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**QLANTIC**
JOURNAL OF
SOCIAL SCIENCES

AI in Education: Balancing Benefits and Challenges Through Professional Development of Teachers

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Abstract: *Since generative artificial intelligence (GenAI) has become accessible to the general public, it has established revolutionary benefits for the education industry workforce. Both teachers and students can benefit from GenAI in a myriad of ways. This research paper delves deeply into the multifaceted positive and negative educational affordances of the use of GenAI while also exploring future possibilities for institutions, teachers, and students and the long-term implications of this new, rapidly evolving technology. This paper explores the five domains proposed by UNESCO in the competency framework for teachers that sets a global trajectory for policy planners, educational leaders, and administrators to consider while developing faculty development programs within their own contexts. The conclusions drawn from this research describe the possible future direction for the professional development of teachers to thrive in the GenAI era.*

Key Words: GenAI, UNESCO AI Framework, Professional Development, Competencies

Introduction

Generative Artificial Intelligence (GenAI) is a collection of smart digital tools that have the ability to reproduce information in the form of new text, audio, video, and codes by using the content available to the GenAI algorithm. GenAI is a notch above traditional AI, with minimal human input. GenAI tools and systems are able to create new outputs (Adnan et al., [2024](#)).

The dawn of Generative Artificial Intelligence (GenAI) has brought revolutionary possibilities in all fields of life, education being the most important of all. From the theoretical realm, GenAI has made its way to grassroots operations through efficient tools that can be used by both teachers and students in a myriad of operations ranging from envisioning the Program Learning Outcomes (PLOs), reflecting these in Students' Learning Outcomes (SLOs), lesson planning, resource development, assessment strategies, and feedback mechanisms (Al-Tkhayneh et al., [2023](#); Raza, [2023](#)). As GenAI continues to be integrated into educational settings, it is crucial to understand the far-reaching implications of this technology, both in terms of its benefits and potential challenges (Bobro, [2024](#)).

This paper unfolds the educational advantages and challenges for the readers to decide the future direction for mitigating the challenges through rethinking the professional development of teachers within their own contexts.

Methodology

This research paper utilizes a qualitative methodology, drawing upon a review of relevant academic literature and scholarly sources to explore the positive and negative implications of AI integration in education, as well as its prospective future incorporation. The literature review was carried out employing a systematic approach, searching for relevant articles in academic databases such as Scopus and Google Scholar. The search terms included "artificial intelligence in education, AI in education", "opportunities and challenges of AI in education", and "ethical implications of AI in education." The sources were carefully selected based on their relevance to the research topic, methodological rigour, and the credibility of the authors and publishing outlets. The analysis of the sources involved synthesizing the key themes, findings, and conclusions to provide a comprehensive understanding of the topic.

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Educational Advantages of GenAI

GenAI has significantly uplifted possibilities for both teachers and students with the advent of personalized learning content to cater to individual needs, an interactive learning environment, provision of real-time feedback, optimized resources, and overall inclusive learning experiences (Raza, 2023).

Incorporating AI in education yields numerous advantages, promising more effective and impactful learning experiences for students at all levels of education, ranging from K-12 to Higher Education (HE) (Bobro, 2024). GenAI tools facilitate personalized learning resources for the diverse needs and learning styles of students from different cultures and contexts. These adaptive technologies empower students to excel within their educational contexts at their individual pace, making their educational journeys more impactful. GenAI facilitates the use of data reporting on students' learning needs and adjusts educational content, resources, and delivery methods (Luckin, 2024). GenAI also enables teachers to increase interaction for students and to collaborate with distant peers in other countries through virtual learning assistants and tutoring systems that facilitate group collaboration in remote settings. GenAI also enables teachers to develop contextualized simulations and create innovative case studies mimicking real-life situations. These opportunities foster a sense of teamwork and, on an individual level, promote problem-solving, innovative thinking, critical reflection and reasoning (Pedro et al., 2019).

Moreover, the real-time feedback and personalized recommendations provided by these adaptive learning systems motivate students to take ownership of their learning process, ultimately enhancing their academic achievements and fostering a stronger sense of self-directed learning (Annapureddy et al., 2024). Additionally, AI-driven assessment techniques can offer more precise and objective evaluations, providing valuable insights for both students and educators (Luckin, 2024). Researchers have highlighted the confluence of curricular and community needs in the instruction of AI, emphasizing the importance of a transdisciplinary approach that goes beyond siloed computer science concepts (Al-Tkhayneh et al., 2023).

Personalization of educational content is the most impactful advantage offered by AI to the modern pedagogical landscape (Adnan et al., 2024). The tutoring systems that incorporate features of AI have the tendency to analyze students' performance and offer automatically modified content as per learners' aptitudes and needs, enabling all students to accomplish the learning outcomes (Raza, 2023). Moreover, AI-enabled adaptive learning platforms offer immediate feedback and tailored remedial plans for learners that target their weak areas and provide them with opportunities to develop the skillset necessary for their age. Beyond personalized learning, AI has also revolutionized the assessment process. Through AI-powered grading and feedback systems, educators can streamline the evaluation of student work, freeing up time for more meaningful interactions and targeted interventions (Pedro et al., 2019).

Challenges of Educational Use of GenAI

While GenAI promises revolutionary advantages to teachers and students, it is not free of challenges. The challenges mandate users to make responsible choices and to consider the use of GenAI thoroughly. Educational use of GenAI projects significant ethical concerns regarding the extent to which students use this technology in their learning experiences. Overstepping may be considered an unethical use of GenAI, thus falling into the sphere of academic cheating. There is a specific need for transparency and accountability in the use of GenAI at different educational levels. The ethical academic use of GenAI complies with the attributes of the institutional academic integrity statement. There are numerous advantages of AI, but this new technology offers many challenges that require thoughtful consideration before institutions and instructors embrace using GenAI for teaching and learning (Webb et al., 2024).

GenAI systems collect data and draw analysis on a vast collection of commands, preferred output, and regional trends in order to customize the output. The customization mechanisms used for reproducing new information using existing data are not openly disclosed to the users, and prior consent for reusing their information is not taken. Research indicates that the GenAI algorithm collects all input data globally and utilize it in different ways without the prior consent of the users, thus posing significant concerns to data confidentiality, access, and data security (Gupta et al., 2023). Lack of openness and accountability of GenAI systems is a potential challenge that the education industry continues to face; regardless of all the benefits, GenAI poses a threat to homogenizing knowledge and students' responses (Al-Tkhayneh et al., 2023).



Another challenge posed by GenAI is the biased content. The algorithms used by GenAI are trained in an unexplained manner and utilize data from all over the world, which unintentionally limits or extends historical, cultural, or regional prejudices, which often results in under-representation of certain geographic contexts, ethnic groups, and regional languages from the GenAI output. Educational promises of equity, accessibility, fairness and social justice are often challenged by the delusional, unrealistic and exaggerated information produced by GenAI, and it results in a tinted perception of reality (Yang & Zhang, [2024](#)).

Over-reliance on GenAI tools to accomplish different tasks is another challenge that poses significant threats to students' critical thinking, logical reasoning, reflection, and uniqueness of ideas (Adnan et al., [2024](#)). Globally, educators have reacted differently to the adoption of GenAI because of these concerns and the long-term impact on human intelligence for problem-solving and innovation (Annapureddy et al., [2024](#)). Alongside, the continuous evolution in GenAI requires both teachers and students to continuously upskill to be able to effectively use GenAI tools. This is only possible if the human agency keeps developing alongside the GenAI competencies. Overreliance on GenAI may hamper the development of human skills, thus posing barriers to the continuous development of digital competencies as well (Webb et al., [2024](#)).

Future Direction

Integrating GenAI into the educational landscape is a multifaceted approach which requires coordination and collaboration among diverse stakeholders, including teachers, educational administrators, and policymakers. The successful adoption of GenAI in any stage of education necessitates the development of a mutually agreed framework that clearly delineates the ethical and responsible use of this technology. Given its rapidly evolving nature and increasing affordances, policy planners must thoughtfully address the challenges posed by GenAI and devise practical solutions that enable its use without imposing undue restrictions on students (Annapureddy et al., [2024](#)).

To ensure a responsible integration, it is crucial to establish contextualized guidelines, policy scopes, and frameworks that address both ethical and practical considerations. These policies should promote a shared understanding of the ethical use of GenAI while addressing key issues such as equity, transparency, and the potential for widening educational disparities (UNESCO, [2024](#)). Addressing these concerns is vital to prevent the marginalization of underserved communities with limited digital literacy or restricted access to technology. Policy planners should develop frameworks that address critical concerns, including data privacy, algorithmic bias, and unequal access to GenAI technologies. These frameworks should be rooted in principles of equity and social justice, ensuring that the benefits of GenAI are accessible to all students and teachers regardless of their socioeconomic status. By doing so, policymakers can safeguard the interests of the broader educational community while fostering a fair and inclusive approach to integrating GenAI. Such comprehensive and equitable policy frameworks can mitigate the risks associated with GenAI and harness its potential to transform education positively. These efforts will help bridge existing inequalities and enable GenAI to enhance learning outcomes for all stakeholders within the educational ecosystem (Lee & Low, [2024](#)).

At the forefront of the collaborative effort to integrate GenAI effectively into the educational landscape are the teachers who directly interact with these innovative tools and systems in the classrooms. They play a pivotal role in the responsible implementation of GenAI. Teachers who understand the long-term implications of GenAI, such as associated ethical considerations, challenges of equity, accessibility, data privacy, and bias, can advocate for transparent and accountable use of GenAI by collaborating with policymakers during the process of policy development. Insights into practices at the grassroots level can mitigate the practical challenges faced by teachers and students while working with GenAI (Luckin, [2024](#)).

Teachers' professional learning and development are crucial for institutions' success in embracing and regulating GenAI in an educational context. Teachers' professional development is mandatory to prepare them with enough knowledge and skills to use GenAI as a teaching tool while preparing students to benefit from the potential advantages of GenAI and leveraging this technology to accomplish tasks in a more efficient manner. Teachers' profiling in the era of GenAI is of immense significance (Adnan et al., [2024](#)). A seamless adoption of GenAI across the landscape of education necessitates teachers' professional development, specifically their digital literacy and other relevant competencies, to be able to make

informed choices (Pedro et al., 2019). In addition to individual digital competencies, teachers' didactic competencies are also significant in terms of embracing GenAI. They should be able to review the curriculum, including the Program Learning Outcomes (PLOs) and the Students' Learning Outcomes (SLOs), to determine areas for meaningfully integrating GenAI across the curriculum. Teachers' clear understanding of students' competencies is essential for them to align SLOs and activities in order to enhance students' individual skills and competencies. The GenAI tools should be utilized as a resource to optimize human potential in their respective fields.

Teachers' professional development should also encompass their ability to choose from a range of resources to best align with their intended learning outcomes. They should be able to assess the impact of using GenAI on human abilities and the overall aim of education. Teachers should be able to make mindful choices about the selection of tools, activities, and output expected by the students to navigate students through the process of learning and development. This mandates professional development programs for teachers within their educational landscape to develop a deeper understanding of principles of technology integration, its advantages and limitations, and the risk that GenAI poses to academic integrity. This knowledge will enable them to navigate the complexities of GenAI-powered tools and systems, allowing them to leverage these technologies in a way that aligns with their pedagogical approaches and the unique needs of their students.

In addition to mastering the technical and didactic aspects of GenAI, it is of significant value to develop teachers' critical thinking to navigate their selection of GenAI tools. Teachers should be mindful of the long-term implication of GenAI in homogenizing knowledge and minimizing essential human abilities of critically analyzing information, expressing human uniqueness through ideas, and self-reflection.

Teachers continue to play the roles of facilitators in students' learning journeys and help them develop skills that will be essential for students' success in future professions. Additionally, teachers can empower students to critically assess the role of GenAI in their academic accomplishments, enabling students to reflect on their human intelligence.

Teachers also play an instrumental role in bridging the gap between industrial needs and academia by envisioning future professional competence needs in the global context and reviewing their SLOs in light of those competencies. GenAI has evolved significantly over the past two years, and given the same trend, as GenAI continues its evolution journey, the educational landscape will be inevitably impacted by teachers, policies, curriculum, and the expectation for students' achievement. Through robust professional development opportunities, educators can be empowered to navigate these complexities infused within the educational landscape through GenAI, ensuring that their academic integration is carried out in a manner that supports and enhances students' learning, competence development, and overall educational outcomes. Teachers don't only require theoretical understanding or clarity in integrity-related issues; rather, a practice-based professional development approach is likely to strengthen their understanding of employing GenAI tools with increased ownership and meaning. GenAI should be integrated for reasons clearly articulated in teaching plans. Integration of any technology should only promise to add value to teaching and experiences. Research asserts that technology that is integrated only for fashion reaps a negative impact on students' learning outcomes, teachers' workload, perceived effectiveness, and overall competence development among students.

The professional development initiatives to prepare educators for effective use of GenAI should be underpinned by a strategic vision of profiling them to prepare students for future employment expectations. It involves a much deeper understanding of GenAI than just being able to select the tools, integrate them within the pedagogy, and consider ethical implications. It also involved strategically envisioning the required graduating competencies for the GenAI era and enabling students to accomplish those through meaningful educational experiences. It is imperative for educators to keep abreast with new knowledge, teaching practices, new technologies, changing trends in the labor market, and industrial evolution. By doing so, they are likely to advance their critical thinking abilities and contribute meaningfully to strengthening the educational landscape within their own disciplines.

A prominent gap in the extant literature on the effective use of GenAI indicates the scarcity of research to address globally acclaimed professional competencies for teachers at different levels of the educational



hierarchy. This resulted in confusion in professional development initiatives to prepare teachers for the responsible use of GenAI. UNESCO is the first to respond to this gap by publishing its first framework for teachers' competencies in the GenAI era. This publication reports the required knowledge, skills, and professional values that teachers must exhibit through their practices in the GenAI era. This framework also provides a direction to educational institutes, individual teachers, and policy planners to determine their trajectories for enhancing human agency among the workforce of teachers. This framework projects fifteen competencies distributed under five dimensions of operations: Human-centered mindset, Ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional learning. The performance indicators are listed in a progressive order that serves as a reference to assert teachers' professional capacities on three levels of expertise: Acquire, Deepen, and Create (UNESCO, 2024). A brief summary of UNESCO's AI competence framework for teachers and progression levels is listed in Table 1.

Table 1

The AI Competency Framework: Aspects and Progression Levels

Aspects	Progression Levels		
	Acquire	Deepen	Create
Human-Centered Mindset	Make judgements to choose, integrate, and practice control over AI tools – Human agency.	Making informed choices based on anticipated consequences of using AI – Human Accountability	Informed actions based on an understanding of the wider impact of the use of AI on students, community, and educational landscape – Social Responsibility
Ethics of AI	Understanding ethical implications of AI – Ethical Principles	Understanding safety and data security threats posed by AI – Safe and responsible use	Reflecting on possible limitations, defining one's own context, and establishing clear guidelines for using AI – Co-creating ethical rules
AI Foundations & Applications	Some understanding of handling AI – Basic AI techniques applications	Ability to demonstrate the use of AI – Application skills	Develop contextualized educational content using appropriate AI – Creating with AI
AI Pedagogy	Use AI for teaching operations – AI-assisted teaching	Infuse relevant AI to strengthen SLOs – AI-pedagogy integration	Rethink individual teaching philosophy to revise the preferred teaching style by integrating relevant AI – AI-enhanced pedagogical transformation
AI For Professional Development	Using AI for professional development – AI enabling lifelong professional learning.	Using AI for professional development to contribute to organizational development – AI to enhance organizational learning	Envisioning future professional roles and preparing for those by using AI – AI to support professional transformation

These five domains intertwine in practice to assert an impactful and meaningful integration of GenAI by teachers teaching at any level ranging from K-12 to HE. These attributes encourage teachers to develop their personal human agency by prioritizing and critically reflecting on their personal contexts and the societal impact of AI integration (Ng et al., 2023). These competencies build on understanding the implications of the use of AI in the view of ethical principles and regulations imposed by educational institutions, thus promoting a sense of responsibility and accountability for using AI for education at any level. It also places the conceptual and operational knowledge of AI at the centre of the competence framework, thus underscoring the significance of technical knowledge and digital literacies, which later

infiltrates teachers' own values and choices for teaching effectively. Teachers should be able to select, implement within their own contexts, and evaluate the impact of GenAI to reflect on their own pedagogical goals and the specific needs of their students. Their ability to make informed decisions about when and how to integrate AI in the classroom ensures that these technologies are used in a way that promotes active learning, critical thinking, and engaging educational experiences (AHMAD et al., [2022](#)).

A competent teacher using GenAI should be able to use these technologies to establish and enhance the process of teaching, assessments, and setting up learning environments while ensuring the ethical and responsible use of AI. The last competence focuses on being a lifelong learner in the AI era and leveraging AI to inform individual, organizational, and industrial skill revolution (Huang, [2021](#)).

Globally, this framework sets a new direction for educational leaders and policy planners who are involved in envisioning and planning teachers' professional development initiatives to provide collaborative learning opportunities to teachers to strategically enhance their competence level from the stage of acquiring to deepening knowledge and skills, to finally being able to create new resources using GenAI - creation being the highest level of accomplishment. This framework also emphasizes adopting a collaborative approach between educators, administrators, and policymakers. The element of personalization in the framework can be fully achieved if the professional development content and strategy are co-created in a cohesive manner while addressing authentic professional development needs (Sanusi et al., [2022](#)). Educational leaders and administrators must closely work with teachers to identify their specific professional development needs and to map the range of challenges of integrating GenAI within their own contexts. Based on this data, they should develop a plan and implement the use of GenAI systems that best suit their educational contexts. It also involves defining institutional policies, regulations, and consequences of non-adherence. In many cases, this process may also include securing funding for the necessary hardware, software, and professional development programs (Huang, [2021](#)).

UNESCO's AI competency framework for teachers ([2024](#)) has been supplemented by a dedicated competency framework for the students. These two frameworks reflect and complement each other while serving as a global reference to inform teacher development programs and revision of PLOs for students' digital empowerment. Together, these frameworks have the potential to revolutionize professional and academic expectations to achieve a more inclusive and equitable global digital future (Sanusi et al., [2022](#)).

Conclusion

The educational practices from K-12 to Higher Education have significantly evolved with the advent of GenAI, which has emerged as a revolutionary teaching and learning resource. This revolutionary resource doesn't come free of challenges, and in order to harness its advantages, it is essential to strategically embrace it by providing a robust structure of support to teachers as well as students. The aim should be to harness its potential to improve human abilities through critical thinking, innovation, and a clear understanding of the ethical and responsible use of GenAI.

The UNESCO AI Competence Framework for teachers provides a new direction to policy planners for strategically adopting GenAI at various levels of education. This framework keeps teachers at the heart of the impact of GenAI on the future of education. The framework clearly delineates professional competencies required by teachers at any level of education to be able to prepare students for the future. If teachers have the skills, knowledge, and aptitude to utilize GenAI to advance their human potential, they are more likely to prepare students for the complexities and opportunities of the future.

The framework aligns GenAI with human-centric values, thus serving as a foundation for fostering critical thinking, informed decision-making, and determining the long-term impact of GenAI on educational trends.

In conclusion, the responsible implementation of GenAI guided by frameworks like UNESCO offers immense potential to transform education in different regional contexts. Empowering educators' human capacities and aligning GenAI's use with core educational values ensures that technological innovation positively transforms the global educational landscape.



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