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Beyond the Algorithm: Student Perspectives on Generative AI in Engineering Education

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ABSTRACT

CONTEXT

The rapid integration of AI tools into engineering education is reshaping traditional pedagogical methods and assessment practices. These tools offer opportunities for enhanced learning experiences through personalised instruction and automated feedback. However, they also raise concerns about academic integrity and the authenticity of student work. Understanding how stakeholders, particularly students, perceive these technologies is crucial to their effective integration into educational frameworks. This study investigates student perceptions to provide insights into applicability and acceptance of AI in engineering education.

PURPOSE

This study aims to explore student attitudes towards AI tools in engineering education. The primary goal is to understand how these tools are perceived in terms of their impact on learning, assessment integrity, and educational practices. The research question guiding this study is: How do students perceive the role and impact of generative AI tools in their learning experiences, and academic performance? By addressing these views, the study seeks to inform strategies for integrating AI in a manner that enhances educational outcomes while maintaining academic standards.

METHODOLOGY

A survey was used to gather insights from students with varying engineering backgrounds. Quantitative data was analysed to identify trends and patterns in perceptions. Qualitative data from open-ended survey responses was analysed thematically to provide deeper insights into the concerns and expectations surrounding AI in education.

OUTCOMES

The study revealed a range of perceptions, with most students expressing optimism about the potential of AI to enhance learning experiences whilst simultaneously voicing concerns about academic integrity. The findings highlight the need for clear guidelines surrounding ethical use of AI in education.

CONCLUSIONS

The findings reveal that students recognise the potential benefits of AI in education but hold concerns about its impact on academic integrity and quality of learning. The study recommends the development of comprehensive policies that balance the advantages of AI with the need to maintain rigorous educational standards. These policies should include ethical guidelines and training to ensure that students use AI responsibly in academic settings.

KEYWORDS

Generative AI, Engineering Education, Student Perceptions, and Academic Integrity.

Introduction

Machines that have the ability to imitate human intelligence by absorbing information to learn, reason and self-correct are colloquially referred to as Artificial Intelligence (AI) (Gallent Torres, Zapata-Gonzalez and Ortego-Hernando, 2023). AI tools were first integrated into education as simple computation programs and have since developed into sophisticated systems such as Generative AI (GAI). GAI specifically refers to Large Language Models capable of comprehending user inputs and generating human-like outputs ranging from text to images to code (Gallent Torres et al., 2023; Haindl & Weinberger, 2024). The integration of GAI technologies, such as ChatGPT, into educational contexts has begun to reshape traditional educational landscapes. These tools have the potential to enhance learning through personalised instruction and automated feedback, but simultaneously threaten academic integrity and risk an increased dependency on technology (Gallent Torres et al., 2023). The adoption of AI advancements is crucial in disciplines like engineering, as educational outcomes and future career opportunities can be significantly influenced by the ability to adapt to rapidly changing technologies (Dai, Liu and Lim, 2023).

This study surveyed engineering students at a large metropolitan university to explore the role and impact of AI in tertiary education. It posits how AI technologies could be integrated in higher education to advance learning outcomes without compromising academic standards.

Background and Literature Review

The historical progression of integrating new technologies into educational systems predicts that AI tools could become a central element of future educational frameworks. However, while the use of AI has a number of key benefits, it also has associated weaknesses.

AI has the potential to optimise education and learning outcomes by enabling personalised assistance that may not otherwise be possible for large cohorts. Studies such as Dai et al (2023) noted that these tools have the ability to shift from the standard one-size-fits-all approach to education to instead cater to the needs of the individual learner. Gallent Torres et al. (2023) explained that AI facilitates this by offering students real-time support, thereby enhancing engagement and increasing efficiency by mitigating the need to wait for an academic to assist (Dai et al., 2023). Haindl & Weinberger (2024) found that in engineering specifically, students found tools like ChatGPT beneficial for understanding programming concepts and acquiring background knowledge.

A major concern surrounding AI is the potential erosion of educational rigour and academic standards, as incorrect use of these tools – such as copying AI-generated content – may undermine the development of critical engineering skills, causing dependence on AI and consequently encouraging academic dishonesty (Gallent Torres et al., 2023; Dai et al., 2023). The use of GAI tools in education could also complicate academic integrity by making it difficult to distinguish between student knowledge and AI assistance (Gallent Torres et al., 2023). Dependence on AI could lead to a deterioration of critical thinking, thereby inhibiting the deeper learning processes necessary for mastering complex engineering tasks and resulting in graduates who might lack critical competencies (Dai et al., 2023; Haindl & Weinberger, 2024).

Institutions are thus challenged to develop new protocols and guidelines that clearly define the use and limitations of AI tools in academic settings, to ensure that these technologies are used in ways that support genuine learning and uphold the principles of academic integrity.

There are noticeable gaps in current research – such as the lack of longitudinal studies that examine the long-term impact of AI on learning outcomes. This is of course challenging with the rapid development in this space. Several key studies focus on the performance and capabilities of these tools, but there is still further research to be completed on student perceptions (Nikolic et al., 2023; Nikolic et al., 2024). This links to the research question guiding this study: How do students perceive the role and impact of generative AI tools in their learning experiences, and academic performance?

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Methodology

Survey Design

The survey for this study was developed to critically evaluate ChatGPT's effectiveness within the context of engineering education at a large metropolitan university. As such, it was designed to encompass a broad spectrum of experiences, perceptions, and insights. Incentives were not offered for survey participation, to ensure that responses were reflective of the participants' true views and experiences. This enhanced the reliability of the data by providing a clear and unbiassed foundation for analysis. Ethics approval for the research was granted by University Human Research Ethics Committee at the Queensland University of Technology (QUT) – approval number 8448.

Survey questions were designed to elicit quantitative responses that could directly inform the investigation. This approach was complemented by the inclusion of open-ended questions to better capture diverse perspectives. This dual approach allowed the survey to gather quantitative data efficiently whilst enriching the dataset with nuanced qualitative insights. Qualitative responses in the survey were categorised based on themes emerging from the data.

The survey targeted students from all engineering disciplines including software, electrical, and mechanical engineering, and aimed to capture diverse insights that reflected both subjective educational experiences and objective evaluations of AI tools' performance. By exploring the views of the respondents, the survey provided valuable data on user satisfaction and qualitative feedback on the practical challenges and benefits of AI in academic settings. This strategic inquiry ensured that the survey fostered a rich dialogue on the integration of AI tools in educational contexts, making it a pivotal tool for both immediate analysis and deeper exploration beyond the initially sought information.

Survey Data Analysis

The analysis procedure for this study followed these steps:

1 - Data Preparation: Scrutinise the completeness and uniformity of survey responses, refining the dataset to ensure accuracy by removing any anomalies.

2 - Descriptive Statistics: Summarise participant demographics and general response patterns using statistical analysis to depict the collected data.

3 - Thematic Synthesis: Conduct a thematic analysis on open-ended responses by sorting the data into distinct themes to discover prevalent opinions and perceptions.

4 - Data Visualisation: Use a variety of visualisation tools to represent data insights from both quantitative and qualitative analyses.

5 - Data Interpretation: Contextualise the data by aligning it with the research question and interpret the findings through the lens of current discourse on AI in education.

6 - Actionable Insights: Deduce practical implications for the application of AI in education and propose potential directions for subsequent research.

Results and Analysis

Quantitative Analysis

Survey Question: “Please rank your perceived effectiveness of AI tools like ChatGPT across various types of engineering assessments.”

Figure 1 shows student ranking of AI’s ability to assist across various assessment types and reveals where AI tools were perceived as most effective. In this analysis, "most effective" refers to the extent to which AI tools improve accuracy, efficiency, and the analytical depth of student

outputs in a specific assessment type. Coding assessments and reports were ranked highest, indicating a strong potential for AI to support areas that benefit from automation or enhanced analytical capabilities. Educators may be able to use these insights to determine where AI integration can be prioritised to enhance educational outcomes, such as in automating or supporting structured tasks.

Figure 1 also reveals that AI assistance was viewed as least effective for exams and presentations, possibly because these assessment formats test often exist in supervised formats (so students may not have access to AI tools) and can require a wide understanding of content and the personalisation of responses (such as individual questions in presentations). This potential limitation of AI could guide educators in deciding what assessment types should continue to be utilised in a world that increasingly uses AI tools, in order to maintain proper learning and academic integrity.

It is crucial that educators and curriculum designers understand these perceived strengths and weaknesses of AI in order to effectively leverage AI while avoiding undermining the educational objectives that require more nuanced human capabilities.

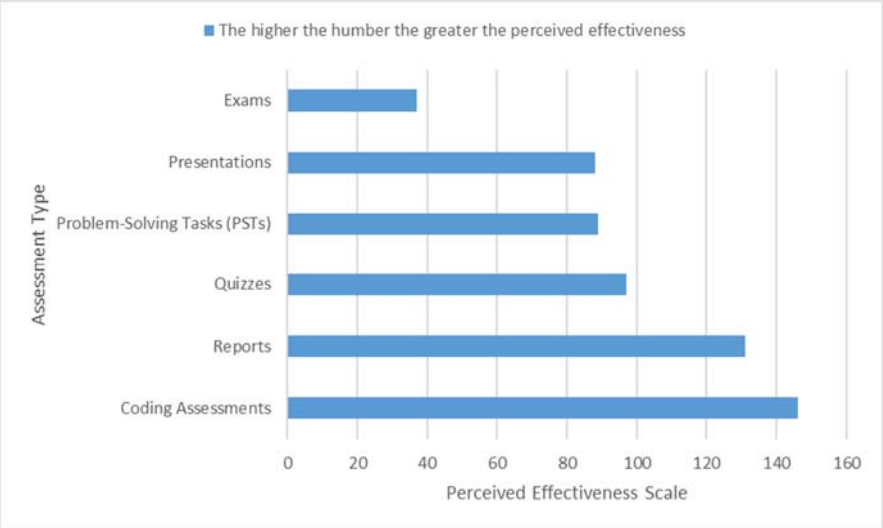

Figure 1 - Ranking of AI Assistance Across Assessment Types

Survey Question: “From an educational standpoint, how do you view the balance between leveraging AI tools like ChatGPT for learning enhancement versus safeguarding academic integrity?”

Figure 2 reveals that most survey respondents were in favour of AI use, with the provision that strict guidelines are implemented to ensure academic integrity. This suggests a general openness among the student participants in this study, towards adopting AI, tempered by a realistic assessment of the risks involved. Balancing AI integration with measures to maintain academic standards is crucial for its acceptance and effectiveness as an educational tool.

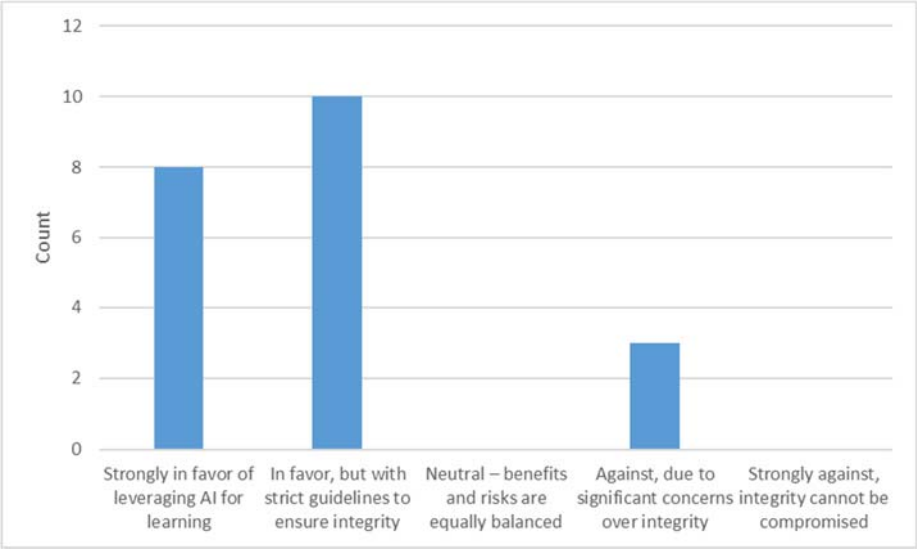

Figure 2 - Student Opinions about AI Integration

Most survey respondents were from Mechatronics', 'Mechanical', and 'Computer and Software Systems' engineering majors, which could suggest a particular interest in or relevance of AI tools within these fields. Conversely, the absence of participation from disciplines like 'Chemical and Sustainable Process', 'Electrical and Renewable Power', and 'Medical' engineering might indicate less exposure or perceived relevance of AI tools. However, this could also be due to the small sample of participants (n=21). The majority of respondents were in later years of study.

Qualitative and Thematic Analysis

In what follows, comments and analysis pertaining to specific survey questions will be discussed.

Advantages of Using AI in Assessments

Survey question: "What advantages do you see in using AI tools for assessments?"

The surveyed students perceive AI tools as most beneficial for enhancing time efficiency and streamlining tasks (n=12), followed by supporting the accessibility of information (n=11) (

Figure **3**). These attributes emphasise AI's role in optimising the assessment process and making information more available, potentially transforming how students prepare and engage with educational materials. Most respondents also utilise AI to enhance learning and understanding (n=8) and for proofreading and writing assistance (n=7), which demonstrates AI's perceived value in improving the quality and depth of learning experiences.

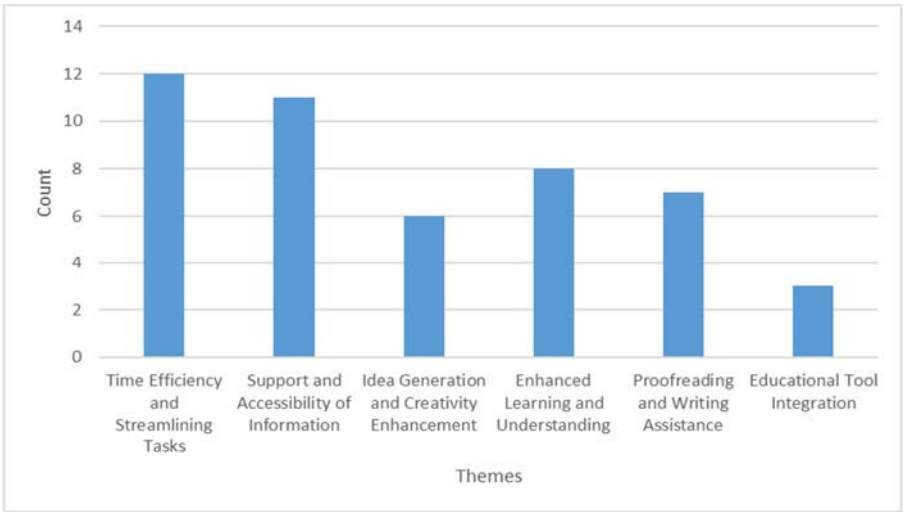

Figure 3 - Advantages of Using AI in Assessments

Impact of AI on Learning Processes

Survey question: “How do you think the use of AI tools like ChatGPT could impact the learning process?”

Survey responses revealed that AI is seen as both a potential enhancer and a disruptor of educational practices. While the majority of respondents recognised AI’s ability to support educational processes (n=8) by citing its ability to generate customised learning materials, facilitate virtual tutoring, and provide real-time feedback, there was also a nearly equal concern (n=7) about AI’s potential to foster dependency leading to disengagement among learners (Figure 4). Several respondents highlighted the possibility of students using AI to “complete assignments for them” or relying on AI for immediate answers without engaging in the requisite critical thinking or problem-solving efforts.

This dual perspective underscores the need for careful integration of AI into educational frameworks to leverage its benefits while mitigating risks. The data suggests that while AI can dramatically enhance the efficiency and accessibility of educational resources, its role should be carefully calibrated to support rather than replace traditional learning processes. Educators and policymakers are thus challenged to develop strategies that utilise AI as a supplementary tool that encourages active learning and critical engagement rather than as a primary solution that might encourage passivity or dependency.

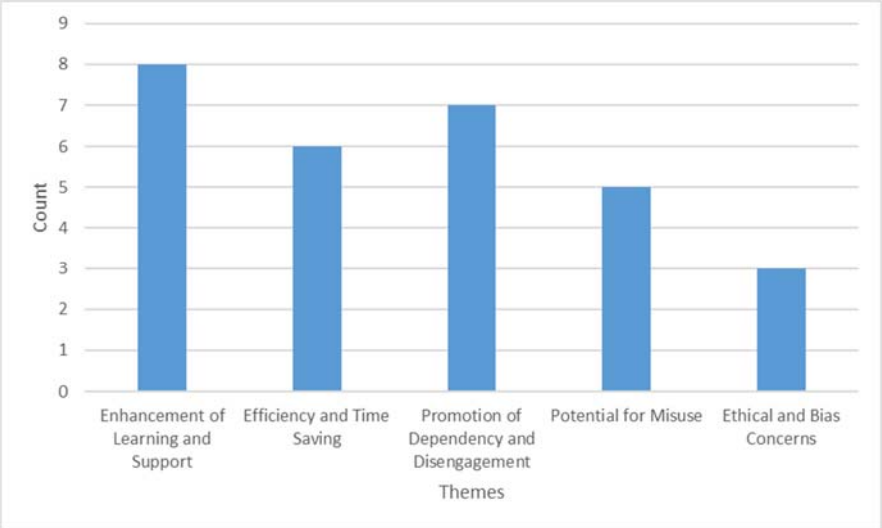

Figure 4 - Impact of AI on Learning Processes

Regulatory Perspective on AI in Assessments

Survey question: “Do you think there should be guidelines or policies regulating the use of AI tools in assessments? Please explain.”

Many student respondents favoured the implementation of guidelines or policies to regulate the use of AI tools in assessments (n=11) (Figure 5). This perspective is supported by calls for increased training and awareness (n=3), emphasising the importance of preparing students to use AI responsibly and ethically.

The explanations provided for responses to this question revealed two distinct perspectives. One viewpoint advocated for strict guidelines and clear disclosures about the use of AI in educational tasks, such as delineating how and where AI was utilised in a task. Other respondents supported a less restrictive approach that incorporates AI as a tool for enhancing learning rather than as an aid. This includes the perspective that, much like how students were taught to use Wikipedia judiciously, students should be educated on the limitations and appropriate uses of AI. These differing views highlight a broader discussion within the educational sector about the balance

between harnessing AI's potential to enhance learning and ensuring it does not undermine educational objectives.

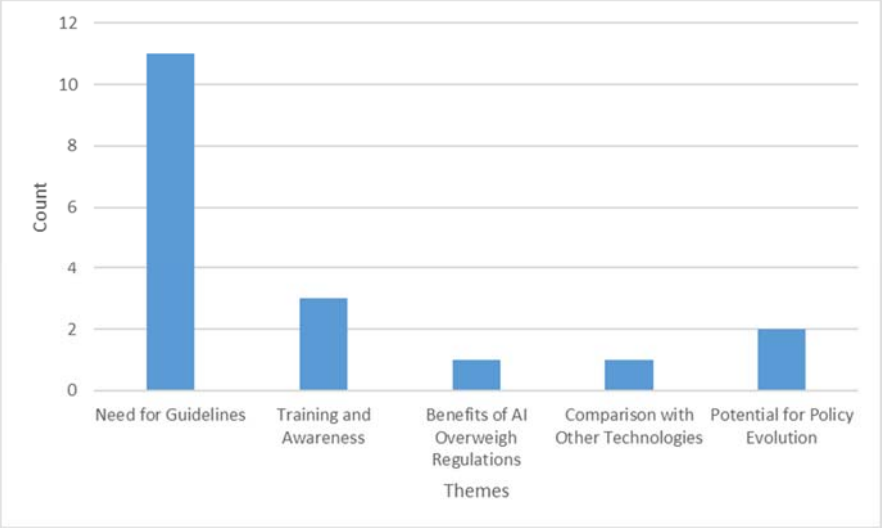

Figure 5 - Regulatory Perspectives on AI in Assessments

Additional Thoughts from Survey Respondents

Generally, there was a consensus amongst survey participants that while AI offers significant benefits, its integration must be approached with caution and foresight. Most respondents recognised the potential of AI to enhance educational experiences, as exemplified by statements that encouraged more widespread adoption and highlighted AI's value as a tool that can aid learning and improve student performance.

There was also a strong emphasis on the need for moderation and oversight to prevent potential misuse and ensure that AI tools are used effectively. Several respondents noted that, without proper guidelines and restrictions, the benefits of AI could be undermined by its improper use. This sentiment underscores the need for a balanced approach where AI assists but does not replace the educational process.

Participants also acknowledged the necessity of preparing students for a future where AI plays a significant role in various aspects of life, including education. This suggests that educational systems should not only incorporate AI but also equip learners with the skills to use these tools responsibly and effectively.

Overall, the responses illustrate a thoughtful and measured approach to the integration of AI in education, reflecting a collective understanding of both its potential benefits and the challenges it presents. The emphasis is on using AI to complement and enhance the learning process while ensuring that its use is governed by clear guidelines and ethical considerations.

Discussion

The survey findings corroborate a growing body of literature that recognises the potential of AI to transform educational settings through personalised learning experiences. While research such as Dai et al. (2023) emphasise the enhancements brought by AI, the findings presented here highlight that students also perceive AI to have limited use in contexts that require nuanced understanding and personalisation. This suggests a gap that AI has yet to bridge in order to provide holistic educational support.

The challenges and opportunities that AI presents in educational settings is well-documented (Dai et al., 2023). The integration of AI into engineering curricula holds significant promise for enhancing educational processes through personalised learning and adaptive content delivery as suggested by the findings of this study. However, this survey determined that use of AI tools also has the potential to jeopardise academic integrity and may lead to student dependency. Survey

respondents suggested that these tools could be most effectively incorporated in a higher education setting if a robust, transparent, and adaptable ethical framework is simultaneously implemented to ensure that academic rigour is not compromised.

The survey clearly identified that engineering assessments may need to evolve to appropriately integrate AI technologies. The use of AI can be particularly advantageous in formative assessments, where it can provide students with broad, hands-on learning experiences. However, summative assessments should continue to involve significant human oversight for the creation and adoption of Identity Verified Assessments and intervention to maintain academic integrity and the measurement of true student competencies. Such a hybrid approach would allow educators to harness AI's strengths in enhancing learning and testing while ensuring that final evaluations are reflective of each student's true abilities.

Cochrane and Ryan (2023) provided practical strategies for reframing assessment tasks to mitigate risks of plagiarism and cheating, to ensure that assessments remain robust and credible. The authors emphasised the importance of designing essay prompts and exam questions that require creative thinking, critical analysis, and engagement with current or local content, which AI tools may struggle to generate accurately. They suggested using collaborative writing tools with version control to track the writing process, integrating reflection and peer review into assessments, and emphasising the accurate citation of sources. These strategies align with the need to maintain academic rigor while leveraging AI tools for educational enhancement. By adopting such approaches, educational institutions can ensure that AI integration in assessments supports genuine learning and development rather than undermining academic integrity.

Limitations of this study include the survey sample size (n=21). Furthermore, respondents to the survey come from a single institution. With this sample size, it was not possible to report or break responses from the participants down further into disciplines. A larger sample size may support further generalisation of the results too. The results presented in this study are also student perceptions given in a survey. These perceptions may not align with actual use of these AI tools.

Recommendations

This study highlighted the need for educators to consider integrating AI tools to supplement traditional teaching methods, particularly for providing customised tutorials and real-time feedback. However, AI should not replace complex problem-solving exercises that are crucial for developing students' practical and analytical skills. Assessments could be redesigned to leverage AI's capabilities without compromising academic integrity. This might involve more project-based assessments that require personal demonstrations of practical skills and critical thinking.

Training programs that focus on the ethical use of AI, understanding its limitations, and strategies for effectively integrating AI into learning and assessment processes should become mandatory for students. Comprehensive policies should be developed to regulate the use of AI tools in educational assessments, ensuring they support educational goals while addressing ethical and integrity concerns. These policies should be regularly updated as AI technology evolves and as more is understood about its implications in educational contexts.

There are some opportunities for future research, as there is a need for more robust methodologies that assess the impact of AI integration across different learning environments and student demographics. As such, one opportunity for future research is to focus on developing comprehensive evaluation frameworks that can accurately measure both the benefits and potential drawbacks of AI in education, ensuring that these tools truly enhance, rather than hinder, the educational experience.

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Concluding Remarks

This research study aimed to canvas students' perceptions of the role and impact of generative AI tools on their learning experiences, and academic performance. Survey results emphasised a cautious optimism about integrating AI into educational practices. While many students recognised the potential benefits of AI in personalising learning and offering new interactive educational tools, there were significant concerns about academic integrity, over-reliance on technology, and the potential erosion of critical thinking skills. Establishing guidelines on the appropriate use of AI in educational settings, promoting awareness of its limitations, and continuously assessing its impact on student learning are critical steps in achieving a balanced integration of AI into the learning process. Future research should explore longitudinal studies to track AI's impact on learning outcomes over time; providing insights into how continuous interaction with AI affects student cognitive and development processes.

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