

A Descriptive Analysis of AI's Role in Enhancing the Quality of Teaching and Learning Outcomes

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Abstract

This study examines the role of artificial intelligence (AI), specifically generative AI, in higher education, mainly in the teaching-learning process, personalized learning, learning outcomes, and challenges. The researcher has employed a descriptive research method to collect the data by reviewing the research articles, books, and conducting a document analysis (policies of universities on using AI). The study's findings provide multifaceted insights into the use of AI in the teaching-learning process. It reveals that optimizing the use of GenAI can support students to become more independent learners, critical thinkers, and it can also provide plenty of Drill-Practice opportunities for them to master the content, particularly, for Afghan students who are believed to be more reliant on teachers and printed learning resources. On the other hand, the findings suggest that GenAI is an invaluable asset for teachers' professional development in terms of planning everyday pedagogical practices for their classrooms and generating materials and content. However, the usage of GenAI can also pose some significant challenges for teachers as well as institutions, particularly in the absence of an established code of conduct and implicit rules that should be abided by the students to avoid unauthorized activities. Additionally, the study also provides some useful suggestions predicated on the findings of the study.

Keywords: Artificial intelligence, Teaching-learning process, Personalised learning, Students' outcomes, GenAI Challenges

1. Introduction

Education in the 21st century is inevitably associated with technology. If we are inclined to explore the evolution of the educational process and to know how the landscape of education has exceedingly transformed over the past two decades since the beginning of the 21st century, technological advancements have to be the cornerstone for our exploration. Technology has modernized educational processes in multifaceted ways such as classroom instruction, curriculum development, and policy construction (Owoseje, 2023; Roberge & Gagnon, 2014; Scholl, 2001). The ability to utilize technology effectively is the key skill for the current (21st) century learners. In some cases, such as tutoring, generating materials, guidance, assessments, classroom management, data analysis, and administrative tasks technology can overtake human intellect and brainpower. In our world today, with the help of technology teachers and parents can track the level of their children's attention in the classroom (National Research Council, 2012; Craig, 2012).

Before the adoption of technology in education, even in most developed countries, including the United States, students were increasingly reliant on teachers and school textbooks as the fundamental learning sources. Learners used to absorb predetermined content and traditional chalk-and-talk pedagogy was the dominant instructional approach in American schools (Lane, 1989). The Internet is considered a forerunner for the Massive Open Online Courses (MOOCs), a new approach to learning that made education accessible for everyone without any restrictions (Wong, 2016).

In light of the above scenario, prior to AI, people of the world were already acquainted with the use of technology, particularly in education. AI has caused sweeping changes in education, including the teaching-learning process. It has pervasively affected educational policies and practices all around the globe. As highlighted by UNESCO (2023), AI has become more relevant now than ever before. But the statistics show that AI is still more relevant to most developed nations as the majority of the publications on AI come only from specific developed countries namely, the USA, China, and the UK (Vaintrob, 2023).

Generative Artificial Intelligence (GenAI)

Artificial intelligence, particularly Generative Artificial Intelligence (GenAI) is a synthetic software-based technology that can automatically generate new and unseen human-like content or materials such as text, images, videos, and audio clips. Generative Adversarial Networks (GAN), and Generative Pre-trained transformer (GPT) are two good examples of GenAI technologies (Rouse, 2024; Grassini, 2023).

AI Vs Human Intelligence

Artificial Intelligence has been developed based on the notion that it should mimic human actions and behave the same as human intelligence by using digital calculations and algorithms. AI-powered tools, for instance, chatbots programmed to interact with humans in a very natural and human-like manner. These types of AI tools are also called Large Language Models (LLM) which are designed to engage with people in dialogue in a very natural way (UNESCO, 2023). The fundamental distinction between Humans and AI stems from the fact that human intelligence is a fully natural and innate cognitive capacity and the mental process taking place in a “human brain”. In contrast, AI is a formulated and human-engineered phenomenon working based on digital programming and algorithms. It is how human intelligence is original and innate while AI is synthetic and inevitably artificial. According to Bennett (2024), terms such as Smartness, Understanding, Brainpower, Reasoning, Sharpness, and Wisdom are closely associated with human intelligence. Bennett has highlighted three specific qualities that are confined to human intelligence only:

One shot Vs multishots learning: Humans can learn from a small group of people or maybe from an individual by generalizing and connecting ideas while AI needs millions or billions of samples to learn.

Imagination and recitation: Humans can imagine things and ideas that are not present or may not even exist and predict future incidents inspired by their emotions. On the contrary, AI can only recite information, in other words, AI forms ideas based on synthetic recitation. That said, humans, in some cases, may act accidentally, but AI tends to be controlled all the time.

Multisensory input and output: Humans can collect information by using their different senses; put their personal perspectives and interpretations, and then make decisions or externalize that in various ways of communication. Compared to this, despite the fact that AI also works based on digital sensory systems e.g. self-driving cars or robots are good instances of multisensory systems, at present, AI is not able to learn by using all the senses a human does.

2. Use of AI in Higher Education

The role of AI has enormously become prevalent in the context of higher education as it can perform different functions in HE institutions. AI like ChatGpt can be applied in four major areas in higher education: teaching-learning, research, administration, and community engagement (UESCO, 2023). Generative AI-powered tools have the capability not only to guide, teach,

and assess learners but also play a crucial role as an invaluable source of inspiration for their self-directed learning. The most important about AI in education is its ability to expand the learning process out of the confines of individual teachers, traditional learning environments (chalk & talk), and one-size-fits-all approach.

AI makes learning more accessible, more personalized, more engaged, and more efficient (Ou, 2024; Harry, 2023). These kinds of developments were essentially accelerated by digital technology, especially by the advancement made in AI. Artificial intelligence has led to the quality enhancement of learning. Learners improve their high-order thinking skills, especially critical thinking, problem-solving, innovation, and creativity (Ou, 2024). Likewise, in the field of research AI has noticeably promoted the quantity of publications, the results of a comprehensive study have informed a dramatic increase in the number of publications in 2021 and 2022 as it rose nearly two to three times the number seen in the previous years. China has replaced the US (Crompton & Burke, 2023).

In addition to academic and teaching-learning processes, AI-powered tools and systems can be used for the management and administrative services in higher education institutions. Particularly, managers and administrators in HEIs employ business intelligence (BI) to assist them in managing, analysing datasets, delivering student services, providing support, making informed decisions, marketing, etc. For the automation of tasks and services public-facing chatbots, as reported by the University of Murcia in Spain, could respond to 38,000 queries from the students and save 91% of its administrative staff time to engage in other activities (UNESCO, 2023).

Bates (2018) has identified four application areas for AI in higher education: 1) Student enrolment and acquisition. 2) Learning and instruction. 3) Proactive student services (counseling, program guidance, etc.). 4) Institutional efficiency (cross-institutional and external data gathering and analysis). Bates has offered examples of these highlighted applications. He mentioned a mobile phone app AdmitHub, which is used to provide automated guidance for potential applicants by responding to their questions about enrolment. The second example of AI in learning and instruction highlighted by Bates is ECoach; this application has been developed by the University of Michigan and used to provide formative feedback on students' work. The mentioned app can also monitor students' progress in a specific course of learning and guide individually each student on what he/she needs to do next. Stellic is another app utilized for providing counseling services to students about preparing their degree plans based on the templates of previously graduated students. For institutional efficiency, an amazing app Genie has been developed by Deakin

University (Australia). This app is used to provide support to the students throughout their studies to be organized and controlled. The app also helps students feel supported and aware by answering their queries.

The primary purpose of this study is to gain better insights and a comprehensive understanding of the usage of AI in the higher education context by conducting a rigorous analysis of the existing body of literature and university instructional policies/ guidelines. The core focus of this study is the quality of the teaching-learning process, personalized learning, student learning outcomes, and major challenges associated with the utilization of GenAI in higher education. Accordingly, this study aims to address the following specific questions:

1. How has the existing body of literature considered the integration of AI in higher education contexts?
2. What are the key recommended practices in the literature about the application of GenAI in the teaching-learning process?
3. How can GenAI engage students in personalized learning and improve overall learning outcomes?
4. What are the current challenges and barriers faced by higher education institutions in the effective integration of GenAI in educational programs?

3. Method of the study

Literature Search

As mentioned earlier, the main purpose of this qualitative study is to undertake a comprehensive investigation of the current literature and institutional policies on the integration and application of GenAI in higher education settings. A Systematic Literature Review and Institutional Policy Guideline Analysis procedures were employed to extract and gather data from the relevant research articles, books, and reports through online and hand searches. Besides, several institutional policies and position statements have been reviewed to gain insights and the landscape of their policies.

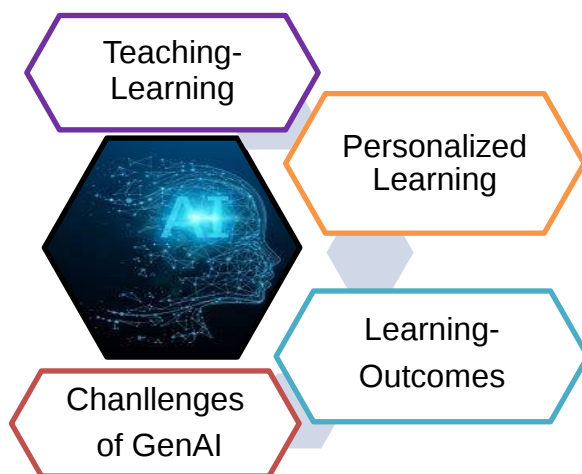
Procedure for Institutional Policy Analysis

For institutional policy analysis, some of the leading institutions and universities were identified and their policies, guidelines, and position statements were collected through an online search. The collected documents were carefully reviewed and systematically analysed. Key information such as institutional principles, ethical policies, frameworks, approaches, and implementation strategies were taken out.

Leading institutions' policies guidelines/position statements such as the University of Texas, University of Michigan, University of California Los Angeles, Yale University, Arizona State University, University of Notre Dame, University of Wesleyen, Boston College, University of Minnesota, John Hopkins University, and University of Mc Master were selected for content analysis.

The collected data has been organized and interpreted with regard to the specific applications of GenAI aligned with the main research focus areas shown in Figure 1. as well as articulated research questions.

Figure 1. Research Focus Areas



4. Findings

The analysis of the data collected from systematic literature review and institutional policies/outlines has yielded valuable insights and a deep understanding of GenAI integration in higher education institutions, particularly in teaching-learning practices. The results of the data analysis have been organized and presented into three distinct yet interconnected major sections aligned with the core research areas mentioned above.

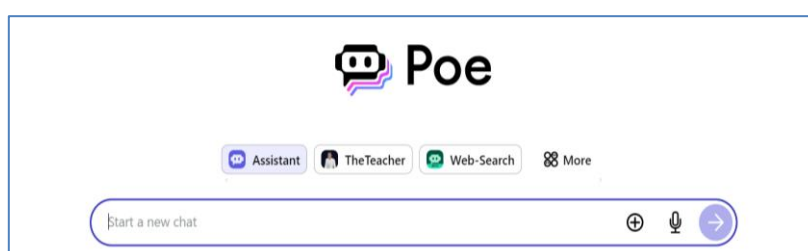
4.1. GenAI Improves the Efficiency and Efficacy of the Teaching-Learning Process (Classroom Beyond Classroom Impact)

Artificial intelligence, particularly Generative Artificial Intelligence (GenAI) synthetic technology can automatically generate content such as text, images, videos, and audio clips, therefore, its leverage continues to grow rapidly in higher education settings. According to a survey, students have indicated that the use of GenAI has a positive impact on their learning (Shaw et al., 2023).

There has been extensive conversation about the application of GenAI in teaching-learning practices. Based on the results of the data analysis of this present study, key applications have been identified as follows:

- As an assistant to the teacher:** The findings from the literature review (Dickey & Bejarano, 2024; Sekli et al., 2024; Ou, 2024; Crompton & Burke, 2023; UNESCO, 2023) reveal that GenAI can help teachers develop course materials, create course syllabi and instructional policies. Teachers can also utilize GenAI to extend students' learning, assess students, and design appropriate pedagogical practices, and assignments aligned with students' needs and course requirements. GenAI can assist teachers in automated grading, providing instant feedback on students' work and preparing students for classroom discussion. Teachers can use GenAI, e.g. ChatGPT to improve their overall instructional and research performance and time management abilities.
- GenAI as a tutor:** GenAI acts as a digital tutor that can deliver knowledge, provide instant feedback, answer students' questions, and assess students, but with the difference that human teachers may be available to their students during classroom hours only, while Chatbot as a tutor is available whenever a student needs assistance. These are the key tasks every teacher often carries out in his/her classroom. GenAI can generate learning materials for students in different forms such as text, image, video, and audio. The most important about GenAI is that it can provide effective guidance, polish students' articles, and provide learning support to every individual student (one-on-one support) (Department of Education UK., 2024; Ocker, et al., 2024; Ou, 2024; UNESCO, 2023; Grassini, 2023). For example, "AI Tutor Pro" is a user-friendly interactive human-kind tutor. Students can ask questions in 29 different languages about any topic from this tutor who in return asks questions from the students. Students can also choose their learning level before interacting with the tutor. In the case of incorrect answers, the tutor gives some hints to encourage the learner to retry. GenAI chatbot "Poe" also acts as a tutor. This chatbot has distinct capabilities as shown in the image below (Assistant, Teacher, and Web-search).

Figure 2. Image of Poe Chatbot, Depicting the Capabilities of its Search Engine



4.2. GenAI Personalizes Learning

Personalized learning is individualized instruction in which the teaching method and learning pace are determined as per the needs of every individual learner (U.S. Department of Education, 2017). In a personalized learning environment, students take charge of their own learning experience and meet the core requirements of the course with the support of technology and employing various learning methods (Grant & Basye, 2014). Likewise, GenAI can tailor teaching-learning materials in connection with individual students' needs and specific learning styles. GenAI can provide personalized learning support by generating customized learning content and providing personalized instant feedback to all learners individually. For example, ChatGPT can support every individual in brainstorming to create novel ideas and solve problems (Ocker, 2024; Ou, 2024; Sekli et al., 2024; Chan & Hu, 2023; 2022; UNESCO, 2020). Additionally, leveraging GenAI tools helps students improve their high-order thinking skills. The Chatbots mentioned earlier engage students in a dialogue exchange which allows learners to improve their cognitive skills, specifically high-order thinking skills and critical thinking (Gou & Lee, 2023).

4.3. GenAI Enhances Learning Outcomes

The previous sections highlighted that GenAI can act as a tutor and provide learners with new knowledge, guidance, formative feedback, increased access to quality learning materials, plus engaging students in personalized learning. These are all the key contributing factors to enhance learning outcomes. Overall, GenAI can improve and reinforce teachers' instruction and students' learning resulting in increased efficiency and effectiveness (Shaw et al., 2023). According to Grant and Basye (2014), reliable and responsive instruction that engages learners in problem-solving practices leads to improvement in learning outcomes. Accordingly, GenAI provides personalized support and engages students in high-order thinking skills including problem-solving which influences students' overall performance and learning outcomes (Noroozi et al., 2024).

4.4. Challenges of GenAI

The analysis of the policies/Guidelines/position statements established by the universities and institutions (the University of Texas, University of Michigan, University of California Los Angeles, Yale University, Arizona State University, University of Notre Dame, University of Wesleyen, Boston College, University of Minnesota, John Hopkins University, and University of Mc Master), demonstrate that these universities and institutions acknowledged the utilization of GenAI in their educational programs, emphasizing the accountable, transparent, and ethically fair

use of all these technologies. The results of the data analysis about the use and integration of GenAI reveal that GenAI integration has come globally into widespread public use. The findings of this study indicate that, despite all the achievements and benefits of GenAI, particularly in the context of education, certain disadvantages and major challenges need to be considered. Some of these notable challenges are ethical considerations, information accuracy, reliability of generated materials, data security, and privacy. In response, to manage these issues, higher education institutions have developed regulatory frameworks, codes of conduct, or protocols to mitigate the harms of misconduct of GenAI in academic environments. For example, Texas University has developed comprehensive and specific policies, e.g. for using the ChatGPT to reduce the risk of misleading directions (Texas University, 2024). The guidelines established by the University of California Los Angeles, describe how students and teachers should leverage AI technologies safely and responsibly. These policy guidelines address the issue of academic integrity and suggest that students need to acknowledge the use of ChatGPT and other AI tools in their work (UCLA, 2024). Yale University, while appreciating the valuable practices of GenAI tools both by students and teachers, also cautioned against sharing the information with these tools as it will become part of the databases upon which these systems operate. The guidelines also advise teachers to address the use of GenAI tools in their course syllabi and clarify how students should utilize GenAI tools (Yale University, 2024).

5. Conclusion and Recommendations

This study has been conducted to examine the role of GenAI in higher education, with a particular focus on three core areas: Teaching-learning, personalized learning, learning outcomes, and challenges. The results of the study indicated that the leverage of GenAI can profoundly support teachers in preparing quality course materials, syllabi, and instructional policies. Further, GenAI tools can assist teachers design effective pedagogical practices and evaluation. The study also revealed the role of GenAI as a tutor who can effectively deliver knowledge, provide feedback, assess, and guide students. Additionally, GenAI offers personalized learning support for the students in planning, managing, and taking charge of their learning. Consequently, GenAI can profoundly enhance the quality and effectiveness of the teaching-learning process, leading to improved students' overall learning outcomes. However, the findings have also highlighted some substantial challenges associated with the use of GenAI in higher education settings that cannot be overlooked. To address these challenges, the researcher offers the following recommendations:

- It is essential that regulatory policies and ethical guidelines should be established to govern the use of AI/GenAI in academic settings. The policies and guidelines should be effectively communicated to students, faculties, and non-academic staff through official websites, program/course orientations, and teaching policies.
- Both students and teachers should not rely solely on GenAI, instead, they need to incorporate their own concepts/insights to mitigate similarities in intellectual and academic output. This approach can help institutions overcome academic fraud and harness GenAI as an effective contributing asset for improving their overall educational practices and student academic achievements.

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