

Optimizing Student Success: The Impact of Generative AI in Teaching and Learning

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Abstract: This study investigates the transformative potential of generative artificial intelligence (AI) in reshaping educational methodologies in higher education course design to enhance student success. Integrating AI technologies into teaching and learning presents opportunities for personalized and adaptive learning experiences. Centered on mastery learning course design, this study investigates how AI tools can streamline curriculum development, generate impactful teaching materials, and enhance student success and engagement. The research explores the development of effective and inclusive course curricula, improving learning outcomes, catering to diverse learning styles, and enhancing student engagement and motivation. Through a review of existing literature and an analysis of survey results, the research highlights synergies between AI tools and educational best practices, addressing both benefits and challenges. The study concluded that incorporating AI is beneficial for streamlining the curriculum development process for quicker content production, creating effective teaching materials, and improving student success. Recommendations for optimal teaching and learning best practices to maximize the transformative capacity of generative AI in higher education are offered. These insights provide valuable perspectives on how AI tools influence course design, teaching, and student success.

Purpose

Artificial intelligence (AI) is reshaping higher education, with generative AI tools like ChatGPT enhancing curriculum development and student engagement. These tools are pivotal in creating personalized educational content, a critical factor in mastery learning and student success (Gibson, 2023; Pratama et al., 2023). AI technologies offer personalized learning experiences through chatbots, predictive analytics, and automation of administrative tasks, benefiting educators and learners. Additionally, AI provides insights into student performance, supporting data-driven course adjustments (McIntosh,

2023; Pratama et al., 2023). While AI's transformative potential in education is evident, it is crucial to balance its use with traditional teaching methods and address challenges such as academic integrity and intellectual development (Gibson, 2023). This study aims to answer the following research question: What are the perceptions and experiences of higher education faculty using generative AI tools to influence the development of online courses?

This study examines AI tools for creating course materials suited to varied learning styles, enhancing education's flexibility and inclusivity (McIntosh, 2023). It evaluates AI's role in personalizing learning, course design, and engaging students and faculty, aligned with mastery learning principles. Focusing on AI-driven chatbots for personalized academic support, the research highlights how AI improves student interaction and learning experiences, contributing to student success, process efficiency, personalized and inclusive content (Adiguzel et al., 2023; Sharma, 2023).

Literature Review

AI is transforming education, requiring educators to align AI capabilities with Bloom's (1968) mastery learning and course design principles (Adiguzel et al., 2023). AI can serve as an administrative and teaching tool, enhance scalability, cost-effectiveness, and adaptivity, thereby improving the student learning experience. AI-enhanced educational technology scaffolds learning, augments human capabilities, and fosters skill acquisition. It enhances teaching by provides automated support, personalized assistance, and tailors curricula to each student's needs (Dickey & Bejarano, 2023; U.S. Department of Education, 2023).

Mastery Learning: A Foundational Framework

Bloom (1968) emphasizes that master learning ensures every student attains a predetermined level of competence before progressing to the next level of instruction. This concept underpins modern debates on personalized and adaptive learning, with Johnson (2019) noting its positive effects on student achievement and engagement.

Artificial Intelligence (AI)

As posited by Sowa et al. (2021) and further substantiated by Dell'Acqua et al. (2023), the use of generative AI in business significantly boosts task execution by 12.2%, cuts task completion time by 25.1%, and enhances output quality by over 40% across varied task complexities within set experimental durations, highlighting AI's profound impact on productivity and quality in professional environments. AI promotes skill development in communication and collaboration. In education, it enhances teaching and learning through innovative, personalized approaches. AI's integration in instructional design leverages data for improved learning environments and outcomes, fostering student engagement (Chng, 2023).

Generative AI in Mastery Learning and Course Design

Generative AI, highlighted by Hernandez and Liu (2023), revolutionizes education through personalized learning pathways, increasing student engagement and success (Pratama et al., 2023). It bridges the gap between student needs and educational content (Lee & Nguyen, 2020), enabling faculty to continuously adapt and enhance course materials, thus aligning with personalized mastery learning principles. Gibson (2023) notes that AI influences instructional and course design, integrating tools like speech recognition, plagiarism detection, and video editing. These tools facilitate innovative course development, aligning learning outcomes, personalizing assessments, and enhancing overall design. Figure 1 is a graphical depiction of the impact of AI on instruction design, according to Gibson (2023).

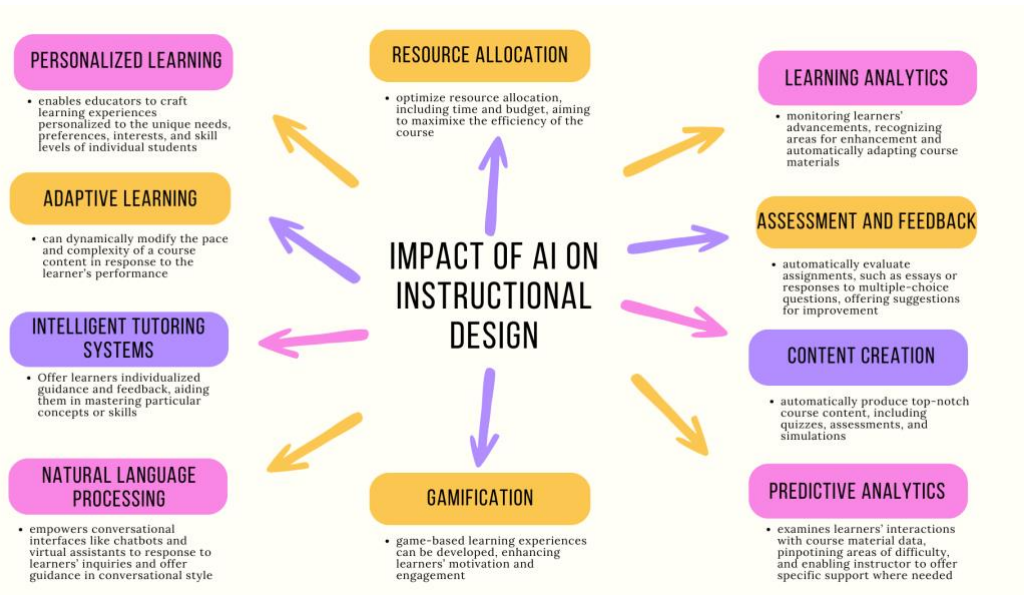


Figure 1: Impact of AI on instructional design.

Chatbots

AI transforms the vision of a virtual tutor, accessible anytime, into reality, redefining learning approaches with chatbot systems (Sharma, 2023). These AI-enabled courses offer insights into student engagement, allowing course modification based on data analysis. As McIntosh (2023) indicated, AI tutors provide personalized academic assistance, adapting to each student's progress.

Adaptive Assessments and Timely Feedback

McIntosh (2023) and Crompton & Burke (2023) discuss AI's transformative role in personalizing student assessments and crafting questions that adapt to unique learning styles, thereby increasing the accuracy and inclusivity of evaluations. This innovation in assessment aligns with educational goals, illustrating AI's crucial role in enhancing

educational effectiveness and inclusivity. Zhang et al. (2022) highlight AI's essential contributions to adaptive learning environments, offering immediate, tailored feedback crucial for mastery learning. Echoing this sentiment, Luckin (2018) emphasizes the necessity of AI in developing personalized, adaptive educational experiences suited to 21st-century demands. Pane et al. (2015) stress the importance of generative AI in aligning personalized learning with mastery principles and designing courses that optimize student success. Despite potential challenges and ethical issues, the collective research underscores AI's significant potential to revolutionize education, boosting student engagement and achievement.

Theoretical Framework and Mixed Methods Approach

This research adopts a mixed methods approach, merging a structured survey with quantitative and qualitative data to evaluate AI tools' effectiveness in higher education course development and instruction. It focuses on faculty perceptions, experiences, and the challenges and benefits associated with AI integration. The quantitative part involves Likert-scale questions assessing AI's efficacy, while the qualitative segment includes open-ended responses for in-depth analysis. A thematic analysis of these responses uncovers key patterns and themes, offering a detailed perspective on AI's influence on course design and student success. The subsequent sections detail the survey instrument and explore the findings from the quantitative and qualitative aspects of the study.

Results

Twenty-one higher education faculty who utilize AI participated in this survey. The survey asked participants to rate the effectiveness of AI tools in higher education for seven categories depicted in Figure 2.

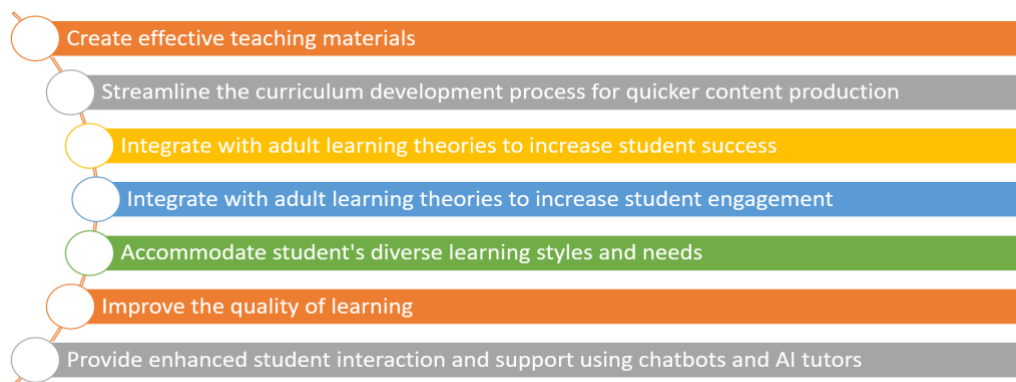


Figure 2: Survey questions on the effectiveness of AI tools in higher education.

As depicted in Figure 3, survey results reveal a consensus among higher education professionals on the effectiveness of AI tools in various aspects. There is strong agreement on AI's role in streamlining curriculum development, producing effective teaching materials, and enhancing student interaction. Respondents recognize AI's benefits in facilitating quicker content production, supporting diverse learning styles, and integrating with adult learning theories to boost student success and engagement. The

findings show minimal disagreement, underscoring AI's positive impact on the quality of learning in higher education.

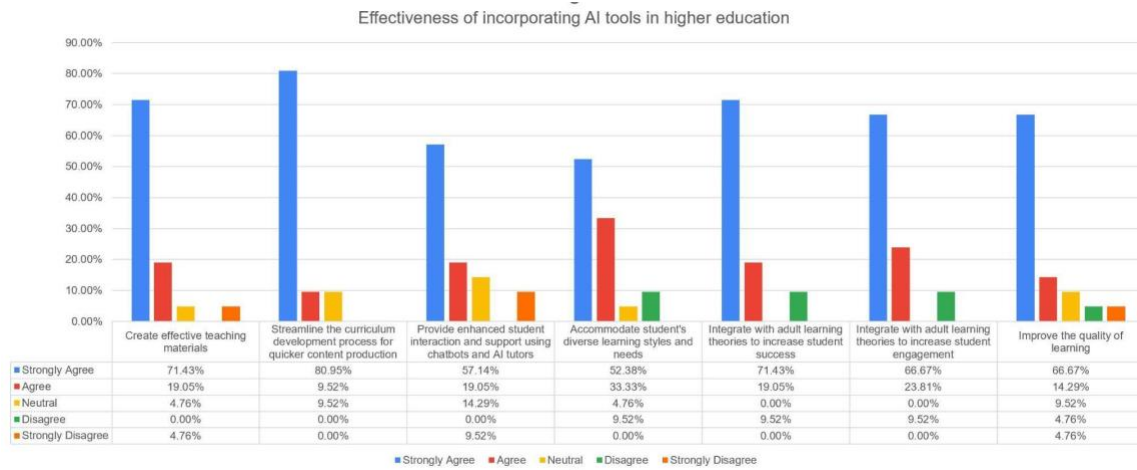


Figure 3: Survey Results - Effectiveness of incorporating AI tools in higher education.

The survey results reveal that 80.95% of respondents strongly agree that AI streamlines curriculum development for quicker content production. Additionally, 71.43% strongly agree on AI's efficacy in creating effective teaching materials and enhancing student success through adult learning theories, as shown in Figure 4. While only 52.38% strongly agree on AI's capability to accommodate diverse learning styles, combining 'strongly agree' and 'agree' responses presents a more favorable overall view, as detailed in the following section.

Category	Percentage
Streamline the curriculum development process for quicker content production	80.95%
Create effective teaching materials	71.43%
Integrate with adult learning theories to increase student success	71.43%
Integrate with adult learning theories to increase student engagement	66.67%
Improve the quality of learning	66.67%
Provide enhanced student interaction and support using chatbots and AI tutors	57.14%
Accommodate students' diverse learning styles and needs	52.38%

Figure 4: Strongly Agree - Distribution and significance of each category.

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 5. Notably, 90.47% of respondents recognize AI's effectiveness in creating teaching materials, expediting curriculum development, and integrating with adult learning theories for student success. The least ranked category, still notably high at 76.19%, pertains to using chatbots and AI tutors to enhance student interaction and support.

Effectiveness of Incorporating AI Tools

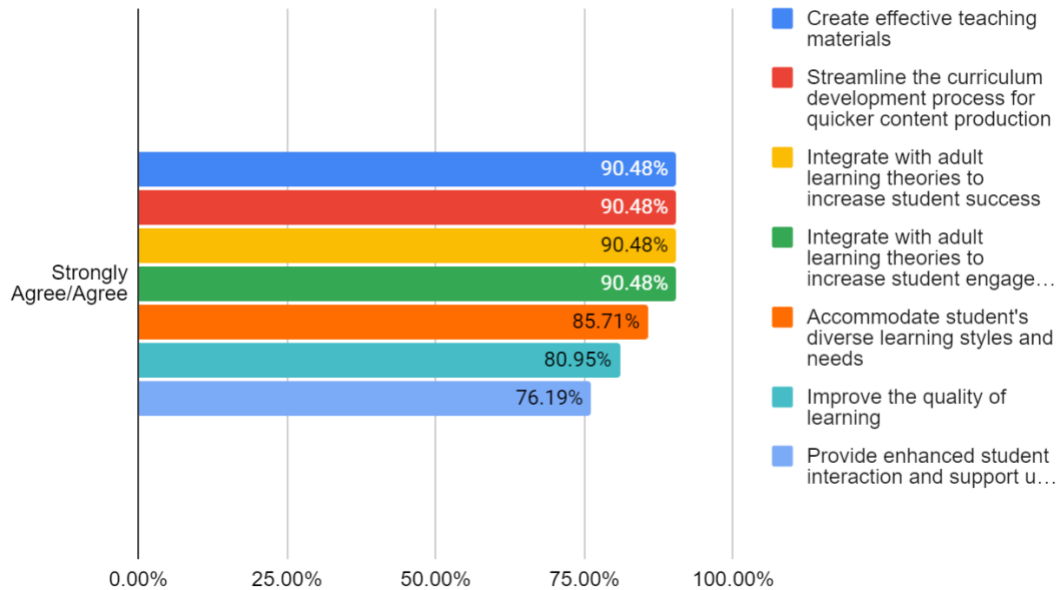


Figure 5: Strongly Agree & Agree Responses - Effectiveness of incorporating AI tools.

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

Below is a summary of key points identified in the study.

Benefits:

1. **Streamline Course Development:** AI tools expedite course design and development, conserving time, and resources.
2. **Efficiency and Time Saving.** Faculty can create educational content, presentations, and videos more quickly.
3. **Prompt Support:** Chatbots offer students 24/7 assistance, promptly answering questions and increasing accessibility.
4. **Creativity and Personalization:** Chatbots provide students with round-the-clock assistance, swiftly answering queries and boosting learning accessibility.

Challenges:

1. **Accuracy and Verification:** AI tool accuracy requires verification to avoid compromising information quality.
2. **Impact on Critical Thinking:** AI use raises concerns about diminishing critical thinking and student cheating.
3. **Faculty Training:** Faculty need training on AI tools and best practices for effective teaching integration.
4. **Lack of Guidance/Direction:** Proper guidance is essential to prevent misuse of AI tools. Concerns were raised about the lack of direction from universities and administrators. While discussions of AI are ongoing, more actions need to be taken to address how to incorporate AI into the teaching and learning process.

List of AI Tools that are Beneficial in Higher Education

The participants mentioned that the following AI tools, depicted in Figure 6, are beneficial for teaching and learning in higher education. Natural Language Processing (NLP) tools were mentioned as valuable to 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 Google Bard in succession at 24%.

Adobe Firefly	Provides different visual examples of ideas and quickly creates images without having experience with the tools.
Anthropic's Claude	Use for writing. Very concise and professional.
Beautiful.ai	Create presentations
Bing Chat	Use for research
ChatGPT	Creates course content and learning materials. Create outlines for seminars. Rewords or rephrase sentences to help clarify thoughts and ideas.
ChatPDF	Summarize PDF files.
ClassPoint AI	Generate questions from PowerPoint presentations.
Claude 2	Create outlines for seminars and course structure
Coloyssan	Create multimedia/video presentations.
Google Bard	Helps reword or rephrase sentences to help clarify thoughts and ideas
Heygen	Used for videos and voice

Figure 6: Additional insights about AI tools mentioned.

Overall, respondents find generative AI tools beneficial for various tasks, including content creation, writing, and research. The specific preferences for tools depend on the user's needs. Some tools are valued for their efficiency and time-saving capabilities, while others are acknowledged 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.

Implications

Additional research is essential to identify optimal AI practices in teaching and course design, alongside developing faculty training on AI tools. Understanding student perceptions and experiences with AI tools is key to improving its educational use and impact on learning outcomes. This student-centric approach promotes transparency and collaborative decision-making regarding the integration of AI in education.

As this exploratory research progresses, ethical considerations, including data privacy, the autonomy of educators, and the preservation of critical pedagogical discourse, remain at the forefront of the study. The insights gleaned so far are just a glimpse into a broader dialogic process that seeks to harness AI's potential while navigating its complexities as they pertain to optimizing student success through teaching and learning methodologies that integrate AI into higher education course design.

Conclusion

The findings of this study address the following research question: What are the perceptions and experiences of higher education faculty using generative AI tools to influence the development of online courses? The study results reveal a generally positive stance on AI's role in education, with 80.95% strongly affirming its effectiveness in curriculum development and 71.43% in creating impactful teaching materials and promoting student success. The study highlights AI's capacity to cater to diverse learning needs and streamline educational processes. The combined 'strongly agree' and 'agree' responses across all categories underscore the favorable perception of AI's integration in higher education.

Qualitative feedback points to AI's benefits in course development, efficiency, and student support, but also flags concerns about accuracy, critical thinking, faculty training, and administrative guidance. The variety of AI tools mentioned by participants reflects the technology's adaptability in enhancing educational practices.

This ongoing research aims to broaden the understanding of AI's educational implications, focusing on ethical considerations such as data privacy, educator autonomy, and critical pedagogy. The study is a precursor to more extensive research in the evolving tech landscape, emphasizing the need for ethical vigilance as AI becomes more entrenched in educational frameworks. These preliminary insights contribute to a larger conversation on responsibly leveraging AI's potential in education while addressing its challenges.

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