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Optimizing Student Success: The Impact of Artificial Intelligence in Teaching and Learning

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This study investigates the transformative potential of generative artificial intelligence (GAI) in reshaping educational methodologies in higher learning to enhance student success. Implementing GAI technologies into higher education opens new possibilities for improving the teaching and learning process. The research highlights synergies between GAI tools and educational best practices, addressing benefits and challenges. GAI tools were identified that can improve teaching and learning. These tools help streamline the curriculum development process, create teaching materials, and improve student success. GAI tools can enhance efficiency, save time, provide instant student support, and personalize course materials. Challenges include the accuracy of GAI-generated content, inadequate faculty training, lack of guidance on ethical use, and the high cost of implementation. The possibility of diminishing critical thinking skills and an increase in student cheating was a significant concern. Recommendations for employing GAI in higher education are provided, offering insights into its impact on teaching and learning.

Keywords: AI tools, Curriculum Development, Generative Artificial Intelligence (GAI), Student Success, Teaching and Learning

Introduction

Artificial intelligence (AI) encompasses technologies designed to replicate human tasks such as problem-solving, decision-making, reasoning, and language processing. A subset of AI, generative AI (GAI), focuses on creating novel content, including text, images, audio, and video by leveraging datasets to generate outputs that closely mimic human-created materials. Unlike traditional AI, which often analyzes or processes existing data, GAI creates new data that mimics the original or is indistinguishable from human-created content (Copeland, 2024). Recently, GAI tools have gained widespread adoption in higher education, enabling educators to innovate curriculum development and enhance the learning experience by tailoring educational content to diverse student needs and interests (Gibson, 2023; Pratama et al., 2023).

Generative AI (GAI) technologies are reshaping higher education by enabling personalized learning through adaptive platforms, chatbots, and predictive analytics while automating administrative processes to enhance efficiency and accessibility. Despite its transformative potential, the integration of GAI tools into teaching and learning remains underexplored due to its novelty and the limited research available. This study investigates higher education faculty's perceptions and utilization of GAI tools, focusing on their role in fostering student engagement, accessibility, and instructional flexibility. Grounded in the Technology Acceptance Model (TAM), the research examines how perceived usefulness and ease of use influence faculty adoption of GAI tools (Davis, 1989; Al-Emran et al., 2018). Central to the study is the question: What are the perceptions and experiences of faculty regarding GAI's impact on teaching and learning? By exploring how GAI contributes to student success, engagement, and instructional efficiency (McIntosh, 2023; Adiguzel et al., 2023; Sharma, 2023), the study aims to address gaps in current knowledge and provide actionable strategies for its responsible integration. These insights will help ensure the effective and ethical adoption of GAI in higher education, enabling educators to leverage its capabilities while addressing emerging challenges.

Generative AI in Higher Education

Generative AI (GAI) has revolutionized education by creating personalized and adaptive learning pathways that enhance student engagement and success (Hernandez & Liu, 2023; Pratama et al., 2023; Luckin, 2018). It bridges the gap between student needs and educational content (Lee & Nguyen, 2020), enabling faculty to adapt course materials while aligning instruction with mastery learning principles (Gibson, 2023). GAI tools such as speech recognition, plagiarism detection, video editing, chatbots, and predictive analytics streamline administrative tasks and improve course development efficiency. Leveraging data, GAI fosters deeper student engagement and empowers educators to focus on innovative teaching practices (Chng, 2023). Additionally, GAI transforms virtual tutors into reality, offering anytime accessibility and redefining learning through chatbot systems (Sharma, 2023). These tools provide personalized academic assistance, adapting to student progress and supporting course modifications based on engagement insights (McIntosh, 2023).

Beyond education, GAI demonstrates significant productivity gains in professional environments. Sowa et al. (2021) reported a 57% increase in managerial efficiency with GAI, while Dell'Acqua et al. (2023) found employees completed tasks 25.1% faster and with 12.2% greater accuracy. In education, Pane et al. (2015) found that students using personalized learning approaches outperformed their peers. Despite challenges, research highlights GAI's transformative potential, driving engagement and achievement across diverse learning environments (Swiecki et al., 2022). ChatGPT tools, such as those studied by Jauhiainen and Guerra (2023) and Mai et al. (2023), enable instructors to create assessments, enhance motivation, and scaffold skill acquisition. GAI also enhances scalability by automating personalized assistance and instructor feedback, improving the student learning experience (Dickey & Bejarano, 2023; U.S. Department of Education, 2023; Dell'Acqua et al., 2023).

Assessment and Timely Feedback

McIntosh (2023) and Crompton and Burke (2023) discuss GAI's transformative role in personalizing student assessments and crafting questions that align with individual learning styles. These GAI-driven approaches not only increase the accuracy of evaluations but also ensure inclusivity by addressing diverse student needs. Zhang et al. (2022) emphasize GAI's pivotal contribution to adaptive learning environments, where immediate, tailored feedback enhances the learning process and supports mastery learning principles. By offering real-time insights, GAI empowers educators to modify instructional strategies, optimizing the overall educational experience. This capability underscores GAI's role in aligning assessments with modern pedagogical goals, improving both engagement and outcomes.

Mastery Learning: A Foundational Framework

GAI is driving a shift in educational strategies, necessitating alignment with foundational principles like Bloom's (1968) mastery learning framework. Bloom's model ensures that students achieve a specific level of competence before progressing, fostering deeper comprehension and skill acquisition. Adiguzel et al. (2023) argue that integrating GAI with mastery learning principles enhances personalized and adaptive learning strategies, allowing for more precise interventions tailored to individual progress. Johnson (2019) further supports this approach, noting the positive impact on student achievement and engagement. This integration not only reinforces the foundational ideals of mastery learning but also introduces a modernized approach to achieving educational excellence by embracing GAI technology.

Technology Acceptance Model

The Technology Acceptance Model (TAM), developed by Davis (1989), is a foundational framework for understanding technology adoption. TAM posits that perceived usefulness (PU) and perceived ease of use (PEOU) shape users' attitudes toward adopting new technologies. Recent studies, such as Al-Emran et al. (2018), validate TAM's effectiveness in predicting e-learning adoption, particularly in higher education, and underscore its relevance in contemporary research. By addressing user attitudes and barriers, TAM offers a framework for enhancing the adoption of innovative AI technologies in education. However, alongside adoption factors, ethical challenges, particularly those related to academic integrity, must be addressed to ensure responsible implementation.

Academic Integrity

Balancing the use of GAI with traditional teaching methods is crucial to transforming higher education while addressing challenges such as academic integrity and intellectual development (Gibson, 2023). GAI tools can make it easier for students to cheat by having the tools generate answers or complete assignments for them. Using GAI tools may undermine the integrity of assessments and the validity of grades, making it difficult to accurately measure a student's knowledge or abilities. Reliance on GAI may hinder the development of critical thinking, creativity, and original thought while reducing student effort and engagement with learning material. GAI-generated content may perpetuate bias and misinformation, compromising the educational experience (Cotton et al., 2023).

Research Foundations

The literature highlights GAI's potential to enhance personalized learning, adaptive assessments, and instructional efficiency, while also presenting challenges such as ethical concerns, academic integrity, and equitable access. However, much of the existing research was not specific to higher education, and limited studies have explored the direct impact of GAI on teaching and learning practices. Additionally, few studies have examined specific GAI tools that can be valuable in higher education. This study examines how faculty perceive and manage these benefits and risks, aiming to inform strategies for responsible and effective GAI integration in higher education. The following section outlines the methodology used to investigate faculty perceptions of GAI.

Research Methods

Theoretical Framework and Mixed Methods Approach

This research adopts a mixed methods approach, merging a structured survey with quantitative and qualitative data to evaluate GAI tools' effectiveness in higher education (Creswell & Creswell, 2003). Grounded in the Technology Acceptance Model (TAM), this study focuses on faculty perceptions, experiences, and the challenges and benefits of AI integration. TAM provides the theoretical framework for understanding how perceived usefulness and ease of use impact faculty adoption of GAI tools.

The researchers developed the Impact of GAI Tools in Higher Education Survey, which was used as the survey instrument for this study. The survey design includes both quantitative and qualitative components. The quantitative section consists of seven Likert-scale questions aimed at measuring faculty perceptions of incorporating GAI tools in higher education. The qualitative section contained two open-ended questions designed to gather insights into faculty experiences of the benefits and challenges of using GAI tools for teaching and developing courses. The qualitative section also was used to gather information on the GAI tools that faculty find useful.

The target population for this study was higher education faculty with experience utilizing GAI tools. Participants were recruited using a voluntary response sampling approach, specifically targeting faculty members actively engaged with GAI technologies. The survey was distributed online via LinkedIn, where faculty meeting the specified criteria were invited to participate voluntarily. This sampling method relies on self-selection, with participants choosing to participate based on their eligibility with the study's criteria. A key advantage of this approach is the ability to facilitate efficient data collection from a targeted audience with specific experience.

Content validity was established by aligning survey items with the Technology Acceptance Model (TAM) and consulting subject matter experts to ensure comprehensive coverage of faculty perceptions of GAI tools (Creswell & Creswell, 2023). Subject matter experts also reviewed the survey for clarity, question relevance, and functionality to enhance reliability. Data was collected via Google Forms. Quantitative responses were analyzed using descriptive statistics and inferential techniques to identify patterns and correlations, while qualitative data underwent thematic analysis, involving coding into key concepts, themes, and patterns.

Results

Twenty-one higher education faculty who utilize GAI participated in this survey. The survey asked participants to rate the effectiveness of GAI tools in higher education for seven categories depicted in Figure 1.

Figure 1
Survey questions on the effectiveness of GAI tools in higher education

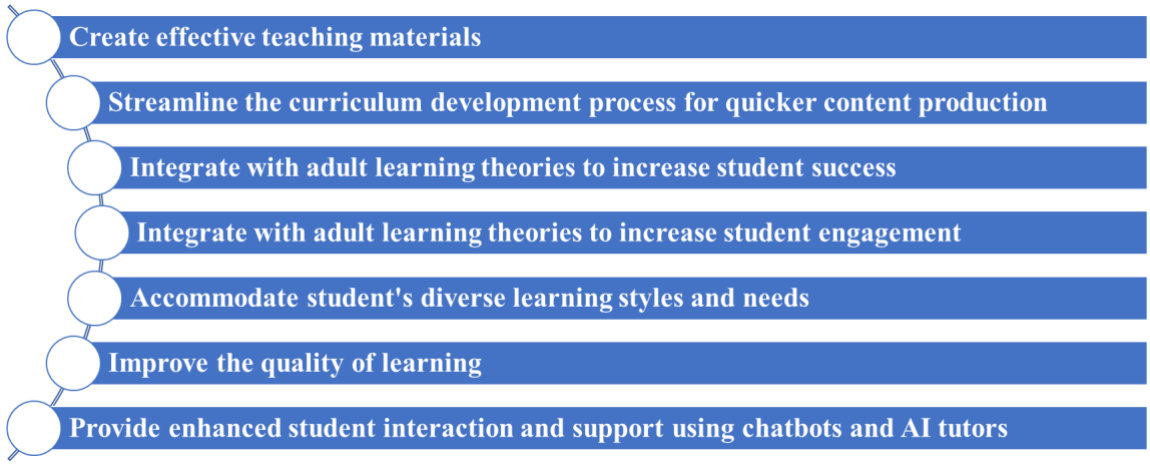


Figure 2 shows that 80.95% of respondents strongly agree that GAI streamlines curriculum development for quicker content production, making this the highest-ranked category in the survey. Additionally, 71.43% strongly agree on GAI's efficacy in creating effective teaching materials and integrating with adult learning theories to increase student success. Respondents recognize that GAI can improve the quality of learning and integrate with adult learning theories to increase student engagement, with 66.67% strongly agreeing on its effectiveness. While only 57.14% strongly agree on GAI's capability to provide enhanced student interaction and support using chatbots and GAI tutors and 52.38% strongly agree on GAI's ability to accommodate diverse learning styles, combining 'strongly agree' and 'agree' responses presents a more favorable overall view, as detailed in the following section.

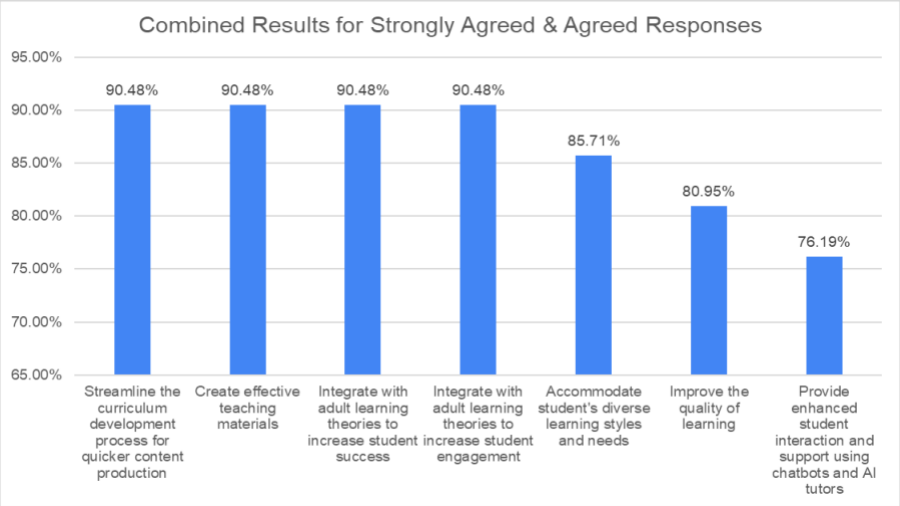
Figure 2
Survey results - Effectiveness of incorporating GAI tools in higher education

Categories	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Streamline the curriculum development process for quicker content production	80.95%	9.52%	9.52%	0.00%	0.00%
Create effective teaching materials	71.43%	19.05%	4.76%	0.00%	4.76%
Integrate with adult learning theories to increase student success	71.43%	19.05%	0.00%	9.52%	0.00%
Integrate with adult learning theories to increase student engagement	66.67%	23.81%	0.00%	9.52%	0.00%
Improve the quality of learning	66.67%	14.29%	9.52%	4.76%	4.76%
Provide enhanced student interaction and support using chatbots and GAI tutors	57.14%	19.05%	14.29%	0.00%	9.52%
Accommodate student's diverse learning styles and needs	52.38%	33.33%	4.76%	9.52%	0.00%

Combining 'strongly agree' and 'agree' responses in the survey yields overwhelmingly positive results, with all categories scoring 76.19% or higher, as depicted in Figure 3. Notably, 90.48% of respondents view GAI's ability to streamline curriculum development, create teaching materials, and integrate with adult learning theories to increase student success and engagement as the most valuable impact of GAI in higher education.

The results also indicate that GAI can accommodate student's diverse learning styles and needs and improve the quality of learning. The least ranked category, still notably high at 76.19%, pertains to using chatbots and GAI tutors to enhance student interaction and support.

Figure 3
Strongly agree & agree responses - Effectiveness of incorporating GAI tools



Qualitative data from the survey highlights the benefits and concerns associated with GAI in higher education. It sheds light on various applications of GAI tools, from course content development to interactive presentations, underscoring their efficiency and time-saving features. These insights reveal the potential of GAI to enhance teaching and learning alongside challenges that need addressing. The responses illustrate the broad spectrum of available GAI tools and their adaptability in higher education, emphasizing their contribution to curriculum development.

GAI Tools that are Beneficial in Higher Education

The participants mentioned that the following GAI tools benefit teaching and learning in higher education (Figure 4). Large language models were noted as being the most valuable tool for learning. These tools enable machines to understand, interpret, and generate human-like language. ChatGPT emerged as the most cited valuable tool by 57% of the respondents, with Anthropic Claude and Gemini in succession at 24%.

Figure 4
Participants comments regarding valuable GAI tools

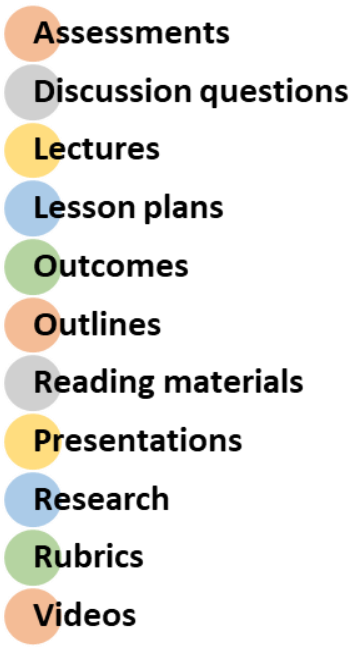
GAI Tool	Category	Comments Made by Participants
Adobe Firefly	Images	• Generates images, text effects, and other content • Integrates with Adobe's suite of creative tools
Claude	Large language model	• Assists with generating written content like articles and reports • Helps users brainstorm ideas and draft content • Creates outlines for lectures • Helps create course content
Beautiful.ai	Presentations	• Creates professional presentations quickly
Bing Chat	Search engine	• Research tool • Finds information quickly • Integrated into the Bing search engine
ChatGPT	Large language model	• Helps create course content and learning materials • Creates outlines for lectures/seminars • Rephrases sentences to clarify thoughts and ideas • Helps draft essays, articles, and research papers • Explains concepts and can help solve problems

ChatGPT with custom GPTs	Large language model	● Creates customized versions of the ChatGPT model tailored to specific needs, preferences, or tasks
ChatPDF	Summarization	● Summarizes PDF files ● Answers questions about the content of a PDF
ClassPoint GAI	Teaching and learning tools	● Creates quizzes, polls, and multiple-choice questions into PowerPoint slides
Colossyan	Video creation	● Generates professional-looking videos using virtual actors, text-to-speech technology, and customizable templates
Gamma	Presentations	● Creates engaging, interactive, and visually appealing presentations, documents, and reports
Gemini (formerly Bard)	Large language model	● Rewords sentences to clarify thoughts and ideas ● Helps draft essays, articles, and research papers ● Explains concepts and solves problems
Grammarly	Writing assistant	● Helps improve their writing ● Suggestions for grammar, spelling, clarity, tone, and style
Heygen	Video creation	● Generates professional-looking videos using virtual avatars and text-to-video technology
Magic School App	Teaching and learning tools	● Creates lesson plans, assessments, academic content, and rubrics
Office 365 with ChatGPT	LLM integration	● Integration of an LLM into an application ● Automates tasks and generates content
Perplexity.ai	Search engine	● Answers queries using natural language predictive text, utilizing sources from the web
SlidesAI.io	Presentations	● Creates presentation slides quickly and efficiently
Synthesia	Video creation	● Converts text into videos quickly

Respondents found GAI tools beneficial for various tasks, including course content creation, writing, and research. The specific preferences for tools depend on the user's needs. Some tools were valued for their efficiency and time-saving capabilities, while others were valued for contributing to visual content creation or interactive presentations. The survey highlights the diversity of tools available and their versatile applications in teaching and course development.

As depicted in Figure 5. GAI tools were found to be highly beneficial for rapidly developing course content, presentations, and videos. GAI tools can help educators quickly and easily create lectures, assessments, rubrics, and other course learning materials. GAI tools are used as writing assistants and for conducting research, with large language models instrumental in these areas. These findings suggest that GAI tools significantly enhance productivity and efficiency in higher education, making it a valuable resource for educators.

Figure 5
How educators use GAI tools



Below is a summary of key points mentioned by the participants in this study.

Benefits:

1. **Streamline Course Development:** Participants noted that GAI tools simplify and accelerate course creation. Centralized models involving faculty, subject matter experts, and designers are often resource intensive. With GAI, educators can independently create high-quality courses, reducing the need for extensive collaboration and saving time and resources, while maintaining the quality typically achieved through larger development teams.

2. **Efficiency and Time Saving.** Participants mentioned that GAI tools enable the rapid creation of educational content, presentations, and videos, significantly reducing the time required compared to traditional methods. This efficiency allows educators to focus on enhancing material quality, engaging with students, and ensuring content remains relevant. While developing a new course traditionally takes weeks or months, GAI tools empower faculty to complete this process in under a week. This accelerated course development benefits institutions by enabling the quick launch of new programs, helping them stay competitive. By streamlining workflows, GAI tools ensure curricula are current, preparing students effectively for the evolving job market.

3. **Prompt Support:** Respondents noted that chatbots can be implemented into courses to offer students 24/7 assistance, promptly answer questions, and increase accessibility. Chatbots ensure that students can receive support outside of regular classroom hours, helping them reinforce learning and stay engaged with the course material. By providing quick and accurate answers, chatbots reduce the dependency on faculty for routine questions, allowing educators to focus on other teaching tasks.

4. **Creativity and Personalization:** Respondents noted that GAI tools can assist with developing creative and personalized educational materials to present information and engage students. Some GAI tools can analyze student data to customize instruction based on individual learning needs and preferences, providing a more effective and customized learning experience. Many publishers offer tools bundled with textbooks that utilize personalized and adaptive learning experiences.

Challenges:

1. **Accuracy of GAI-Generated Content:** Participants highlighted the risk that GAI-generated content could contain errors, misinformation, or biased perspectives, which could undermine the quality of the information presented in courses. Maintaining high standards of information integrity is essential in an educational setting, as course content must be accurate. The reliability and trustworthiness of GAI tools are critical to ensuring that the information produced meets these standards.

2. **Impact on Critical Thinking:** Using GAI tools raises concerns about students' diminishing critical thinking skills. While GAI tools can help students learn the material, educators must ensure that students understand it and can complete their assessments independently without relying on these tools. Educators should reconsider their assessment strategies to encourage critical thinking while finding ways to prevent students from using GAI tools to complete their assessments.

3. **Lack of Faculty Training:** Participants raised concerns about the need to be adequately trained on the various tools. Proper faculty training is essential to ensure that GAI tools are used responsibly and effectively in the classroom. Training programs should utilize GAI tools to improve learning, personalize education, develop curriculum, and engage students. The training should address ethical considerations, such as preventing bias and maintaining academic integrity.

4. **Lack of Guidance and Direction:** Participants raised concerns about the lack of direction from educational institutions on implementing and using GAI tools in the teaching and learning process. Educational institutions should develop a guidance policy on how faculty and students should use these tools responsibly to prevent the misuse of these tools and enhance the overall educational experience in the classroom.

5. **Cost and Implementation**: Implementing GAI tools in classrooms can be costly, creating financial challenges for institutions and faculty. While some free tools exist, they often lack essential features for practical use. Institutions must carefully evaluate which tools to provide, as they are critical for enhancing teaching and learning. Many participants noted paying for GAI tools themselves, which is unsustainable. Faculty expressed concerns that without institutional support, they might be unable to afford these tools, limiting their ability to use them effectively. To address this issue, educational institutions must allocate resources to ensure fair access for faculty. Providing institutional support is crucial for leveraging GAI tools to enhance teaching, learning, and the overall academic experience.

The Future of Higher Education

Many participants in this study were concerned about the potential impact of GAI on the future of higher education. Faculty questioned what this future might look like in higher education. Will new pedagogies be developed? Will assessment methods need to evolve? Due to this changing landscape, some participants expressed concerns about the future roles of faculty members, instructional designers, and other staff members at educational institutions.

How will the classroom change with the integration of GAI tools? Adopting GAI technologies may compel educational institutions to completely rethink education, as it can transform traditional teaching methods and alter how faculty teach and assess students. Educators might shift their focus from delivering information to fostering critical thinking, creativity, and problem-solving skills. This change may necessitate reevaluating assessment methods, as traditional exams and assignments may no longer effectively measure student understanding. Instead, educators might consider other assessment techniques, such as project-based learning, real-world problem-solving, and hands-on presentation, to assess the learning outcomes.

Ethical Concerns

Participants expressed ethical concerns about using GAI tools in higher education, particularly regarding academic integrity and plagiarism. Students might submit GAI-generated content as their own or use these tools to cheat on assignments and exams, prompting faculty, especially in online education, to consider proctored assessments. Additionally, GAI tools may generate inaccurate information or be trained on biased data, further complicating their ethical use. Data privacy also emerged as a concern, as some tools collect user data, raising questions about the security and misuse of sensitive information. To address these

challenges, institutions could develop clear guidance documents promoting the responsible and ethical use of GAI tools in educational settings.

Participants are concerned that some institutions lack the financial resources to obtain GAI tools, placing their faculty and students at a disadvantage compared to other well-funded institutions. Students who attend institutions with socio-economic disparities may not benefit from GAI tools due to limited implementation and access within their schools. This disparity can lead to unequal learning experiences for students. Ensuring equitable access to GAI tools, establishing clear policies on GAI usage, and providing inclusive training may help educational institutions maximize the benefits of GAI tools while mitigating these risks.

Limitations of the Study

A limitation of this study was the small sample size, which may impact the reliability and validity of the findings. This constraint could have been influenced by the limited number of faculty in higher education institutions currently integrating GAI tools in their teaching practices. As generative GAI adoption increases, future studies with larger samples may provide a broader understanding of faculty perceptions and the impact of GAI tools on teaching and learning.

Implications

The cost of implementing GAI tools can be significant. Educational institutions should provide these tools to faculty to encourage widespread adoption and better support teaching and learning. If faculty must cover the expense, many may be unable to afford them, limiting their effectiveness. Institutions must evaluate and select GAI tools that most effectively enhance the learning experience for students while ensuring accessibility for faculty. Developing faculty training programs is critical for successful implementation, and further research is essential to identify best practices in teaching and course design. Understanding student perceptions and experiences with GAI tools is equally important for improving learning outcomes.

GAI tools streamline curriculum development by reducing the time required to create and revise courses. This efficiency allows institutions to introduce new programs and courses quickly, staying competitive in a dynamic educational landscape. Higher education may also need to rethink traditional curriculum development processes and team roles. If GAI tools can efficiently perform tasks traditionally handled by instructional and media designers, the need for these roles could decrease. By leveraging GAI, institutions can maintain relevant and competitive curricula while potentially reducing resource demands.

Integrating GAI tools in the classroom may require rethinking teaching and assessment strategies. Since GAI tools could enable cheating, educators may need to shift to hands-on assessments, project-based learning, and real-world problem-solving tasks. These approaches ensure academic integrity while leveraging GAI to improve teaching methods and enhance the educational experience for both faculty and students.

Conclusion

This study addresses the research question: What are the perceptions and experiences of higher education faculty regarding the impact of GAI tools on teaching and learning? Results reveal a positive stance on GAI, with 80.95% affirming its effectiveness in curriculum development and 71.43% in creating impactful teaching materials and promoting student success. GAI's ability to address diverse learning needs and streamline educational processes received broad support, as reflected in the combined 'strongly agree' and 'agree' responses. Qualitative feedback highlights benefits in course development, efficiency, and student support while raising concerns about content accuracy, critical thinking, faculty training, costs, ethical use, and administrative guidance. Participants emphasized the adaptability of various GAI tools and their potential to enhance educational practices.

As educational institutions adapt to the future of learning, additional research is necessary to fully understand the impact of GAI tools on teaching and learning. Faculty training is critical to ensure educators are motivated and well-prepared to integrate these tools effectively. Concerns about critical thinking, dependency on technology, and academic integrity necessitate reexamining strategies to maintain genuine learning outcomes. Additional studies should also explore how students engage with GAI tools and the perceived impact on their learning experiences.

This research lays the groundwork for future studies by identifying key benefits and challenges in GAI integration. Further research should validate these findings with larger sample sizes and explore the long-

term implications of GAI on teaching methods, course design, and student engagement. As new GAI tools emerge, studies should assess their impact on curriculum development, faculty roles, and the overall structure of higher education. Understanding these effects will help institutions harness the potential of GAI while addressing its challenges, ensuring high-quality education in an evolving digital world.

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