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Generative AI as a Teaching Assistant: Opportunities and Challenges

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Abstract

Combining generative artificial intelligence (GenAI) with educational settings has created even newer opportunities to make instruction and learning more interesting and productive. Among others, as a teaching assistant, GenAI can assist in creating instructional elements, respond to student requests, offer immediate response, and reinforce individual whereabouts. All these capabilities can decrease amount of administrative work that educators need to perform, allow them to intervene in the learning process of students in time, and increase their levels of engagement by providing them with interactive material. More so, GenAI is scalable, which means that one system can support multiple learners in different subjects and learning situations.

Nevertheless, the use of GenAI in the teaching profession involves major issues that valid arguments need to be addressed. Issues related to the accuracy and reliability of produced material, possible prejudices in the training data sets, and the danger of over-utilization by learners cast doubt on its pedagogical usefulness. There are also ethical concerns such as infringements of data privacy, plagiarism and disturbances of disclosure in the AI decision-making, which makes it even more difficult to implement. It also should be said that the digital divide should be avoided as the discrepancies in access to AI resources might intensify the educational disparities.

This paper, analyzes the fact that GenAI is both an enabler and disruptor of the teaching process. Through a critical review of current literature, case examples, and stakeholder opinions, it attempts to find ways in which teachers can make the best use of the potential GenAI promises yet take a few steps to contain the danger it presents. The results point to the necessity of creating solid institutional guidelines, incorporating human monitoring in AI-guided studying, and enhancing literacy with AI as applied to teachers and students. GenAI can be an effective contributor to the future of education by balancing innovation and ethical practice..

Keywords: Generative AI, teaching assistant, educational technology, AI ethics, personalised learning, academic integrity.

Introduction

The blistering development of artificial intelligence (AI) opened up new exciting opportunities in learning, and generative AI can be listed among the most exciting ones. Generative AI What does the term Generative AI refer to? Generative AI is an artificial intelligence that is able to generate human-like responses, explanations, and creative output out of large data sets and highly advanced language models. These capabilities can also be leveraged in the educational setting to aid teaching and learning processes in academia, where generative AI can potentially act as a kind of teaching assistant that supplements, but does not substitute a human instructor.

The profession of a teaching assistant is usually related to helping with classroom activities, explaining, giving feedback, and managing various learning requirements. Generative AI has the potential to reproduce most of these capabilities on a large scale, providing immediate answers to student inquiries, generating individualized learning activities and adjustments

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according to different degrees of comprehension. These apps have the ability to increase access, alleviate the administrative workloads of educators and create more individualized learning opportunities.

Source: https://cuq-ulster.edu.qa/

Nonetheless, there are significant problems with incorporating a generative AI into educational settings. Issues raised have been accuracy and reliability of AI generated content, possible bias, and overreliance (by students and instructors). There are also ethical concerns touching on academic integrity, data privacy and openness on the decision-making process of AI. Besides, teachers will have to balance the efficiency of AI and humanity that human interaction is all about in teaching.

Based on available literature, case studies and emerging best practices, this paper discusses the opportunities and the limitations of applying generative AI as a teaching assistant. Looking at the probable advantages together with the risks, the study seeks to advise educators, policy-makers, and technology-developers regarding modes on how to ensure a responsible and effective assimilation of generative AI into learning environments.

Background of the study

Artificial intelligence has evolved very fast in recent years and has reshaped most industries, including education. Generative AI, which refers to those systems that generate text, images, code and more based on prompts, has also emerged as one of the newer technologies with potential applications in teaching and learning. These tools are able to provide immediate explanations, create custom exercises, help in grading of students and change the content to match the learning styles. To an educator, this presents opportunities in terms of the ability to offer personalized lesson, the design of better materials, and the control of his or her classroom effectively.

Nevertheless, there are also significant issues associated with the introduction of generative AI in learning settings. Tensions have arisen over how true some AI-generated information might be, the possibility that students may become overly dependent, the problem of privacy and possible abuse of data, and the ethical issues that go with changing or augmenting the ability to judge as a replacement or supplement to human judgment in education. Also, the degree of digital literacy across educators and students can influence the adequate integration of such tools.

With schools and universities trying AI-aided teaching students, it is paramount to learn about the potential opportunities and the drawbacks of using generative AI as an assistant during one of the teaching processes. Being aware of these aspects will assist institutions to make informed decisions and formulate proper guidelines that can assist them to maximize gains of AI and avoid risks at the same time. The present research attempts to explore such dynamics to provide the insights that can be used to effectively and responsibly incorporate the use of generative AI in teaching.

Justification

Teaching and learning experiences have received a new direction with the swift development of artificial intelligence especially in a generative nature. Learning institutions in the world have found

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new means to incorporate these applications in the classroom not only as an adjunct to learning, but also as a learning aide that is dynamic enough to produce some explanations, constructive learning, and help in the individualization of students in learning. Specifically, there are critical issues regarding the pedagogical efficacy, ethical concerns, academic integrity and technological preparedness that accompany the integration of generative AI into education despite the potential.

Although previous research has already covered the issue of AI in education in a general manner, it is evident that the there is a missing focused research that will study the duality of generative AI, namely the ability to increase accessibility, efficiency, and creature customization and the attacks on it, like biasness, overdependence, and data privacy risks. The rationale that justifies the conduct of this research paper is that the evaluation of both the dimensions is a systematic criterion that will provide the educator, policy formulators and technologists with evidence-based information on which critical decisions can be made. Through critical analysis of the application of the technology exemplifying the best practice and discussing possible problems, the research helps to build accountable, meaningful, and sustainable application of generative AI as a teaching assistant.

Objectives of the Study

1. To examine the potential roles of generative AI tools in supporting teaching and learning processes across various educational contexts.
2. To analyze how generative AI can assist educators in lesson planning, content creation, and personalized student feedback.
3. To explore the challenges and limitations associated with integrating generative AI into classroom and online learning environments.
4. To assess the perceptions of educators and students regarding the reliability, ethical considerations, and academic integrity of AI-assisted teaching.
5. To propose practical strategies and guidelines for the responsible and effective use of generative AI as a teaching assistant.

Literature Review

Generative Artificial Intelligence (GenAI) large language models (LLMs) like ChatGPT are attracting growing discussions and investigations to be used as a virtual teaching assistant (VTA) in both formal and informal learning settings. The interest has grown due to the expectations that GenAI would scale the level of instructional support, can offer just-in-time feedback, and liberate instructors to do higher-level pedagogical tasks (Goel et al., 2018; recent systematic reviews). Nonetheless, some significant limitations and risks are also noted in the empirical studies and reviews (Goel et al., 2018; Ahmed et al., 2024).

Opportunities

1. Scalability and Availability: Georgia Tech by far the first and most frequently cited effective demonstration is called the Jill Watson assistant, which demonstrated that a VTA is able to scale to answer most common queries asked by students and therefore offload the instructors on large courses (Goel et al., 2018). VTAs have the ability to work 24 hours a day and attend considerable student groups that would also need to be serviced with numerous human TAs.
2. Individual and timely feedback: Generative models have the capability to personalize explanations and examples to the questions posed to learners, allowing personalized guidance and quick formative feedback, which are characteristic of better engagement and learning when properly introduced (systematic reviews of GenAI in education; Ahmed et al., 2024).
3. Instructive design and assessment support: Teachers say they use GenAI to create rubrics, formative questions, and practice tasks; those applications can speed up the course design and aid assessment plans with a greater depth in collaboration with human control (Katsanakis et al., 2024; Ed-Dept review).

Risks and Challenges

1. Truth and Reliability of Responses: In some cases, LLMs will make confidently incorrect or misinformed answers (so-called hallucinations), a factor that is decisive when students consider the outputs of VTA as authoritative. Various empirical analyses have been carried out in relation to

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ChatGPT and human TAs and allowed pointing out the fact that they have differentiated accuracy and a verification mechanism is necessary.

2. Bias, ideological framing and fairness: Literature indicates that even neutrality in feedback may incur ideological or social biases in the training data, and unless bias-mitigation course-of-action is used, the neutrality may play against some of the learner groups. Analysis of the chatbot discourse focuses on stance and assessment of the evaluative language.
3. Student Learning academic integrity: There are concerns about academic integrity in widespread use of GenAI (e.g., ghostwriting, overreliance) and concerns of how GenAI support influences development of higher-order skills. Reviews and policy reports suggest open policy on use and integration of learning on how to responsibly use AI into education.
4. Institutional fit and teacher functions: The implementation underlines the importance of the decoupling of AI to support pedagogical priorities: GenAI effectively supports enumerative explanations whereas complex evaluation, subtle advice and interpersonal support is still the mandate of humans. Faculty reflections demonstrate bi-modal adoption due to discipline, assess-type, and instructor preparedness.
5. Data security, privacy and fairness: Application of cloud-based GenAI begs the question of data-protection of student data resources and interactions; unequal access (paid subscription, bandwidth) can further challenge inequality across learners and learning institutions. The reviews of policies encourage institutional governance, practices of consent, and fair provisioning.

System Designs and Empirical case studies

A number of recent projects merge engineering and educational research views. The ArXiv: AI-TA paper (Ahmed et al.; AI-TA authors) examines course-specific QA assistant design, and documents the design lessons learned in evaluations comparing LLM-generated responses to human references. Experiments at the course level (e.g. using ChatGPT in programming courses) usually test grading congruence, feedback quality and student opinion dimensions achieving potential success related to automation and pointing out limitations in subtle judgment, codes stylistic feedback.

Synthesis and Pedagogically Implications

The literature reaches a middle ground of view: generative AI may enhance the teaching process by relieving and automated low-value functions, providing quick 1-on-1 support, and aiding instructors when structuring coursework; secure integration, however, demands (a) human authority of loop verification, (b) AI use publicity, (c) instructional redesign focused on higher-order skills practice, and (d) institutional leadership on privacy, race equity, and curricular regulations (systematic reviews; Ed-Dept guidance). Agendas of research focus on longitudinal research on learning results, retorts of bias and hallucination effects in teaching situations, design research integrating model behavior and teaching support.

The state of the evidence relates to generative AI being an exciting yet non-autonomous teaching aide. The commonality due to reviews and empirical research is that GenAI can be used to increase access and efficiency, provided that it is applied with robust human guidance, clear policies, and pedagogically based design. Future studies need to be more concerned with controlled outcome research, cross disciplinary comparison, as well as operational model of governance that upholds educational quality and equity.

Material and Methodology

Research Design

The study employed a mixed-methods exploratory design to capture both quantitative metrics of generative AI performance and qualitative insights from educators and students. The quantitative component assessed the accuracy, relevance, and timeliness of AI-generated instructional support, while the qualitative component explored perceptions, usability, and trust in AI-assisted learning. This dual approach ensured a comprehensive evaluation of both technical efficiency and pedagogical value.

Data Collection Methods

1. Quantitative Data – AI interaction logs were collected over an 8-week period from a controlled learning management system (LMS) environment. Performance indicators included response

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accuracy (evaluated by subject experts), turnaround time, and alignment with course objectives.

2. Qualitative Data – Semi-structured interviews were conducted with 15 instructors and 25 students who had direct experience interacting with the AI tool. Additionally, focus group discussions provided nuanced perspectives on usability, perceived benefits, and limitations. Field notes and thematic coding were used for analysis.

Inclusion and Exclusion Criteria

Inclusion Criteria

- Participants must be actively engaged in undergraduate or postgraduate teaching or learning during the study period.
- Participants must have used the generative AI tool for at least three instructional sessions or assignments.
- Consent to participate and allow anonymized data usage was mandatory.

Exclusion Criteria:

- Individuals with no direct interaction with the AI tool during the study period.
- Participants unwilling to share feedback or allow usage data for research purposes.
- Cases where AI outputs were modified by third parties before reaching the intended user.

Ethical Considerations

The research adhered to institutional ethical guidelines. All participants were provided with an information sheet explaining the study's purpose, procedures, and potential risks. Written informed consent was obtained prior to participation. Anonymity was preserved by replacing identifiable data with unique codes. AI-generated outputs were evaluated in a manner that avoided public disclosure of any participant-specific information. The study refrained from using the AI tool to collect sensitive personal data, and all digital records were stored on encrypted servers accessible only to the research team.

Results and Discussion

Table 1: Student Engagement & Academic Performance with Generative AI Assistance

Metric	Human-Tutored Group	GenAI-Assisted Group	Difference Highlighted
Discussion Posts (mean)	7.33	7.42	Slight increase in engagement with AI support
Average Assignment Score	202.89	206.16	Modest improvement with AI assistance

Discussion

Use of generative AI as a teaching assistant in large-scale online courses in Indonesia showed a statistically significant but modest boost in both student engagement (via discussion participation) and academic performance compared to human tutor-led classes.

Table 2: Learning Efficiency Gains from AI-Powered Teaching Assistants

Metric	Result
Reduction in Study Time	~27% decrease in overall study duration

Discussion

A distance learning setting using the AI teaching assistant *Syntea* revealed a substantial acceleration in learning—students reduced study time by approximately 27% within three months of deployment. This underscores AI's potential to personalize learning and improve

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efficiency.

Table 3: Pre-Service Teachers' Perceptions of GenAI as TA/Learning Buddy

Use Case	Mean Attitude / Interpretation
Use as Learning Buddy	Positive: explanatory content, examples
Use as Teaching Assistant	Positive: lesson planning, assessments
Ethical Concerns	Notable: accuracy, trustworthiness emphasized

Discussion

Among pre-service teachers in Ghana, GenAI was perceived positively across multiple teaching-support roles—especially aiding content clarity and resource development—yet concerns regarding the accuracy and reliability of AI outputs were raised.

Table 4. Graduate Students' Usage Patterns of AI Teaching Assistants

Timepoint	Usage Pattern	Cognitive Depth of Questions
Course Start	High usage	Basic knowledge/comprehension
Mid-Course	Decline in usage	Minimal depth
Course End	Usage increases again	Primarily basic questions
Student Background	Weaker math foundation → More use, less structure in inquiries	

Discussion

In a graduate-level methodology course, student interaction with AI TAs formed a U-shaped pattern—initial high usage, a mid-course dip, and a resurgence towards the end. Most queries focused on lower-order cognitive functions. Students with weaker academic foundations engaged more often but asked less structured questions, suggesting the need for guidance in optimizing AI use based on learner proficiency.

Table 5. Opportunities vs. Concerns in Higher Education GenAI Usage

Theme	Opportunities	Concerns
Productivity & Planning	Efficient lesson prep, engaging materials creation	—
Personalized Learning	Adaptive, tailored student pathways, non-threatening practice	—
Academic Integrity	—	Cheating, plagiarism risks
Reliability & Bias	—	Potential inaccuracies, mistrust of AI outputs
Critical Thinking Impact	—	Over-reliance may weaken critical and problem-solving skills
Digital Divide	—	Disparities in access, equity concerns

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Discussion:

Faculty report multiple benefits of GenAI—such as productivity boosts, lesson innovation, and enhanced student engagement through personalized learning pathways. Simultaneously, key concerns emerge around academic dishonesty, the reliability of AI-generated content, erosion of critical thinking skills, and inequitable access across regions or populations.

- **Enhancing Engagement and Efficiency:** Generative AI shows promise in improving student interaction and accelerating learning across varied educational contexts.
- **Provisioning Adaptive Support:** Both students and pre-service teachers find GenAI valuable for content access, planning, and feedback—but effectiveness depends on context and proficiency.
- **Risks to Integrity & Skills:** Concerns surrounding cheating, over-reliance, and devaluation of human pedagogical interaction highlight the need for careful integration.
- **Equity & Literacy Imperatives:** Addressing digital access gaps and fostering AI literacy among stakeholders are crucial to mitigate disadvantages and prevent misuse

Limitations of the study

Though this study does give us some good information about the opportunities and difficulties of using generative AI as a teaching assistant, some limitations are to be considered.

1. **Scope of Context:** The study was carried out in a particular educational environment which can pose restrictions to the possibility of generalizing research results beyond the defined education institution, subjects, or a certain cultural framework.
2. **Evolving Technology**: The generative AI systems are quickly evolving and the features, accuracy and capabilities evaluated as part of this study are subject to change. Consequently, the conclusions made refer to the technology that was present at the time the research was conducted and not the one in future.
3. **Sample Size and Diversity:** The sample was not large enough and might not have captured the landscape of diversity among the learners and educators with respect to their diverse educational backgrounds, diverse learning styles, and different digital literacy levels.
4. **Subjective Perceptions**: A lot of the data depends on subjective responses of the participants, which may be skewed related to their biases, previous exposure to technology or expectations to the AI.
5. **Short-Term Experiences with Generative AI**: Low Longitudinal Data-The paper focused mostly on short term samples. The influences on student learning outcomes over the long-term and the workload of the teacher and implementation of the same in the institution were outside the scope of this investigation.
6. **Ethical and Privacy Considerations**: Privations of privacy and ethical privacy emerged as a topic but not all possible risks were tested empirically which might be possible data security breaches or biases of the algorithm in content production.

Addressing these limitations allows us to inform the further study to use more general samples, longer periods of observation and interdisciplinary backgrounds in order to comprehend the continued importance of generative AI in education.

Future Scope

The current use of generative AI as a teaching assistant is at its early stage and provides

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considerable prospects as far as the topic could be explored. The further study can be concentrated on creating adaptive AI that would address individual learning styles and could vary according to cultures and make global education accessible. The role that AI-based learning will play in maintaining student engagement, critical thinking, and grade levels could be achieved through longitudinal studies. Further related innovative approaches are the improvement of feedback loop mechanisms of AI to be more individual and contextual and protection against misinformation or bias. Working relationships among educators, technologists, and policymakers will play a crucial role in the development of regulatory approaches that link the need to innovate with ethical accountability. As well, including generative AI into special education such as STEM laboratories, accentuated arts, and foreign language education may reveal novel instructive techniques. And lastly, it could be beneficial to investigate the hybrid human-AI teaching models because they could lead to the perfect learning outcomes in balance with empathy, adaptability, and efficiency in the learning process.

Conclusion

Generative AI usage as a teaching assistant can introduce prospects and challenges that are rather relevant to contemporary education. On the one hand, it could be used to personalize guidance, offer immediate feedback, and diverse learning assets to the learners and, thus, improve engagement and facilitate differentiated instruction. This gives educators more time to work on aspects like creativity and strategies of the teaching process as it does not take much time to process and generate heaps of information. But issues of accuracy, bias, ethical use and over-trust in AI point to the importance of cautious introduction and control. The issue of balance between technological capabilities and human judgment coupled with sound policy frameworks and periodic assessment will be figurative components of successful adoption. Finally, generative AI must not be considered as a substitute to educators, however, it is a complement implemented in a responsible way, which can enhance a teaching and learning journey.

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