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IMPLEMENTATION AND IMPACT OF ARTIFICIAL INTELLIGENCE GENERATED CONTENT (AIGC) IN HIGHER EDUCATION: A SYSTEMATIC REVIEW

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Abstract:

The rapid development of artificial intelligence technology has ushered in a new era of content generation, with artificial intelligence generated content (AIGC) emerging as a transformative force in higher education. This systematic review aims to synthesize current research findings on AIGC applications in higher education, focusing on empirical studies published between 2023 and 2024, to understand its implementation patterns, impacts, and challenges. Using three major academic databases, this study identified and analyzed 29 peer-reviewed articles that met our inclusion criteria. The findings reveal both significant opportunities and challenges: while AIGC demonstrates remarkable potential in enhancing learning engagement and outcomes across various disciplines, particularly in programming, digital design, and critical thinking development, its effectiveness varies considerably depending on factors such as disciplinary context, user characteristics, and technological infrastructure. Trust emerges as a crucial mediating factor in AIGC adoption, with studies showing a gradual transformation from initial skepticism to effective utilization among students. The review concludes that successful AIGC integration requires careful consideration of both technical capabilities and psychological factors, suggesting the need for balanced implementation strategies that maximize educational benefits while addressing potential limitations in accuracy, creativity development, and critical thinking.

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Keywords:

Artificial Intelligence Generated Content (AIGC), Higher Education, Learning Outcomes, Empirical Research

Introduction

The rapid development of artificial intelligence technology has ushered in a new era of content generation, with artificial intelligence generated content (AIGC) emerging as a transformative force in various fields, including education (Chan & Hu, 2023). In 2022, the breakthrough success of applications like ChatGPT, Midjourney, and Stable Diffusion marked AIGC's entry into mainstream consciousness, signaling a significant shift in how content can be created and utilized in educational contexts. This technological advancement has sparked widespread interest in understanding its implications for teaching and learning in higher education.

Recent studies have demonstrated diverse applications of AIGC across different academic disciplines in higher education (Rudolph et al., 2023). From enhancing programming education through intelligent tutoring systems to facilitating art and design learning through AI-generated content, AIGC tools are reshaping traditional pedagogical approaches. These technologies not only assist in content creation and delivery but also offer new possibilities for student assessment and feedback provision (Crompton & Burke, 2023). However, the effectiveness of AIGC integration and factors influencing its adoption by students and teachers remain important areas for investigation.

While existing research has explored various aspects of AIGC in education, there is a growing need to systematically understand its implementation patterns and impacts across different disciplines (Rawas, 2024). This is particularly important given the rapid evolution of AIGC technologies and their increasing adoption in higher education. Understanding how different disciplines utilize AIGC, what factors influence its adoption, and what challenges exist in its implementation has become crucial for educational institutions and practitioners.

This review aims to synthesize current research findings on AIGC applications in higher education, focusing on empirical studies published between 2023 and 2024. By examining evidence from various academic disciplines, we seek to provide a comprehensive understanding of AIGC's educational applications, its impacts on learning outcomes, and the challenges and opportunities it presents for the future of higher education. This review is guided by the following research questions (RQ):

RQ1: What is the current status of AIGC implementation in higher education, including its applications, user attitudes, and adoption factors?

RQ2: What are the impacts, challenges, and future directions of AIGC in higher education?

Method

To systematically understand the impact of AIGC tools on higher education, this study conducts a comprehensive review of relevant empirical research. The literature search was conducted using three major academic databases: Scopus, Web of Science Core Collection

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(SCIE/SSCI), and Google Scholar. The search focused on peer-reviewed English journal articles published between January 1, 2023, and December 1, 2024. The search terms included combinations of keywords such as "artificial intelligence," "AIGC," "AI-generated content," "ChatGPT," "education," "higher education," "university," "college," "teaching," and "learning." Additionally, we conducted forward and backward citation tracking of identified articles to ensure comprehensive coverage of relevant literature.

The selection of articles followed strict inclusion and exclusion criteria. For inclusion, studies had to: (1) focus specifically on AIGC applications in higher education settings; (2) be empirical research with clearly described methodology and results; (3) include quantitative or qualitative data on learning outcomes, student attitudes, or implementation effectiveness; and (4) be published in peer-reviewed English language journals. We excluded conference papers, book chapters, theoretical papers without empirical data, and studies focused solely on technical aspects of AIGC development. Studies examining AIGC applications outside educational contexts were also excluded. The initial search yielded 487 articles, which were reduced to 29 studies after applying the inclusion/exclusion criteria and removing duplicates (Table 1).

The analysis of selected articles followed a systematic approach. First, we extracted key information from each study, including research objectives, methodology, sample size, key findings, and recommendations for future research. We then conducted a thematic analysis to identify recurring patterns and themes across studies. The analysis focused on three main aspects: (1) the types and characteristics of AIGC applications in different educational contexts; (2) the reported impacts on learning outcomes and student engagement; and (3) implementation challenges and proposed solutions. To ensure reliability, two researchers independently coded the articles, with any discrepancies resolved through discussion to reach consensus.

Results

Current Status of AIGC Implementation in Higher Education (RQ1)

To systematically understand how AIGC tools influence higher education, this section synthesizes findings from recent empirical studies published. Our review particularly focuses on examining specific applications across different disciplines and user attitudes toward these technologies. While early research primarily emphasized technical aspects, recent empirical studies have increasingly investigated pedagogical implementations and user perspectives, indicating a shift toward understanding AIGC's practical educational value.

Applications and Use Cases Across Disciplines

The application and impact of AIGC technology in higher education have attracted significant attention from the academic community. Based on systematic analysis of the literature, we present the findings across different disciplinary domains. In educational psychology, studies by Lin and Chen (2024), Jia and Tu (2024), and Obenza et al. (2024) demonstrate AIGC's role in enhancing learning engagement while identifying limitations regarding creativity and critical thinking. Huang et al. (2023) further validated this finding through their research on AI-driven personalized video recommendation systems, which showed significant improvements in

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learning performance and engagement, particularly for students with moderate levels of motivation.

In engineering education, research by Tossell et al. (2024) and Sun et al. (2024) reveals AIGC's effectiveness in programming assistance and technical skill development. Abichandani et al. (2023) complemented these findings by demonstrating how active learning techniques significantly improved students' understanding and engagement with AI/CV concepts, leading to positive outcomes in both skill acquisition and attitudes toward the subject.

In medical education, studies by Divito et al. (2024) explore how ChatGPT can enhance problem-solving skills in clinical scenarios while highlighting accuracy concerns. In chemistry education, research by Schrier (2024) and Busch et al. (2024) investigates AIGC's capabilities in solving chemical calculations, noting both potentials and limitations.

In art and design education, Jaradat (2024) demonstrates significant improvements in digital design skills through AIGC applications. This finding is further supported by Kim and Lee (2023), who investigated the impact of student-AI collaboration on creativity, expressiveness, and practicality, noting that effects vary depending on students' attitudes toward AI and their skill levels.

The development of customizable learning experiences has also emerged as a significant application area. Pesovski et al. (2024) developed a tool that automatically generates learning materials based on teacher-set learning objectives, offering content in three different styles. Student response to this diverse learning material was positive, with automatically generated quizzes being particularly well-received. These diverse applications reflect AIGC's adaptability across disciplines while also revealing discipline-specific implementation patterns and challenges.

User Attitudes Toward AIGC

Research reveals complex and nuanced attitudes toward AIGC among higher education stakeholders. A large-scale survey (N=5,894) by Stöhr et al. (2024) found significant demographic and disciplinary differences in AIGC attitudes and usage patterns. Male students in engineering and technology fields showed higher usage rates and more positive attitudes, while female students and those in humanities and medical fields demonstrated more cautious approaches. This disciplinary variation is further evidenced by Busch et al. (2024)'s multinational study of pharmacy students, which revealed that while 58% of students generally hold positive attitudes toward AI and 72% strongly desire increased AI education, they currently lack AI knowledge overall (63%) and feel underprepared (51%). These findings highlight significant differences between different groups based on factors such as gender, grade level, and technical proficiency.

Studies by Habibah (2024) and Zheng et al. (2024) indicate that while students generally hold positive attitudes toward AIGC's potential in education, they also express concerns about technological adaptability, ethical issues, and information overload. Research by Hutson et al. (2024) revealed that students' initial anxiety and distrust toward AI writing tools gradually transformed into effective and moderate use during the writing process.

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Teacher attitudes, as shown in studies by Tossell et al. (2024), emphasize the need for appropriate supervision and maintaining human involvement in educational processes. However, some teachers express concerns about AIG's accuracy and feedback limitations, particularly in assessment contexts. These findings suggest that while there is growing acceptance of AIGC tools, attitudes vary significantly based on user characteristics, disciplinary contexts, and specific use cases.

Factors Influencing AIGC Adoption

Research has identified several key factors that influence AIGC adoption in higher education settings. Multiple studies have examined both enabling and inhibiting factors that affect how students and educators embrace these technologies. Wu et al. (2024) found that ease of use positively influences students' willingness to use AIGC by affecting their attitude toward AI, which differs from traditional Technology Acceptance Model (TAM) assumptions that emphasize perceived usefulness. This finding is further supported by Pillai et al. (2024), who identified multiple influencing factors including ease of use, practicality, personalization, interactivity, trust, human-like features, and perceived intelligence. Additionally, their research revealed that students' reliance on traditional classroom teaching has a negative moderating effect on the relationship between adoption willingness and actual usage.

Trust emerges as another crucial factor in AIGC adoption. Obenza et al. (2024) demonstrated that AI trust plays a significant mediating role between college students' AI self-efficacy and their attitude toward AI. Similarly, Amoozadeh et al. (2024) found that trust in generative AI, confidence levels, and motivation to learn vary significantly, and these factors directly influence adoption patterns and learning outcomes. In the context of writing assessment, Maheshwari (2024) discovered that while ease of use primarily influences ChatGPT adoption, perceived usefulness indirectly affects adoption willingness through personalization (positively) and interactivity (negatively), though the mediating role of perceived trust and intelligence was not significant.

Technical support and institutional factors also play important roles. Studies by Chen et al. (2023) and Cao and Jian (2023) highlight the importance of institutional infrastructure and technical support in facilitating AIGC adoption. Moreover, disciplinary differences significantly impact adoption patterns, with Stöhr et al. (2024) revealing varying adoption rates across different academic fields, suggesting that disciplinary context and specific educational needs influence AIGC implementation decisions.

Impacts, Challenges and Future Directions (RQ2)

Building on the understanding of current AIGC implementation status, this section examines the educational impacts, challenges encountered, and future directions suggested by recent empirical research. The analysis reveals both promising opportunities and significant concerns that need to be addressed for effective AIGC integration in higher education.

Educational Impacts

The impact of AIGC on higher education manifests across multiple dimensions. Regarding learning outcomes, multiple studies confirm positive effects. Sun et al. (2024) found that AIGC significantly improved debugging frequency and feedback reading behavior in programming learning, while Jaradat (2024) demonstrated that AI significantly enhanced students' digital

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design skills. Ruiz-Rojas et al. (2024) discovered that 64% of students showed improved critical thinking after using AIGC tools.

These positive findings are further supported by several key studies. Ouyang et al. (2023) demonstrated that integrating AI prediction models with learning analytics significantly enhances student engagement, collaborative learning performance, and overall learning satisfaction. Habib et al. (2024) found that AI technology can significantly enhance students' divergent thinking abilities across all four dimensions of creativity assessment. However, their research also cautioned that over-reliance on AI may suppress students' independent creative thinking abilities, adding an important nuance to our understanding of AI's impact on creativity development.

However, these positive effects are not without limitations. Studies by Schrier (2024) and Busch et al. (2024) both pointed out that ChatGPT has notable deficiencies in the accuracy of chemical calculations, while Lin and Chen (2024) cautioned that AIGC might restrict creativity and trigger learning anxiety.

In terms of teaching practice, AIGC has shown potential in enhancing instructional efficiency and pedagogical innovation. Studies by Inoferio et al. (2024) demonstrate how AIGC tools can function as "tutors" and "learning partners," making learning more accessible through personalized step-by-step explanations. Huang et al. (2023) provided additional evidence in this area, showing that AI-driven personalized video recommendation systems can significantly improve learning performance and engagement, particularly effective for students with moderate levels of motivation. The technology has also impacted assessment methods, with studies by Busch et al. (2024) showing both possibilities and limitations in automated evaluation systems.

Implementation Challenges

The implementation of AIGC in higher education faces several significant challenges. Technical challenges include accuracy and reliability issues, particularly in specialized disciplines. Schrier (2024) and Busch et al. (2024) highlighted AIGC's limitations in handling complex chemical calculations, while Divito et al. (2024) noted concerns about accuracy in medical education contexts.

Pedagogical challenges emerge around maintaining academic integrity and ensuring meaningful learning. Tossell et al. (2024) emphasized the need for appropriate supervision and human involvement in educational processes. Studies by Habibah (2024) and Al-Qerem et al. (2023) identified challenges related to technological adaptability, ethical concerns, and information overload. Zhang et al. (2023) introduced another significant dimension to these challenges, finding that while 93.71% of students support using AI in higher education's ideological and political education, there are concerns about its impact on traditional values and the potential weakening of educators' subjectivity.

Institutional challenges include infrastructure requirements and the need for faculty training. Research by Chen et al. (2023) highlighted the importance of institutional support systems, while studies by Obenza et al. (2024) and Pillai et al. (2024) emphasized the need for developing trust and understanding of AIGC systems among users. Olatunde-Aiyedun (2024)

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further identified the need for developing adaptive curriculum systems focused on cultivating students' AI-related skills, particularly in science education, suggesting that successful AI integration requires substantial curricular reform.

Cross-disciplinary implementation also presents unique challenges. Kim and Lee (2023) found that the effectiveness of student-AI collaboration varies significantly depending on students' attitudes toward AI and their skill levels, suggesting the need for more nuanced implementation strategies that account for individual differences. This is further complicated by Abichandani et al. (2023)'s findings that while active learning techniques can significantly improve student engagement with AI concepts, maintaining this engagement across different disciplines and skill levels remains challenging.

Future Directions and Recommendations

Based on the reviewed literature, several key directions for future development emerge. At the technical level, researchers call for enhanced accuracy and reliability in AIGC systems. Zhao (2024) recommends larger-scale data validation, while Alabbas and Alomar (2024) emphasize the need for framework improvements.

For educational practice, Tossell et al. (2024) suggest using AIGC as a supplementary tool while maintaining appropriate supervision. Ruiz-Rojas et al. (2024) emphasize the necessity of conducting long-term tracking studies to understand sustained impacts. Regarding system integration, Pillai et al. (2024) and Wu et al. (2024) propose recommendations from the perspectives of enhancing system interactivity and exploring more influencing factors.

Policy recommendations focus on institutional support and guidelines. Zhang et al. (2023) suggest promoting deep integration between AIGC and educational curricula, while Al-Qerem et al. (2023) call for strengthening AIGC-related curriculum development. These recommendations emphasize the need for a balanced approach that maximizes AIGC's benefits while addressing potential risks and challenges.

The application and impact of AIGC technology in higher education have attracted significant attention from the academic community. To systematically understand how AIGC tools influence college students' learning processes and outcomes, this review synthesizes findings from recent empirical research. Based on our systematic analysis, we present the research findings across different disciplinary domains in Table 1, which summarizes the key studies including their research areas, sample sizes, findings, and future recommendations.

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Table 1: Applications of AI in Higher Education

Author (s)	Field	Sample	Findings	Future recommendations
Lin and Chen (2024)	Educational psychology	N=120	AI in education has a dual nature: it can enhance learning engagement through interaction and personalized design, but may also limit creativity and induce learning anxiety due to fixed frameworks. Overall, both teachers and students hold a positive attitude.	The study recommends that when applying AI systems in education, emphasis should be placed on balancing the system's structural requirements with the cultivation of creativity, while also enhancing personalization and technological stability to alleviate students' learning anxiety and optimize the learning experience.
Jia and Tu (2024)	Educational psychology	N=637	AI technology can indirectly enhance critical thinking awareness by boosting students' self-efficacy and motivation, but it does not have a significant direct impact on critical thinking awareness.	Further exploration is needed on how to cultivate students' critical thinking awareness through AI technology. Additionally, a cautious approach should be taken when developing and applying AI capabilities in the educational field, fully considering its indirect impact mechanisms.
Tossell et al. (2024)	Engineering Education	N=24	Students' perception of ChatGPT has shifted from a "cheating tool" to a "collaborative resource that requires human supervision and moderate trust." While they acknowledge its value in learning, they do not trust its ability to independently grade and express concerns about its accuracy and feedback limitations.	It is recommended to use ChatGPT as an auxiliary tool in educational settings, with appropriate teacher supervision, and to maintain human involvement in writing and grading processes to balance the advantages and limitations of AI tools.
Obenza et al. (2024)	Educational psychology	N=500	AI trust plays a significant mediating role between college students' AI self-efficacy and their attitude toward AI.	The study should further explore how to cultivate students' trust in AI within educational environments to foster a more

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Author (s)	Field	Sample	Findings	Future recommendations
				positive attitude toward AI learning and skill development.
Wu et al. (2024)	Language education	N=464	The study found that the ease of use of AI positively influences students' willingness to use it by affecting their attitude toward AI (rather than perceived usefulness), which differs from the assumptions of the traditional Technology Acceptance Model (TAM).	It is recommended that when promoting AI applications in distributed EFL learning environments, more emphasis should be placed on improving the system's ease of use and user-friendliness, rather than solely focusing on its functional value. Additionally, further research is needed to explore other potential factors influencing learners' use of AI.
Pillai et al. (2024)	Educational psychology	N=1380	The willingness to adopt T-bots is influenced by multiple factors, including ease of use, practicality, personalization, interactivity, trust, human-like features, and perceived intelligence. Additionally, students' reliance on traditional classroom teaching has a negative moderating effect on the relationship between adoption willingness and actual usage.	It is recommended that T-bot developers focus on enhancing the system's interactivity and personalization features, while strengthening its human-like characteristics. Additionally, education policymakers should fully consider these influencing factors and develop relevant policies to promote the effective and appropriate application of T-bots in the educational field.
Sun et al. (2024)	Computer education	N=82	Students using ChatGPT for programming assistance showed more active behaviors in areas such as debugging frequency, code copying and pasting, and feedback reading. Although there were no significant statistical differences in programming	It is recommended that future instructional designs thoughtfully integrate AI tools like ChatGPT, balancing students' autonomous learning abilities with AI-assisted functions. Additionally, attention should be given to students' experiences at different

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Author (s)	Field	Sample	Findings	Future recommendations
			performance compared to the autonomous programming group, students' perceptions of ChatGPT (including usefulness, ease of use, and willingness to use) significantly changed after use.	stages of using ChatGPT, in order to optimize the development and application of AI-driven programming education tools.
Zhao (2024)	Educational technology	N=649	The proposed CDBN-RFO hybrid model achieved a high accuracy of 99.34%, a low error rate of 0.152%, and an efficient computation time of 2.76 seconds in evaluating college students' comprehensive abilities, significantly outperforming existing evaluation methods.	It is recommended to conduct longitudinal studies with larger-scale data to verify the model's scalability and reliability in real educational environments. Additionally, there is a need to explore the model's ability to handle heterogeneous data across different educational contexts.
Jaradat (2024)	Art and design education	N=38	In terms of digital design skills, the experimental group using the AI application (Midjourney) performed statistically significantly better than the control group with traditional teaching methods.	It is recommended to formally adopt AI applications as an educational strategy for students in art and design schools.
Ruiz-Rojas et al. (2024)	Educational psychology	N=121	The study shows that generative AI tools have a significant effect in promoting students' critical thinking (64% of students reported improvement), while also having a positive impact on collaborative learning (60% of students indicated that the tool enhanced team cooperation). The most popular tools include Canva (33%), Chat PDF (26%), and YOU.COM (24%).	It is recommended to conduct longitudinal studies to assess the long-term impact of generative AI tools on students' collaboration and critical thinking skills. Additionally, exploring students' diverse experiences and perspectives is necessary to more effectively integrate these tools into different learning environments.

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Author (s)	Field	Sample	Findings	Future recommendations
Divito et al. (2024)	Medical education	Not stated	ChatGPT, as an auxiliary tool in medical education, can enhance students' critical thinking and problem-solving skills. However, it also faces challenges such as issues of accuracy, dependence, and ethics.	Future research should focus on optimizing the use of AI tools in medical education and exploring solutions to ethical and accuracy-related issues, in order to enhance their educational value.
Alabbas and Alomar (2024)	Educational psychology	N=200	The developed Tayseer chatbot achieved 90% accuracy in intent and entity prediction, capable of recognizing over 50 types of inquiries, significantly enhancing the efficiency of admissions counseling services.	The study recommends further refining this framework and emphasizes that the technology can be adapted to other linguistic environments, providing a replicable model for developing educational chatbots.
Pesovski et al. (2024)	Educational psychology	N=20	A tool has been developed that automatically generates learning materials based on teacher-set learning objectives, offering content in three different styles. The results show that students responded positively to this diverse learning material, with the automatically generated quizzes being particularly popular.	Although the small sample size limits the generalizability of the findings, the study recommends expanding the application of similar tools and suggests conducting larger-scale research to validate the effectiveness of AI-supported educational strategies.
Olatunde-Aiyedun (2024)	Educational psychology	N=180	There is a clear correlation between AI integration and science education. Through regression analysis and thematic analysis, the study reveals the positive impact of AI integration on student performance, while also providing a comprehensive presentation of its advantages and limitations.	It is recommended to develop an adaptive curriculum system focused on cultivating students' AI-related skills, enabling them to drive scientific innovation in Nigeria's evolving technological landscape.

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Author (s)	Field	Sample	Findings	Future recommendations
Schrier (2024)	Chemical education	N=50	ChatGPT performs well in solving acid-base calculation problems, but it still has limitations in accuracy and handling of details, and cannot fully replace the student's thought process.	Further exploration is needed to improve the accuracy of ChatGPT and to investigate how AI tools can be more effectively integrated into chemistry education to enhance students' learning experiences.
Busch et al. (2024)	Chemical education	N=10	GPT-3.5 performs poorly on salt and titration calculation problems, with accuracy rates of only 10% and 0%, respectively. Even when the correct heuristic methods are used, mathematical errors and strategic flaws still occur.	It is recommended to use the GPT-4 model combined with specific prompting techniques and calculator usage patterns, as this can fully resolve the errors in these calculation problems.
Hutson et al. (2024)	English Writing	N=28	The study found that students' initial anxiety and distrust toward AI writing tools gradually transformed into effective and moderate use of these tools during the writing process, particularly in refining arguments and developing ideas at the paragraph level.	The study recommends developing a blended writing instruction model that combines traditional writing techniques with guidance on the use of AI tools, while ensuring the maintenance of academic integrity.
Habib et al. (2024)	Educational psychology	100	The study found that AI significantly enhances students' divergent thinking (with statistically significant improvements across all four dimensions), but also revealed that over-reliance on AI may suppress students' independent creative thinking abilities.	It is recommended that future research explore how AI affects students' problem-identification skills and convergent thinking, as well as investigate the long-term relationship between students' creativity confidence levels and AI usage.
Habibah (2024)	Educational psychology	N=300	Students have a positive attitude toward the potential of AI in education, but they also	Future research should focus on addressing the technological and ethical challenges of

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Author (s)	Field	Sample	Findings	Future recommendations
			face challenges such as technological adaptability, ethical issues, and information overload.	AI usage and explore how to integrate it more effectively into educational systems to maximize its positive impact on student learning.
Inoferio et al. (2024)	Educational psychology	N=20	The study found that students are using AI models as a coping mechanism to alleviate math anxiety and boost confidence. AI, as a "tutor" and "math partner," makes math learning more accessible by providing personalized step-by-step explanations and support.	It is recommended to develop an AI-assisted learning system focused on psychological interventions and behavioral interconnection to improve students' self-efficacy in learning and boost their confidence in math learning.
Stöhr et al. (2024)	Interdisciplinary research	5,894	Students have a high level of awareness and usage of ChatGPT, but there are significant differences between groups—female students and those in humanities and medical fields tend to be more cautious, while male students and those in engineering and technology fields show higher usage rates and more optimistic attitudes.	It is recommended to develop localized AI education solutions tailored to the characteristics and needs of different student groups, providing a reference for developers, educators, and policymakers.
Zheng et al. (2024)	Educational psychology	N=18	The study found that students' different attitudes toward AI influence their preferences in analyzing and understanding AI usage. Additionally, workshops gathered various scenarios and analytical methods employed by students when using AI in Problem-Based Learning (PBL).	It is recommended to further study the ways in which students interact with AI and how to better understand AI-enhanced learning models.

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Author (s)	Field	Sample	Findings	Future recommendations
Chen et al. (2023)	Business education	215	Chatbots can assist students in learning foundational content in a responsive, interactive, and confidential manner, and can serve as an effective conversational learning tool to teach basic concepts and provide educational resources.	The study recommends exploring how chatbots can be used to support inclusive learning, while also considering the ethical implications involved.
Zhang et al. (2023)	Computer vision education	1048	The application of AI technology in ideological and political education in higher education holds significant value, with 93.71% of students supporting the use of AI in this field. However, issues such as the impact on traditional values and the weakening of the subjectivity of educators need to be addressed.	It is recommended to explore samples from more diverse disciplinary backgrounds in future studies, conduct in-depth field research, and promote the deep integration of AI with ideological and political education through pathways such as improving traditional teaching methods and developing online education.
Abichandani et al. (2023)	Computer vision education	153	Active learning techniques significantly improved students' understanding and engagement with AI/CV concepts, leading to positive outcomes in both skill acquisition and attitudes toward the subject.	The approach of integrating practical applications (such as drones) into AI/CV education is worth promoting and further researching in other institutions.
Cao and Jian (2023)	Environmental education	400	The use of AI and VR technologies in environmental education significantly enhanced students' understanding of environmental issues and encouraged them to develop eco-friendly values and participate in environmental actions.	It is recommended to integrate AI and VR technologies into environmental education to cultivate a more environmentally conscious generation.

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Author (s)	Field	Sample	Findings	Future recommendations
Kim and Lee (2023)	Art and design education	20	The impact of student-AI collaboration on creativity, expressiveness, and practicality is significant, but the effects vary depending on students' attitudes toward AI and their level of painting skills.	It is recommended that when designing educational AI systems and AI literacy programs, student individual differences (such as attitudes and skill levels) should be taken into account.
Al-Qerem et al. (2023)	Medical education	483	Students have a moderate level of awareness of AI, with complex attitudes (both skeptical about AI replacing humans and recognizing its value). However, its widespread application in medical education and practice is still limited by factors such as lack of knowledge, limited usage opportunities, time constraints, and curriculum design.	It is recommended to strengthen AI-related content in medical education, eliminate application barriers, and better harness AI's potential in patient care and medical training.
Ouyang et al. (2023)	Engineering education	62	The research results indicate that integrating AI prediction models with learning analytics significantly enhances student engagement, collaborative learning performance, and overall learning satisfaction.	It is recommended that future research expand the educational environment, curriculum subjects, and sample size to further validate the experimental results and insights. Additionally, designing automated data collection and analysis features to provide real-time feedback should be considered.
Busch et al. (2024)	Pharmaceutical education	387	Students generally hold positive attitudes toward AI (58%) and strongly desire increased AI education (72%). However, they currently lack AI knowledge overall (63%) and feel underprepared (51%). There	It is recommended to increase the proportion of AI education content in pharmacy curriculum.

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Author (s)	Field	Sample	Findings	Future recommendations
			are significant differences between different groups (such as gender, grade level, and technical proficiency).	
Amoozadeh et al. (2024)	Computer education	253	Users' trust in GenAI, confidence levels, and motivation to learn vary significantly, and these factors directly influence their adoption of GenAI and learning outcomes.	Further research is needed to explore the various factors that influence students' trust in GenAI.
Huang et al. (2023)	Systems programming education	102	AI-driven personalized video recommendation systems can significantly improve the learning performance and engagement of students with moderate levels of motivation.	It is recommended to apply AI-driven personalized recommendation systems in flipped classrooms to enhance learning outcomes.
Maheshwari (2024)	Educational psychology	108	Students' willingness to adopt ChatGPT is primarily influenced by its ease of use, while its perceived usefulness indirectly affects adoption willingness through personalization (positively) and interactivity (negatively). However, the mediating role of perceived trust and intelligence is not significant.	Educational institutions should cautiously integrate ChatGPT into the assessment process, establish clear usage guidelines, and ensure that AI tools are used appropriately while preserving students' critical thinking and creativity.

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Discussion

Based on our systematic review of empirical studies on AIGC applications in higher education, several key insights emerge regarding its implementation patterns, impacts, and future prospects. This section discusses the implications of our findings and their significance for the future development of AIGC in educational contexts.

The Dual Nature of AIGC's Educational Impact

The reviewed literature reveals a complex and nuanced picture of AIGC's impact on higher education, characterized by both significant opportunities and notable challenges. On one hand, AIGC demonstrates remarkable potential in enhancing learning engagement and outcomes across various disciplines. Studies by Sun et al. (2024) and Jaradat (2024) provide compelling evidence of AIGC's positive effects on specific skills development, such as programming debugging and digital design abilities. The technology's capacity to provide personalized learning experiences and immediate feedback, as highlighted in research by Inoferio et al. (2024), represents a significant advancement in educational support systems.

However, this positive impact is accompanied by important limitations and concerns. The accuracy issues identified in specialized fields, particularly in chemical calculations (Busch et al., 2024; Schrier, 2024), highlight the current technological constraints of AIGC systems. More fundamentally, the potential suppression of creativity and critical thinking skills, as cautioned by Lin and Chen (2024), raises important questions about the optimal balance between AI assistance and independent learning. This duality suggests that while AIGC can significantly enhance educational processes, its implementation must be carefully calibrated to preserve and promote essential cognitive development in students.

Emerging Patterns in AIGC Adoption and Integration

The adoption of AIGC in higher education exhibits distinct patterns that merit careful consideration. The significant demographic and disciplinary differences in AIGC attitudes and usage, as revealed by Stöhr et al. (2024), point to the importance of considering user characteristics in implementation strategies. Male students in engineering and technology fields showing higher usage rates and more positive attitudes, compared to their counterparts in humanities and medical fields, suggests that AIGC adoption is influenced by both individual and disciplinary factors.

Trust emerges as a crucial mediating factor in AIGC adoption, as demonstrated by studies from Obenza et al. (2024) and Amoozadeh et al. (2024). The gradual transformation of students' attitudes from initial skepticism to effective utilization, documented by Hutson et al. (2024), indicates that successful AIGC integration requires careful attention to trust-building processes and user experience design. These findings suggest that effective AIGC implementation strategies must account for both technical capabilities and psychological factors that influence user acceptance and engagement.

Conclusions and Limitations

This systematic review of empirical studies from 2023-2024 reveals the complex landscape of AIGC applications in higher education. The findings demonstrate significant positive impacts on learning outcomes across various disciplines, particularly in areas such as programming skill development (Sun et al., 2024), digital design enhancement (Jaradat, 2024), and critical thinking improvement (Ruiz-Rojas et al., 2024). However, the effectiveness of AIGC

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implementation varies considerably depending on factors such as disciplinary context, user characteristics, and technological infrastructure. The analysis further indicates that successful AIGC integration requires careful consideration of both technical capabilities and psychological factors, particularly user trust and acceptance (Amoozadeh et al., 2024; Obenza et al., 2024).

Several limitations of this review warrant consideration. The rapid evolution of AIGC technology means that some findings may quickly become dated, particularly regarding specific tools and applications. The focus on recent studies, while ensuring currency, may have excluded valuable insights from earlier research. Additionally, the relatively short implementation periods in many studies make it difficult to assess the long-term impacts of AIGC on learning outcomes. Future research should address these limitations through longitudinal studies examining sustained impacts, cross-cultural investigations of implementation variations, and the development of comprehensive frameworks for curriculum integration that maintain academic integrity while promoting critical thinking skills.

Declaration of Competing Interest

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