI systems that affects the output quality. OER has the potential to reduce hallucinations by offering AI systems access to openly licensed educational content that were developed, revised, or remixed by content experts and educators worldwide. When AI models are trained on reliable OER, their responses can be built on accurate knowledge, minimizing the likelihood of fabricating information. Perhaps more powerfully, OER can be added directly to prompts in order to provide models with just-in-time access to additional ground truth context. This approach can be significantly more helpful in improving the accuracy of model responses than fine-tuning (Ovadia et al., 2024). Additionally, the open and transparent nature of OER enables collaborative verification, allowing educators and learners to cross-check AI outputs, fostering correction and continuous learning. On the other hand, OER can also contribute to poor content if low-quality or outdated materials are included without sufficient curation. The diversity in formatting, inconsistent metadata, and varying levels of academic rigor across different OER sources may lead to errors or misinformation. Furthermore, the dynamic and remixable nature of OER means that conflicting or unvetted content could be used to train AI models, increasing the risk of erroneous output. To sum up, the influence of OER on AI hallucination depends not merely on its open access, but on how carefully and systematically it is curated, structured, and integrated into AI development and retrieval systems. The quality of the data curation process has long been a predictor of the effectiveness of the model training process, and this remains true both for traditionally copyrighted training materials as well as openly licensed materials.

Discussion: Should we continue to define things as "open" or "closed"?

The emerging picture is that a binary open/closed dichotomy does not adequately reflect what is happening with GenAI, since there are many dimensions which could be considered open or closed to different degrees. Widder et al. (2024) propose transparency, reusability, and extensibility as the key dimensions of open AI, reflecting wider sociotechnical elements which go beyond the technical system. White et al. (2024) similarly recommend reproducibility, transparency and usability as critical. Further complicating this picture is the difference between openness as a property of a technical or pedagogical system compared with openness as a feature of a combination of contextual factors.

GenAI systems are composed of many individual components, including the content used for training, the software used for training, the weights that result from the training process, and the software used with those weights for inference (responding to user prompts). Each of these kinds of components - content, software, and data - has its own rich history of open definitions, frameworks, and licenses. Rather than trying to characterize the entire complex conglomerate as "open" or "closed," discussants might rely on the lessons learned in each of these domains over the decades and choose instead to talk about whether the training content is open content, whether the training software is open-source software, whether the model weights are open data, etc. We acknowledge that there remains a lively discussion about whether model weights are data, software, or content.

However, that conversation concludes, there are decades of licensing knowledge to draw upon. For example, a user might use the 5Rs framework as a reference and ask, “Am I allowed to retain, revise, remix, reuse, and redistribute these training materials? This training software and inference software? These model weights?”

Additionally, “openness” could be understood not only as an intrinsic property of an educational AI system. It’s also important to draw on the extrinsic relation of educational AI systems to wider matters of social impact and pedagogical equity. Technological developments have the potential to shift the way we produce and share information, but they are not isolated tools to be used, and instead are part of a wider sociotechnical system. Therefore, open educators should renew their sense of what ‘open’ means in their own contexts in response. Furthermore, the rapid GenAI development should be rooted in the open science movement if we want to adopt a clear box technology, where we can see what process and outcome, allowing us to make the needed adjustments or reuse accordingly.

Conclusions

The integration of GenAI into the openness landscape marks a definitive transition from a focus on static content to dynamic, algorithmic infrastructure. As this commentary has argued, this shift functions as a double-edged sword: it offers the potential to democratize content creation and accelerate localization, yet simultaneously threatens to enclose the digital commons within proprietary, opaque, and commercially driven systems.

To navigate this paradox, the OER movement must look beyond the traditional binary of "open" versus "closed" licensing. The critical imperative for the future is the adoption of "clear box" technologies. In an "opaque box" paradigm, educators are passive consumers of outputs generated by opaque models where the provenance of data and the logic of assembly are hidden (Amiel, 2025). Conversely, a "white box" approach—rooted in the principles of Open Science—demands inspectability, replicability, and transparency. Authentic openness in the AI era requires that we can see "what really happened" inside the model, allowing educators to audit biases, verify sources, and understand the pedagogical logic that drove the output. Without this transparency, "open" content generated by "closed" tools remains a form of epistemic dependency.

Only with societal responsibility and innovative and critical pedagogical approaches will we be able to achieve quality education for all, as urgently needed and demanded by SDG4, for our whole society (Mills et al., 2023). It is, therefore, crucial to remain critical about the GenAI tools to be adopted in education. We must rigorously question how such tools can promote pedagogical equity and inclusivity, rather than facilitating extraction and profit-seeking behaviors that reduce educational users to mere numbers for commercial gain. The goal of OER in the age of AI should not merely be the proliferation of free resources in the public domain, but the cultivation of a digital public infrastructure that protects the sovereignty of the knowledge creation ecosystem.

In all, this speculative inquiry suggests that the definition of "Open Educational Resources" must be expanded. It is no longer enough to ask if the content is free and openly licensed; we should also reflect on whether the technical systems used to create OER should also be open as well, or at least a critical understanding of the interplay between content, tools, and practices that emerge in GenAI and OER. We leave the field with the following critical provocations to guide future research and policy:

- If the majority of future OER is synthesized by machines from the existing commons, does the concept of "human authorship" become a relic of the past, or does it transform into a role of ethical curation and stewardship?

- Can we claim to be decolonizing knowledge through AI translation tools if the underlying "truth" of the models is overwhelmingly trained on data from the Global North?

- If "openness" is decoupled from "transparency"—allowing proprietary opaque boxes to generate open content—do we risk building a future where the products of education are free, but the means of production are entirely enclosed?

- Does our conception of OER need to evolve? Are openly licensed prompts, openly licensed model weights, openly licensed inference software, and the interactive learning experiences they facilitate an important part of our future conceptions of OER?

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