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ARTICLE

DEVELOPING AN OPEN EDUCATIONAL RESOURCE (OER) FOR GENERATIVE AI IN HIGHER EDUCATION[1]

DESENVOLVENDO UM RECURSO EDUCACIONAL ABERTO (REA) PARA IA GENERATIVA NO ENSINO SUPERIOR

DESARROLLANDO UN RECURSO EDUCATIVO ABIERTO (REA) PARA IA GENERATIVA EN LA EDUCACIÓN SUPERIOR

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ABSTRACT:
The launch of generative AI marked a significant technological disruption, compelling industries, including higher education, to rapidly adapt. This study explores the University of the Free State's (UFS) interdisciplinary project initiated in 2023 to develop an open educational resource (OER) focused on generative AI. The OER aims to provide a comprehensive guide for educators and institutions to responsibly and effectively implement AI-driven educational tools. The OER consolidated content around generative AI in a South African higher education context, addressing real and potential use cases, challenges, and philosophical debates. Included in the content are highlights illustrating the rise of generative AI as a disruptive force, challenging traditional educational practices and raising concerns about academic integrity, over-reliance on technology, and algorithmic bias. The development of the OER integrated conceptual and theoretical frameworks to contextualise and underpin the research, emphasising the importance of ethical considerations and the socio-historic context of generative AI use in academia and society. Key insights from panel discussions and sandbox sessions underscored the need for targeted and contextual educational resources and the exploration of diverse AI

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use cases across research, teaching, and administration. The study concludes justifying for a humanistic perspective, advocating for inclusive and equitable technological integration.
Keywords: generative AI, open educational resource; university; humanistic perspective
RESUMO:
O lançamento da inteligência artificial generativa marcou uma significativa disrupção tecnológica, obrigando indústrias, incluindo a educação superior, a se adaptarem rapidamente. Este estudo explora o projeto interdisciplinar da Universidade do Estado Livre (UFS) iniciado em 2023 para desenvolver um recurso educacional aberto (REA) focado em inteligência artificial generativa. O REA tem como objetivo fornecer um guia abrangente para educadores e instituições sobre como implementar de forma responsável e eficaz ferramentas educacionais impulsionadas por IA. O REA consolidou conteúdos sobre inteligência artificial generativa no contexto da educação superior na África do Sul, abordando casos de uso reais e potenciais, desafios e debates filosóficos. O conteúdo inclui destaques que ilustram o surgimento da inteligência artificial generativa como uma força disruptiva, desafiando práticas educacionais tradicionais e levantando preocupações sobre a integridade acadêmica, a dependência excessiva da tecnologia e o viés algorítmico. O desenvolvimento do REA integrou estruturas conceituais e teóricas para contextualizar e fundamentar a pesquisa, enfatizando a importância de considerações éticas e do contexto socio-histórico do uso da inteligência artificial generativa na academia e na sociedade. As principais percepções das discussões em painel e das sessões práticas destacaram a necessidade de recursos educacionais direcionados e contextualizados, além da exploração de diversos casos de uso de IA em pesquisa, ensino e administração. O estudo conclui justificando uma perspectiva humanística, defendendo a integração tecnológica inclusiva e equitativa.
Palavras-chave: inteligência artificial generativa; recurso educacional aberto; universidade; perspectiva humanística
RESUMEN:
El lanzamiento de la inteligencia artificial generativa marcó una disrupción tecnológica significativa, obligando a las industrias, incluida la educación superior, a adaptarse rápidamente. Este estudio explora el proyecto interdisciplinario de la Universidad del Estado Libre (UFS) iniciado en 2023 para desarrollar un recurso educativo abierto (REA) centrado en la inteligencia artificial generativa. El REA tiene como objetivo proporcionar una guía completa para educadores e instituciones sobre cómo implementar de manera responsable y efectiva herramientas educativas impulsadas por IA. El REA consolidó contenidos sobre inteligencia artificial generativa en el contexto de la educación superior en Sudáfrica, abordando casos de uso reales y potenciales, desafíos y debates filosóficos. El contenido incluye aspectos destacados que ilustran el surgimiento de la inteligencia artificial generativa como una fuerza disruptiva, desafiando prácticas educativas tradicionales y generando preocupaciones sobre la integridad académica, la dependencia excesiva de la tecnología y el sesgo algorítmico. El desarrollo del REA integró marcos conceptuales y teóricos para contextualizar y fundamentar la investigación, enfatizando la importancia de las consideraciones éticas y del contexto sociohistórico del uso de la inteligencia artificial generativa en la academia y en la sociedad. Las principales ideas de las discusiones en panel y las sesiones prácticas subrayaron la necesidad de recursos educativos específicos y contextualizados, así como la exploración de diversos casos de uso de IA en investigación, enseñanza y administración. El estudio concluye justificando una perspectiva humanística, abogando por una integración tecnológica inclusiva y equitativa.
Palabras clave: inteligencia artificial generativa; recurso educativo abierto; universidad; perspectiva humanística

Introduction

When OpenAI launched ChatGPT in September 2022, industries and institutions across the globe were caught off guard, compelled to grapple with its disruptive effects for good or ill. Institutions of higher learning were no exception, with many attempting to make rapid adjustments to their teaching, learning and assessment practices. Up to this point, universities had – at least to some extent – started to embrace traditional artificial intelligence (AI) as a collaborative learning tool, but generative AI abruptly took this accommodation to a new level, igniting heated debates around issues such as academic integrity, over-reliance on the technology and algorithmic bias (Firat, 2023). Against this background and in the absence of a generative AI 'playbook', as it were, this paper describes an interdisciplinary project that the University of the Free State (UFS) initiated in 2023 aimed at developing a context-specific open educational resource or OER around this technology. OERs are teaching, learning, and research materials that are either in the public domain or have been released under an open license (UNESCO, 2023).

This allows anyone to access, re-use, re-purpose, adapt, and redistribute these resources at no cost (Elder, 2019). They can include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge. The project was initiated by the Interdisciplinary Centre for Digital Futures (ICDF) at the UFS and supported by the Library and Information Services' Digital Scholarship Centre (DSC). The ICDF is an interdisciplinary centre residing within the Faculties of Humanities and Natural and Agricultural Sciences. The DSC was established in 2020 to provide UFS academics with accessible, consistent, and discoverable support in the digital environment. The goal of the DSC is to expand the capacity of the UFS community to create and share new kinds of scholarship, including using AI in teaching, learning and research.

The OER we developed is intended to serve as a comprehensive guide for educators and institutions, developed by those with in-depth knowledge and experience of our contextual realities, to enable an understanding and means of implementing AI-driven educational tools responsibly and effectively. The choice of this design allowed for the systematic exploration of how generative AI could be integrated into higher education in a South African context, providing a broad overview of potential use cases, challenges, and deeper philosophical debates around the use of generative AI.

The OER described here was developed with a particular technology organisation framework (TOF) in mind. Unlike technology frameworks such as the technology acceptance framework (TAM) or the theory of planned behaviour (TPB), for example, the TOF takes the organisation's rather than the individual's perspectives on the adoption of a given technology into account (Neumann, Guirguis and Steiner, 2024). This conceptual framework is considered below as is the theoretical framework that informed the study. It is uncommon for a paper to include both a conceptual and theoretical framework. However, the former was employed to contextualise what we aimed to explore, while the latter provided the project's epistemological underpinnings.

Conceptual and theoretical frameworks

The advent of generative AI-assisted tools based on large language models, with ChatGPT catapulting this technology into common parlance and extensive use, has led to references of technological disruption within educational contexts (Yu, 2023). Boucher *et al*. (2020) describe disruption as "a specific form of change which occurs relatively quickly or dramatically." This characteristic trait is assigned to this type of AI-assisted tool in education, given that its manifestation and generalised use challenge various common and entrenched epistemic practices. Of these fundamental concepts considered to be uniquely human traits, we refer explicitly to human agency, responsibility, intelligence, reasoning, creativity, autonomy, and personhood. This disjuncture between technological developments and our ability to aptly and wisely reflect on it philosophically leads to widespread uncertainty as to the way ahead. Moreover, while the advanced use of these technology supposedly enhances productivity and minimises workforce-related costs, the World Economic Forum warns that the adverse impacts by AI technology will be society's sixth most severe long-term risk during the next decade (WEF, 2024). In this context, and mindful of the disruption that associates with it, risk is categorised as intended or unintended negative consequences of advances in AI and related technological capabilities, inclusive of generative AI, on individuals, businesses, ecosystems and economies (WEF, 2024).

AI-infused tools potentially imply extensive ramifications, a force that Hopster (2021) calls "techno-social disruption" as it removes theoretical certainty and challenges normative and conceptual foundations. To denote the increased vigilance associated with a term such as "disruption", Hopster (2021) indicates that in the European Commission's legislative proposal for an Artificial Intelligence Act, it uses the notion "disruption" to "refer to societal risks that

warrant caution". It is important to note that the Artificial Intelligence Act aims to regulate AI used by organisations, inclusive of institutions of higher education, through a pyramid of criticality ranging from AI-tools with a "minimal risk" to "unacceptable risks." Hopster (2021) also emphasises the importance of techno-social disruption being a contextual notion as it is bound by socio-historic contexts, as these disruptions "may come along with an unequal distribution of costs, benefits, and risks, thereby raising issues of justice".

These unequal divisions typically befall specific groups, creating a schism, for instance, between generations, the abled and disabled, rich and poor, employed and unemployed, lowly and highly skilled, and current and future generations (Hopster, 2021). Considering this, the same use of AI-tools in an educational context could have different impacts on people from diverse backgrounds (Spinei, 2024). In other words, although the AI-tools use is similar, the access to the AI-tool and skills and knowledge to use it responsibly and effectively ultimately intensifies the digital divide between groups from diverse backgrounds (Spinei, 2024). This is even more relevant, given the education sector in South Africa, which is marred by comparatively poor learner outcomes at school level, as well as concerning trends related to academic success at institutions of higher learning. Acknowledgement of the dynamic and complex interactions between technology and society should therefore undergird discussions on this type of tool within the South African context. It bears mentioning again that if left unregulated in the educational sector, AI-tools will in all probability increase existing social and educational inequalities. This, in turn, calls for a human-centred AI approach that considers the ethical, social, and economic implications (DCDT, 2024).

Given generative AI-assisted writing technology's relative novelty, accompanied by its partial introduction, fluctuating use, arbitrary forms of sanction, but more importantly, the current lack of consensus within institutions of higher education, the notion of uncertainty is exacerbated. "Uncertainty" refers to "an epistemic state at the limits of knowledge" (Wakeham, 2015). An additional qualification of "uncertainty" pivots on the difference between this concept and "ignorance", where the latter, according to Andreoletti, Chiffi and Taebi (2022) denotes a complete lack of knowledge. However, Smithson (1989) created a taxonomy of ignorance, which largely explains varying approaches and behaviours commonly encountered in relation to an emerging and far-reaching technological development. His first level of distinction identifies the difference between "irrelevance" and "error". Phenomena that are deemed unworthy of engagement are "irrelevant", whereas "error" implies inaccuracies, incompleteness, confusion and distortions of information. Smithson (1989) further categorises

"incompleteness" to capture two nuanced differences, the first relating to "absence" or missing pieces of information, whereas the second classification is developed as "uncertainty". Uncertainty, in Smithson's explanation, should be understood as vagueness, ambiguity, and probability.

This heuristic categorisation provides a continuum of explanations to understand the emergence of technology, together with its advantages and shortcomings, as well as the adoption/ lack of adoption thereof (behavioural factors). This categorisation provides a fruitful opportunity to consider this emerging technology *sui generis*, but also in conjunction with agents opting (or not) to experiment with it. Such an enquiry also distinguishes between "epistemic uncertainty", which could be addressed by heightened forms of enquiry and study, and "ontological uncertainty", characterised by an inability to ever surmount (Wakeham, 2015). This emerging technology falls under the category of "epistemic uncertainty", as it is couched in incomplete forms of knowledge or information, as well as uneven uptake, which aptly summarises our current predicament in relation to AI-assisted writing tools in institutions of higher education.

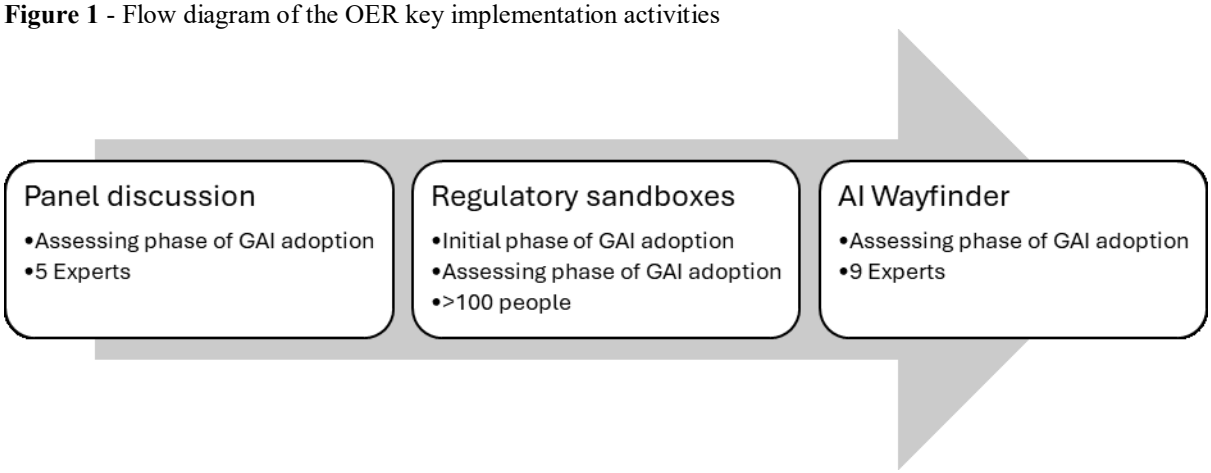
Partial and unevaluated – or rather "under-evaluated" deployments of technology are shown to be common in today's science and society setting (Andreoletti, Chiffi and Taebi, 2022), which inevitably leads to simply ignoring potential disadvantageous outcomes. Such attitudes are captured by conceptualisations of the notion of the "risk society" that characterises contemporary living (Beck, 1992). One well-known method to deal with technology and its accompanying uncertainty is to embrace what Andreoletti, Chiffi and Taebi (2022) refer to as "the precautionary principle.". Unsurprisingly, uncertainty around an emerging technology means that users tend to follow specific phases of adoption that Alsheiabni, Cheung and Messom (2019) have identified in their 'AI maturity model' as initial, assessing, determined, managed, and optimise levels. With respect to generative AI, the initial phase would reflect an absence of knowledge as well as any plan as far as using this technology is concerned, while the assessing phase would entail experimenting with the technology to explore its potential affordances and risks in higher education. The determined phase, which is regarded as an intermediate stage in the maturity model, would involve implementing AI projects, while simultaneously determining the infrastructure that would be required to run them successfully. Next, and during a managed phase, large-scale implementation would take place, ultimately leading to optimisation, which is when the institution has the necessary architecture in place to fully adopt and standardise AI tools (*cf.* Neumann, Guirguis and Steiner, 2024).

In terms of the definitions of these five phases, the project outlined in this paper may be described as one that straddles the first two: we have moved beyond the initial phase during which no institutional awareness of generative AI existed to the discovery phase, with a view to evaluating ChatGPT and other (generative) AI tools. Being able to identify the various phases of AI adoption and to conceive of this adoption in terms of an ongoing process and not in terms of one event (Neumann, Guirguis and Steiner, 2024) is, in our view, important for two reasons: First, it is useful to consider where a given institution and its AI stakeholders-in-the loop are positioned in terms of their knowledge of and experience in utilising AI tools, since this positioning may have bearing on their willingness or resistance to adopting these tools. Second, as Neumann, Guirguis and Steiner (2024) point out, tracking AI adoption in terms of what they refer to as "a time dimension" enables the construction of specific theoretical "propositions" that they propose are reflected in the various phases. For our purposes, Neumann, Guirguis and Steiner (2024) first proposition is relevant and posits that "Organisations that are relatively inexperienced in AI technologies depend on motivated staff and external partners to implement the AI project" (Neumann, Guirguis and Steiner, 2024). Therefore, our objective with the creation of the OER at our university is to address and potentially reduce uncertainty as well as to enable responsible and adoption of these emerging tools. We want to achieve this through processes of education and reflection to establish a critical and AI-literate cohort of potential implementers, who could in turn, accord this important skillset to students.

Methods

The OER we developed is the culmination of an interdisciplinary project that followed a multi-faceted approach to facilitate the critical adoption of generative AI technologies in a higher education institution in South Africa, incorporating a combination of research methodologies. The development of the OER revolved around three key implementation activities: regulatory sandbox experiments, an AI Wayfinders webinar series, and panel discussions with key institutional stakeholders. The panel discussion corresponds with the initial and assessing phases of AI adoption, while the regulatory sandbox experiments and Wayfinder series align with the assessing phase (Figure 1).

Figure 1 - Flow diagram of the OER key implementation activities



Source: Authors' original diagram

Given the widespread level of uncertainty, the panel discussion facilitated the initial engagement in the dialogue related to the use, misuse, and potential use cases that may exist for academics to consider. This led to the establishment of content that facilitated the foundation of the regulatory sandbox experiments. Bases on these sandbox engagements, different ways of using generative AI were illustrated, which enabled the creation of the AI Wayfinder series. In the next section, each of these focused activities is discussed in more detail.

Panel discussions

Panel discussions informed the OER content and the development of ethical guides for AI use in the UFS context. Participants were selected based on their AI expertise, higher education experience (particularly within the South African context), and familiarity with UNESCO guidelines for generative AI, regulatory sandboxes, OER creation, as well as domain specific expertise. The panel was comprised of a statistician and expert user of GenAI in the classroom, a seasoned facilitator of regulatory AI sandboxes, an expert on AI in Africa, and a data scientist with experience in the use and teaching of advanced GAI competencies. This diverse group ensured a diversity of opinions and comprehensive understanding of AI and education, focusing on adapting these technologies for South African higher education institutions. During the panel discussion, demonstrations and use cases of generative AI from the experts were shared, as well as their domain specific reflections on their specific use and context of these tools. The four primary topics of concern that were outlined included AI ethics

in higher education, AI adoption, the strength and concerns of generative AI, and generative AI use cases (*Link: https://ufs.libguides.com/c.php?g=1321859&p=9725503*).

Regulatory sandbox experiments

A regulatory sandbox represents a controlled environment in which innovative products, technologies, or business models in the live marketplace can be tested on a time- and scope-limited basis, (Jenik; Duff, 2020), the main aim being to gather evidence on how, and how well, a new product, technology, or business strategy works. At the UFS, regulatory sandboxes were implemented due to unclear regulatory requirements concerning generative AI technologies like ChatGPT at the institution and served as an innovative way to implement generative AI sensitisation and adoption. The UFS implemented a regulatory sandbox design aligned with the framework proposed by the Consultative Group to Assist the Poor (CGAP) that includes five essential components: Eligibility, Governance, Timing, Test Restrictions, and Exit Options (Bresnyan, 2004). Eligibility defines who should participate in a sandbox. Governance refers to the operating structure and processes of the sandboxes. Timing and test restrictions demarcate the timeframe, scope, and scale of the sandbox, while exit options define the termination of participation and key performance indicators determining the experiment's end (Jenik; Duff, 2020). The sandbox design for our OER followed the CGAP guidelines and adapted them to fit our higher education context and were conducted under the auspices of the Interdisciplinary Centre for Digital Futures (ICDF)[2] and the library's Digital Scholarship Centre (DSC).

Table 1 - Sandbox Design

Design Element	Description	Design Choices
Eligibility	UFS staff members	● Introductory sessions for those who have not used GAI tools before/ limited knowledge. ● Advanced sessions for those with advanced knowledge of GAI tools.
Governance	Managed by ICDF and DSC	● University library (DSC) as venue ● Coordination by a facilitation team comprised of a lead facilitator/ presenter, and session facilitators (post graduate students). ● Decision-making informed by written reporting, documented feedback from

[2] The Interdisciplinary Centre for Digital Futures (ICDF) was officially created at the University of the Free State in 2021, to embark on inter- and transdisciplinary research endeavours related to the ubiquitous realm of the digital and its manifold consequences.

		participants and post-session debriefing meetings. ● Institutional ethical clearance obtained; consent forms signed by participants
Timing	2 hours per session Sessions run twice weekly over 3 months	● Aligns with the university semester system. ● 2 hours for introductory sessions. ● 2 hours for advanced sessions.
Test Restrictions	8 to 10 participants per session	● Limited participants. ● Only free GAI tools explored. ● Participation limited to staff members.
Exit	Participant feedback and DELPHI study report	● Surveys or interviews for feedback. ● Planning the way forward.

Source: University of the Free State. (n.d.). AI-assisted technology in education. LibGuides. Retrieved June 9, 2025, from https://ufs.libguides.com/c.php?g=1321859&p=10179948

AI Wayfinder series

The project initiated a series of webinars termed AI WayFinders that featured discussions on AI applications by various university experts. The content (videos) from these webinars were made available on the UFS Library Lib Guide, serving as OER (Table 2).

Table 2 - AI-assisted Technology in Education Wayfinder Series

Topic	Presenter
Ethics and Policies with AI	Prof. Susan Brokensha (Digital Humanities)
AI in Writing: Implications of Overreliance	Ms. Zonnike Coetzer & Dr Peet Van Aardt (Academic writing)
Assessment Design and Teaching with AI	Dr Grey Stopforth & Dr Ina Gouws (Law and Governance)
AI in the Library	Mrs. Cornelle Scheltema-Van Wyk (Librarian)
AI as a Support Tool for Clinical Simulation-Based Teaching and Learning	Dr Riaan Van Wyk (Medical Sciences)
Challenges and Shortcomings Using Google Gemini for Programming	Dr Adewuyi Adegbite (Computer Sciences)
Unpacking Blackboard & AI	Ms. Jani van der Merwe (Learning design)
AI in Business: The Invisible Game Changer	Dr Emile Nkwei (Business Management)
Generative AI as Dialectic Agents in Education	Dr Angela Stott & Mr. Stefanus Scheepers (Education)

Source: University of the Free State. (n.d.). AI-assisted technology in education. LibGuides. Retrieved June 9, 2025, from https://ufs.libguides.com/AI

Data collection

Data collection for this study was conducted through a combination of a pre-sandbox survey administered to participants who attended the sandbox sessions, as well as measuring engagement metrics from the content created. The pre-sandbox surveys gathered detailed

information on the participants' current use of AI tools, including the specific technologies they used, the frequency of use, and their comfort levels with these tools. Ethical approval to conduct the sandbox experiments and administer the survey was received under the protocol UFS-HSD2023/0744. This data provided a baseline understanding of the participants' familiarity with AI, which informed the tailoring of the OER content to better meet their needs. To collect the number of content views as well as information related to the AI Wayfinder series and the panel discussion, metrics such as the number of online engagements, including likes, as well as unique site visits to the OER, were tracked.

Results and discussion

The panel discussion (see par 3.1) was attended by 60 virtual participants from the UFS staff, followed by more than 200 views online. The questions posed to the panel from participants ranged from where the data for a large language model comes from, to how relevant the information is to the future of work in terms of "thinking about thinking" and "planning for the future of higher education". Other issues arose concerning the ethical use of GAI, with specific emphasis on plagiarism, and the use of GAI for academic writing, and general administrative processes. Following the panel discussion and sandbox sessions, several key insights emerged that have significant implications for the integration of generative AI in higher education. The first was the emphasis on the ethical use of generative AI, specifically around the early adoption of generative AI without the proper academic peer review.

This point illustrated the disruptive nature of generative AI and that its implementation still needed extensive refinement for the implementation to be successful. The second salient theme outlines the diverse usage patterns of AI tools across different domains—research, teaching within different disciplines, and administration—highlighting the need for more targeted educational resources. Unfortunately, owing to the disruptive nature of generative AI, the unintended consequences, wide adoption and best use cases for generative AI across all disciplines have not been explored. This justified the need to explore and illustrate these use cases so that a greater pool of knowledge around potential use may emerge for critique as a means to materialise the greater potential impact of this technology. From this, the regulatory sandbox experiments could be refined.

In total, approximately 120 participants engaged in the regulatory sandboxes and 46 (38.34%) completed the pre-sandbox survey. The survey results highlighted variation in the

use of different AI tools, with 56.52% of participants indicating that they use ChatGPT either frequently or very frequently, as opposed to the 65.22% of participants that indicated the same frequency for text editing software like Grammarly. Conversely, only 8.70% - 13.04% of respondents reported a frequent use of generative AI tools like BingAI, and Google Bard (the legacy name of Gemini). The higher frequency of the use of tools like ChatGPT and Grammarly by university staff suggests a growing reliance on well-known tools for academic writing and research. The survey revealed that 73.91% of participants used AI tools for research purposes, while only 45.65% employed these technologies in teaching. Some respondents (43.47%) indicated that they use AI for administrative purposes.

The relatively lower adoption rates of other generative AI tools like BingAI and Google Bard indicate that there may be barriers to broader usage, such as awareness, accessibility, or perceived utility. This variation underscored the necessity of the OER content to cater to different levels of AI adoption and use within the institution. This wide use case disparity and gap in understanding of the various tools for higher education led to the creation of different content pages that explored potential use (*Link: https://ufs.libguides.com/AI/recommendations*). The web scraping of engagement metrics provided quantifiable evidence of the OER content's impact. The content generated 3,791 unique site visits between 1 January 2024 – 28 August 2024. This included access to all content sites on the OER. Some OER content received more traction than others. The ethical policies in AI and AI writing implications, for example, received 460 views in contrast with AI in assessment and AI as a support tool with only 80 views collectively. The "Stepping up with ChatGPT" guide had 536 views with 226 downloads (*Link: https://ufs.libguides.com/AI/SteppingupwithChatGPT*) . The video content with the highest number of participants was the ChatGPT in higher education presentation which had more than 125 participants, and 367 views. The number of views given the different content, underscores the varying levels of interest in different aspects of AI in education. The high number of views and downloads for resources like the "Stepping up with ChatGPT" guide and the "ChatGPT in Higher Education" presentation is likely influenced by the uncertainty that staff experienced around what this novel, but widely popular, AI tool would mean for higher education, and demonstrate their efforts to search for practical, application-oriented content on this topic. In contrast, the lower engagement with topics such as AI in assessment and AI as a support tool may indicate a need for more emphasis on these areas in future OER content as well as highlight that the adoption of these tools requires sensitisation and training for users to explore the tools.

This feedback points to a need for further exploration into the integration of generative AI in higher education institutions as all levels of the academic compliment, including the operational and administrative staff, are impacted by the disruption and uncertainties caused by the introduction of these technologies into higher education spaces.

The advantages of utilising a framework such as the one described here are myriad. As alluded to earlier, technological uncertainty abounds, and several dilemmas inherent in this phenomenon that relate to human-AI interaction are what Magni, Yang and Gong (2022) usefully refer to as those around AI usage, AI processes, and AI outcomes. Extending this framework to education, we could conceive of stakeholders in the higher education space as being uncertain with respect to what tasks generative AI is able to perform (i.e., uncertainty with respect to usage), how it works (i.e., uncertainty around process), and what its consequences will be (i.e., uncertainty around outcomes). The latter type of uncertainty may be defined as "possibilistic uncertainty" (Nordström, 2022), which is epistemic in nature and reflects difficulties in attempting to predict what the effects of a novel technology will be. We argue that our multi-dimensional framework may function as a scoping instrument to address the three uncertainties, albeit that it is not possible to entirely eliminate possibilistic uncertainty as this relates to nascent technologies (*cf*. Nordström, 2022). Navigating and attempting to resolve some of the uncertainties through the proposed framework is critical, since research that focuses on how AI is evolving in higher education spaces in South Africa is in its infancy (Patel; Ragolane, 2024). The findings that are generated may also be leveraged by higher education stakeholders who are responsible for drafting guidelines and policies around the responsible use of generative AI. We further argue that the framework aligns with a dialectical process that constitutes what Chiffi, Moroni and Zanetti (2022) refer to as "a perspective on change and innovation that assumes the existence of a plurality of different and even contradictory values and opinions of multiple actors". Allowing for a plurality of voices in co-producing an OER under conditions of uncertainty is, in our view, an important foundation for responsible and prudent future decision-making around the regulation of responsible generative AI in higher education spaces.

The multi-faceted approach is not without its flaws, and one of these is that in light of the techno-social disruption instigated by AI-infused tools, the socio-historic contexts within which these tools are deployed may be ignored (Hopster, 2021). The unequal distribution of costs, benefits, and risks associated with these technologies raises issues of justice, particularly in the South African education sector, which faces challenges related to students' academic

performance and ultimate career success. The digital divide in South Africa is a significant barrier to growth in these two areas. This divide encompasses, among others, lack of sufficient technological infrastructure, unreliable internet access and digital skills deficits, to name a few (Patel; Ragolane, 2024). The complex interplay between technology and social context is therefore paramount to consider with the integration of generative AI tools in higher education as such endeavours will outline whether the benefits are equitably distributed and that potential disadvantages are addressed through informed and cautious approaches. In creating the OER content, uncertainty and its symbiosis with early implementation risk the early adoption of potentially harmful generative AI tools and usages that in practice might significantly impact the academic compliment. On the other hand, failing to engage in the development of innovative resources for the broader education community in the advent of the types of disruptions posed by generative AI coud be just as detrimental.

OERs themselves exhibit limitations. A significant critique is that they may not necessarily foster democratic education as they claim to do (Prinsloo and Conrad, 2020), the reason being that "the OER movement tends to naturalise an archetypal human condition; a set of idealised qualities to which learners are expected to adhere" (Knox, 2013). Another criticism that should not be discounted relates to the extent to which a technological perspective is built into the OER movement in the sense that technology is perceived as *the* solution to a society's problems: "This fetishization of technology, excluding the political acumen of humans and their ability to create the world around them, is condemned to fail" (Lutris and Simon, 2021).

Conclusions and recommendations

We have described how implementing activities that interrogated generative AI from multiple perspectives enabled the development of a systematic and structured framework that not only culminated in an OER, but also facilitated shifting to some degree away from uncertainty as conceptualised earlier. The integration of generative AI in higher education, as evidenced by the panel discussion and sandbox sessions reveals a complex landscape of adoption, application, exploration, and potential exploitation. We therefore assert that, in navigating the uncertainties of early adoption, the development of OER content reflects a critical step – as well as a work in progress and iterative processes – towards responsible and ethical use of generative AI in higher education.

We have also conceded that OERs do not necessarily result in a democratised educational landscape. In our future research endeavours, this limitation will be addressed

through regulatory sandboxes that specifically include a focus on students so that their voices become part of a creative synthesis of ideas that feed into ever-developing OERs. Our future endeavours would also emphasise disciplinary differences related to uses, abuses, and expectations related to generative AI. Indeed, the voices of both students and a wide range of academic staff will need to be taken into consideration on an ongoing basis, given that generative AI is constantly evolving and therefore a perpetual moving target.

With respect to the legitimate critique that technological determinism may be over-emphasised in the OER movement, we argue that our approach abjures this perspective in favour of a humanistic approach, given its emphasis on a dialectical process that embraces voices that may or may not converge.

Finally, our approach to developing an OER for generative AI in higher education is not intended to be prescriptive in the sense that we are proposing a case for relevant stakeholders to follow set rules or what Chiffi, Moroni and Zanetti (2022: 3) describe as "specific phases or sequences to be accomplished in order to provide change and innovation". Indeed, in embedding our innovation process in conceptualisations of uncertainty as well as recognising different perceptions of generative AI's nature and uses, we acknowledge that humans-in-the-loop will need to shape the type of engagement approach adopted to develop an OER for this disruptive technology.

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