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Exploring College Students' Acceptance of Artificial Intelligence Tools: A Bibliometric Analysis (2014–2024)

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Abstract
Aim: This bibliometric analysis investigates the acceptance of artificial intelligence (AI) tools among college students, highlighting the evolving research landscape from 2014 to 2024. Despite AI's transformative potential in enhancing educational experiences and supporting personalized learning, gaps persist in understanding its application in physical classroom settings. This study systematically reviews literature on AI tool adoption, focusing on research productivity, collaboration patterns, citation impact, and thematic evolution
Methodology: Utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), AI-related research post-2020 were analyzed.
Results: Findings indicate robust international and interdisciplinary collaboration among researchers and underscore the shift from theoretical exploration to practical applications of AI in education. As discussions around ethical considerations grow, this analysis provides critical insights into the factors influencing college students' acceptance of AI tools, ultimately contributing to the ongoing dialogue on AI's role in modern educational practices.
Conclusion: Based on the findings, it is concluded that the acceptance of AI tools among college students in education has been significantly shaped by diverse methodological approaches and theoretical frameworks such as Unified Theory of Acceptance and Use of Technology (UTAUT) and the Diffusion of Innovation Theory. The increase in research productivity, particularly after 2020, reflects the growing integration of AI in educational settings, especially in language learning, academic writing, and Science, Technology, Engineering, and Mathematics (STEM). The study highlights the influential role of systematic reviews and bibliometric analyses in identifying research trends and gaps. It is recommended that future research continue to embrace interdisciplinary collaboration to enhance the quality and impact of AI-related studies. Moreover, emphasis should be placed on addressing ethical considerations, data privacy, and the personalization of learning to ensure responsible and effective AI integration in higher education. This review underscores the dynamic and evolving nature of AI research in education and its critical implications for pedagogy and policy-making.
Keywords: *Artificial intelligence (AI), Artificial Intelligence Tools, AI tools acceptance, student acceptance of AI, AI in higher education, college students and AI, perception of AI tools, AI usage in education*

INTRODUCTION

Artificial Intelligence (AI) is rapidly transforming the educational landscape by providing innovative solutions that enhance both teaching and learning experiences. The integration of AI tools in education has the potential to significantly improve teacher effectiveness, boost student engagement, and optimize overall educational outcomes (Dwivedi et al., 2021). Beyond supporting traditional educational practices, AI is poised to revolutionize educational services, particularly for international students, by providing adaptive and personalized learning environments (Wang et al., 2023).

Aligned with the United Nations' Sustainable Development Goal (SDG) 4, which focuses on ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all, AI offers promising solutions to many of the challenges currently faced in education. By leveraging AI, educational institutions can

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improve teaching methodologies, accelerate the learning process, and ultimately enhance the development of modern educational systems. (Borsatto, et.al, 2024)

However, despite its transformative potential, gaps remain in the existing body of research. The exploration of AI's application in physical classroom settings, for instance, is still underdeveloped, indicating the need for more comprehensive studies in this area (Chen, et al. 2020). Additionally, while systematic reviews have been conducted on AI's integration into educational practices, they tend to focus on general AI applications rather than specifically addressing pedagogical outcomes or student acceptance of AI tools (Prahani, 2022) This bibliometric review aims to fill these gaps by systematically analyzing research trends, collaboration patterns, and the impact of AI tools on college students' learning experiences over the past decade.

Objectives

The purpose of the study is to investigate the acceptance of artificial intelligence (AI) tools among college students, highlighting the evolving research landscape from 2014 to 2024

This bibliometric review sought to address several key research questions:

1. What are the distinctive characteristics of literature on college students' acceptance of AI tools in terms of methodology, theoretical framework, and learning context?
2. How has research productivity on AI tool adoption in educational settings evolved over the past decade?
3. What patterns of collaboration emerge among authors studying AI in education, specifically in relation to college students' acceptance?
4. What is the level of citation impact of studies focusing on the acceptance of AI tools by college students?
5. How have the topics of research on AI acceptance in education evolved over time?

Conceptual Framework

The conceptual framework for this study is grounded in Hallinger and Kovacevic's (2019) approach to bibliometric analysis. This framework provides a structured method for examining the characteristics of the academic literature, focusing on research productivity, citation impact, patterns of collaboration, and thematic evolution. By applying this framework, the study will provide a comprehensive overview of the research landscape related to AI tools in college education, identifying key trends and gaps in the existing body of knowledge

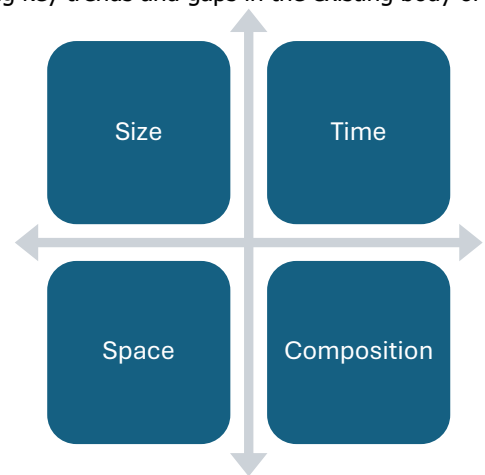

Figure 1. Hallinger and Kovacevics, 2019

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METHODS

Research Design

In this study, the researchers adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol to guide the systematic literature review focused on the acceptance of Artificial Intelligence (AI) tools among college students. PRISMA is a well-established framework utilized for reporting systematic reviews and meta-analyses across various research fields, including education and technology (Moher et al., 2009; Liberati et al., 2009). Developed by an international consortium of researchers, PRISMA offers a comprehensive approach to ensure methodological rigor and quality in systematic reviews. Given the study's focus on AI tools in educational settings, the researchers found PRISMA's structured approach particularly beneficial for this review process.

The PRISMA protocol comprises four stages: identification, screening, eligibility, and inclusion. In the identification stage, the researchers initiated a thorough search for potential articles across key academic databases, including Scopus, Google Scholar, ERIC, ProQuest, and EBSCOhost. This extensive search aimed to collect a wide range of literature on the acceptance of AI tools among college students.

During the screening stage, the researchers applied initial inclusion and exclusion criteria to the search results, focusing primarily on the titles and abstracts of the articles. Articles that appeared potentially relevant were saved to an EndNote library, where duplicates were systematically removed to ensure a clean dataset for further analysis.

The eligibility stage involved a meticulous review of the full texts of selected articles to confirm they met the outlined criteria for inclusion. The researchers assessed whether the articles provided insights into the acceptance of AI tools specifically among college students. Irrelevant articles or those not aligned with the study's focus were excluded at this stage.

In the final inclusion stage, the researchers compiled a comprehensive list of articles that satisfied all inclusion criteria for the systematic review. An Excel spreadsheet was created to document essential details from each article, including titles, authors, methodologies, and significant findings related to AI acceptance among college students. To ensure rigor and minimize bias, three authors independently reviewed the selected articles, comparing their notes and findings. Any discrepancies were resolved through virtual meetings, fostering collaboration and consensus among the researchers. This collaborative approach facilitated the development of a summary table of the included articles, ensuring a robust and accurate analysis of the literature on college students' acceptance of AI tools.

Search Plan and Techniques

To identify relevant studies on the acceptance of Artificial Intelligence (AI) tools among college students, a comprehensive search was conducted across several academic databases, including Scopus, Google Scholar, ERIC, ProQuest, and EBSCOhost. This systematic search aimed to gather a wide range of literature and ensure a thorough review of existing research from 2013 to 2023.

Table 1.

Concept	Keywords
Concept 1: Acceptance of AI Tools	"AI tools acceptance," "student acceptance of AI," "AI in higher education," "college students and AI," "perception of AI tools," "AI usage in education"
Concept 2: College Students	"college students," "university students," "higher education," "student experiences with AI," "student perspectives on AI," "AI tools in academic settings"

The search for relevant studies on the acceptance of AI tools among college students was meticulously structured to ensure a comprehensive review of the existing literature. The search strategy focused on two primary concepts: the acceptance of AI tools and the specific demographic of college students.

Concept 1 involved utilizing a carefully selected set of keywords related to the acceptance of AI tools. Terms such as "AI tools acceptance," "student acceptance of AI," "AI in higher education," "college students and AI," "perception of AI tools," and "AI usage in education" were employed to capture various dimensions of how students perceive and interact with AI technologies. This broad range of keywords aimed to include studies that explore both the positive and negative sentiments students hold toward AI in their academic environments.

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Concept 2 concentrated on the demographic aspect, using keywords associated with college students. This included terms like "college students," "university students," "higher education," "student experiences with AI," "student perspectives on AI," and "AI tools in academic settings." The purpose was to refine the search to studies specifically involving college students, highlighting their unique experiences and challenges in relation to AI tools within the context of higher education.

The search strategy combined these keywords to ensure comprehensive retrieval of relevant articles. Specific keyword combinations used in the search included "AI tools acceptance AND college students," "student perceptions of AI AND higher education," "AI in education AND student experiences," and "AI usage AND university students." These combinations were designed to capture a wide range of studies that address both the acceptance of AI tools and the specific context of college students.

To enhance the quality and relevance of the search results, several filters were applied. The search was limited to articles published within the last decade to ensure the research is current and applicable. Additionally, the search focused on peer-reviewed articles, conference papers, and theses to maintain a high standard of academic credibility.

Search techniques included the use of quotation marks to encapsulate phrases like "AI tools acceptance" and "student perceptions of AI," which facilitated accurate retrieval of articles discussing these specific concepts. Boolean operators (AND, OR, NOT) were also utilized to combine or exclude keywords, further refining search results and enhancing precision.

Overall, this structured search strategy was designed to capture a comprehensive and relevant body of literature, ensuring that the identified studies provide valuable insights into college students' acceptance of Artificial Intelligence tools.

Ethical Considerations

To ensure the quality, credibility, and ethical integrity of the study, the researchers strictly adhered to established research protocols. The researchers applied for approval from the PUP Research Ethics Committee (REC), in accordance with the requirements set by the Philippine Health Research Ethics Board (PHREB). Additionally, the list of systematic literature included in the review was independently checked and validated by three research experts to ensure accuracy, minimize bias, and uphold ethical standards in the selection and inclusion of studies.

RESULTS and DISCUSSION

This section presents the analysis and interpretation of the data gathered from the literatures. The findings are organized based on the research questions. The thematic presentation follows the sequence outlined in the study's statement of the problem to ensure coherence and alignment with the research objectives.

1. Distinctive Characteristics of Literature on College Students' Acceptance of AI Tools

The body of literature on AI adoption in education, especially among college students, is characterized by a mix of qualitative, quantitative, and mixed methods approaches. Many studies, like Alharbi (2023), use the PRISMA method to systematically review large datasets of academic articles, focusing on how AI tools like Grammarly and other writing assistants are perceived in foreign language learning.

Theoretical frameworks like the Diffusion of Innovation Theory, as utilized by Alhumaid et al. (2023), and the Unified Theory of Acceptance and Use of Technology (UTAUT), featured in Gonzales-Calatayud et al. (2024) are foundational to understanding students' attitudes and behaviors regarding AI tools. These theories emphasized the role of perceived usefulness, ease of use, and social influence in the acceptance of new technologies.

Additionally, many studies employ survey-based research designs, like Alhumaid et al. (2023), which distributed 400 questionnaires to university students in the UAE to explore their acceptance of AI. With a 97% response rate, this study reflects the high interest and engagement of students in AI-related educational tools. Another common method is content analysis, as seen in Al-Tkhayneh et al. (2023), which analyzed secondary sources such as journal articles to study the social and legal risks of AI.

Moreover, mixed-method studies, such as Awalin et al. (2023), combine both qualitative and quantitative approaches to provide a comprehensive overview of AI's role in education. These studies frequently explore specific tools, such as AI-based writing assistants and automated feedback systems, within the higher education context, examining how these technologies can be applied to improve learning outcomes and engagement.

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2. Evolution of Research Productivity on AI Tool Adoption in Educational Settings (2013–2023)

Research productivity on AI tool adoption in education has significantly increased over the last decade. A bibliometric analysis of studies from 2013 to 2023 reveals a growing interest in applying AI to various educational contexts, with substantial increases in the number of published articles starting around 2020, coinciding with the rise of more advanced AI tools like ChatGPT.

For instance, Bilad et al. (2023) and Chui, et al. (2023), noted a surge in AI-related research in educational settings post-2020. The use of the PRISMA method in their review highlights the systematic growth of AI adoption studies in higher education. Similarly, Hinojo-Lucena et al. (2019) conducted a bibliometric study that indicated a steady increase in AI publications from 2015 onwards, reflecting the broader academic interest in AI's potential in educational innovation.

By 2023, studies like Aithal and Aithal (2023), Baidoo-anu and Owusu (2023), Chaka (2023), and Patil, et.al (2024) began exploring more futuristic applications of AI tools like ChatGPT in education, reflecting the rapid evolution of research topics towards cutting-edge AI tools. This study, which is exploratory, gathers information from various scholarly sources using AI-based search tools, highlighting how technology itself is facilitating more advanced research.

In earlier years (2013–2018), research largely focused on theoretical explorations of AI in education, such as Chassignol et al. (2018), who examined AI trends in education from a narrative overview perspective. However, by 2020, the focus had shifted to empirical applications of AI tools, with a sharp increase in studies assessing AI's practical impact on teaching, learning, and assessment, as evidenced by Chen et al. (2020), which received 575 citations, making it one of the most influential studies in this field.

3. Patterns of Collaboration Among Authors Studying AI in Education

The patterns of collaboration among researchers in AI and education reveal a robust tendency toward international and interdisciplinary partnerships. Many studies reflect cross-institutional cooperation, particularly among institutions in Asia, Europe, and North America. For instance, the research conducted by Alharbi (2023) highlights collaboration between multiple institutions to analyze AI's impact on foreign language learning. This type of international partnership is vital, as it allows researchers to leverage diverse educational contexts and perspectives, thereby enriching the overall quality of the research.

Collaboration patterns also demonstrate significant interdisciplinary engagement. A notable example is the work of Shaikh et al. (2022), which brings together experts in both educational technology and machine learning. This intersection is essential, as it underscores the necessity for varied skill sets to thoroughly explore the multifaceted role of AI in education. Similarly, studies such as those by Aithal and Aithal (2023), which focus on ChatGPT's role in higher education, illustrate how scholars from diverse academic backgrounds unite to understand the pedagogical implications of AI tools.

These partnerships enhance the scope of AI research by incorporating insights from various disciplines, including computer science, linguistics, psychology, and education. This interdisciplinary approach fosters a more comprehensive understanding of how AI tools can be effectively adopted in different educational contexts. Moreover, such collaborations can lead to innovative methodologies and frameworks that address complex challenges in integrating AI into educational systems, further propelling the field forward.

4. Citation Impact of Studies Focusing on the Acceptance of AI Tools by College Students

The citation impact of studies on AI adoption in education varies significantly, influenced by the scope and methodology of the research. High-impact studies, such as those by Chen et al. (2020), which have been cited 575 times, underscore the growing influence of AI research within the educational sector. The substantial citation count indicates that comprehensive reviews and empirical studies play a crucial role in shaping future research directions, as they provide foundational knowledge that other scholars build upon.

Conversely, studies like Al-Tkhayneh et al. (2023), which examine the social and legal risks of AI in education, exhibit lower citation counts (only 2 citations) due to their recent publication date and narrower focus. However, as the field of AI research expands and these newer studies gain more visibility, it is anticipated that their citation numbers will increase. This suggests a lag in recognition for emerging topics that may eventually gain traction as the discourse around AI's role in education continues to evolve.

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Notably, citation impact tends to be higher for studies employing systematic reviews or meta-analyses. For example, works by Bilad et al. (2023) offer valuable overviews of the field, which are frequently referenced by subsequent researchers. Such studies not only synthesize existing knowledge but also highlight gaps in the literature, guiding future research endeavors and contributing to a more cohesive understanding of AI's educational implications.

5. Evolution of Research Topics on AI Acceptance in Education

Research on AI acceptance in education has undergone significant evolution over the past decade. Early studies predominantly centered on the theoretical implications of AI, often exploring its potential transformative effects on education. However, recent investigations have shifted toward practical applications, examining how specific AI tools are integrated into teaching and learning environments.

For instance, the study by Alhumaid et al. (2023) emphasized the practical use of AI in higher education through online surveys measuring student acceptance of tools like ChatGPT in UAE universities. This focus on operationalization reflects an increasing recognition of the need for empirical evidence regarding AI's effectiveness and acceptance in educational contexts.

Other studies, such as those by Singh and Das (2022) and Fitria (2021) showcased the application of AI in areas such as student assessment, personalized learning, and digital literacy. This transition from theoretical explorations to applied research aligns with the rapid advancement of AI technologies and their growing integration into educational settings. By focusing on practical implications, researchers can better understand the benefits and challenges of implementing AI tools in real-world educational scenarios.

Furthermore, emerging topics like the ethical considerations of AI in education, as discussed in Al-Tkhayneh et al. (2023), illustrate the field's increasing awareness of the broader societal impacts of AI adoption. These discussions are becoming increasingly relevant as AI tools become more ubiquitous in both K-12 and higher education environments. The growing emphasis on ethical considerations not only highlights the responsibility of educators and policymakers to ensure equitable AI use but also reflects a broader societal discourse about technology's role in shaping educational experiences. As this dialogue progresses, it will be crucial for researchers to continue exploring the ethical dimensions of AI to inform best practices and safeguard against potential risks.

Conclusions

The systematic review of studies on college students' acceptance of AI tools in education reveals several key trends. First, the distinctive characteristics of the literature include diverse methodological approaches, such as qualitative, quantitative, and mixed methods, with theoretical frameworks like UTAUT and the Diffusion of Innovation Theory being widely applied. The research covers various educational contexts, predominantly higher education, with an emphasis on AI's role in language learning, academic writing, and STEM education.

The productivity of research on AI adoption has increased significantly from 2013 to 2024, with a notable surge in publications post-2020 due to the rise of AI-based tools and the necessity of digital education during the COVID-19 pandemic. Studies that conducted systematic reviews and bibliometric analyses are particularly influential, contributing to the growth of the field by providing comprehensive overviews and identifying gaps for future exploration.

Collaboration among researchers is increasingly international and interdisciplinary, involving experts from education technology, computer science, and pedagogy. These collaborations enhance the depth and breadth of AI research in education, leading to higher citation impacts for studies that combine multiple academic perspectives.

In terms of citation impact, high-quality meta-analyses and systematic reviews tend to be the most influential, with studies like Chen et al. (2020) receiving hundreds of citations, signaling their critical role in shaping the direction of AI research in education. Finally, research topics have evolved from theoretical explorations of AI's potential to more practical applications, with an emerging focus on ethical considerations, data privacy, and personalized learning.

Recommendations

In light of the conclusions, the study recommends Enhancing Interdisciplinary Research: Given the complex nature of AI's role in education, further interdisciplinary collaboration between experts in AI technology, pedagogy, and educational policy is essential. This will facilitate more comprehensive studies that address both the technical and educational implications of AI adoption. Focus on Ethical and Social Implications: As AI tools become more prevalent in educational settings, researchers should prioritize studies that explore the ethical considerations and

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societal impacts of AI in education. Topics like bias in AI algorithms, data privacy, and AI's role in shaping educational equity should be further investigated to ensure responsible AI integration. Expand Research on AI's Practical Applications: While much progress has been made in theoretical research, future studies should focus more on empirical evidence related to the effectiveness of AI tools in improving student outcomes, engagement, and learning experiences. This includes assessing AI's impact on personalized learning, student assessment, and teacher-student interaction. Increase Longitudinal Studies: To better understand the long-term effects of AI adoption in education, researchers should conduct longitudinal studies that track how AI tools influence learning over extended periods. This will provide deeper insights into how students' acceptance of AI tools evolves as they become more integrated into daily educational practices. Strengthen Global Collaboration: Encouraging more international collaboration among researchers, especially in developing countries, will broaden the scope of AI research and ensure that the benefits of AI in education are equitably distributed. Collaborative efforts could lead to innovative solutions that address regional educational challenges using AI technologies.

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