



Use of Artificial Intelligence in Entrepreneurship Education: A Systematic Review

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Abstract

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Artificial Intelligence (AI) has emerged as a transformative force in entrepreneurship education in recent years. This study aims to advance the understanding of AI's role in entrepreneurship education through a systematic review providing future research directions. Spanning the period from 2019 to 2024, the review synthesizes insights from 32 peer-reviewed journal articles systematically identified using the PRISMA methodology. Data was extracted from Web of Science (WoS) and Scopus databases, with a focus on English-language journal publications directly relevant to the subject area. The thematic analysis identified four key themes: "AI as a Transformative Tool," "AI-driven pedagogical Strategies in Entrepreneurship Education," "Challenges and Ethical Considerations," and "AI Ecosystems and Policy Implications." The findings highlight the growing academic interest in this domain and call for further exploration of AI's potential to address challenges and foster innovation in entrepreneurship education.

Keywords: Artificial Intelligence, Application of AI, Entrepreneurship Education, Systematic Review.

1. Introduction

Artificial Intelligence (AI), a widely recognized buzzword today, transcends the boundaries of computer science, integrating with diverse fields and professions (Chen, et al., 2024). Pedro et al. (2019) define AI as the capability of computers, systems, or software to replicate human performance and rational thinking. As a key trend in educational technology, especially within higher education, AI streamlines processes through automation, reducing educators' workload and optimizing time and resource utilization. With advancements in big data, neural networks, cloud computing, and machine learning, engineers have developed computers and algorithms that replicate human intelligence (Zhai et al., 2021). The incorporation of AI into the educational system, its capacity to enhance learning, and its role in promoting AI literacy and teaching individuals about AI are gaining significant attention and becoming central to policy discussions (Miao et al., 2021). Artificial intelligence in

education involves utilizing technologies like chatbots, robots, intelligent tutoring systems, and automated evaluation tools to enhance and complement educational processes (Chiu et al., 2023).

Through the introduction of novel concepts, goods, services, and technologies that form the basis of new endeavors, entrepreneurs can reduce unemployment rates and promote economic growth by enrolling in entrepreneurship education and launching their own companies (Chen, et al., 2024). Consequently, all educational levels have integrated AI into STEM (science, technology, engineering, and mathematics) teaching and learning, but the complexity of unstructured information has made it difficult to integrate it into the social sciences (Roll & Wylie, 2016). Nonetheless, educators in the entrepreneurship education field hardly ever use educational technology in their regular administrative and teaching activities (Chen et al., 2021). There is still a significant void in the creation of theoretical frameworks to guide future practices in entrepreneurship and entrepreneurship education, despite the growing awareness of the integration of AI into entrepreneurship (Chen, et al., 2024). Besides, both practitioners and scholars are keen to explore its potential and opportunities.

Moreover, empirical evidence from entrepreneurship programs worldwide indicates that traditional teaching models struggle to nurture entrepreneurial competencies such as innovation, problem-solving, and resilience. Studies reveal that lecture-based instruction and standardized curricula fail to capture the complexity of entrepreneurial processes, which are inherently dynamic and uncertain (Chen et al., 2021; Maritz et al., 2022). As a result, learners often face challenges translating abstract theories into real-world entrepreneurial action, underscoring the need for AI-driven adaptive learning models that simulate authentic business environments.

Consequently, many systematic reviews have been focused on the application of AI in education; however, there is a significant gap in reviews that particularly address the use of AI in entrepreneurship education. Despite the growing number of empirical studies on the application of AI in entrepreneurship education, the lack of systematic organization and categorization has led to new studies, often starting from scratch. This highlights the need for an updated review in the field. Therefore, there is a clear need for organization and systematization, particularly focusing on thematic content. The main objective of this paper is to systematize and organize the current knowledge on the application of AI in entrepreneurship education, focusing on identifying areas where further research is required. To achieve this objective, a systematic literature review has been conducted, offering valuable insights and serving as an essential source for understanding the current level of research. It also examines the existing body of work, identifying gaps that need further exploration to advance knowledge in this field. The structure of the paper is as follows: First, a detailed discussion of the methodology; next, the data analysis; and finally, key findings and discussion directing towards suggestions for future research will be presented.

Despite the growing application of AI in educational contexts, its integration into entrepreneurship education remains underexplored, particularly regarding its pedagogical effectiveness, ethical challenges, and policy implications. Therefore, this study addresses the research problem; How is Artificial Intelligence transforming entrepreneurship education and what are the emerging pedagogical, ethical, and policy implications? The objectives of this review are:

1. To synthesize existing literature on the application of AI in entrepreneurship education from 2019–2024.

2. To identify the major themes, trends, and gaps within the current research landscape.
3. To examine how AI facilitates entrepreneurship learning, highlighting both challenges and opportunities.
4. To propose directions for future empirical research and policy formulation.

2. Literature Review

Entrepreneurship education traditionally emphasizes experiential learning, critical thinking, and innovation (Maritz et al., 2022). However, evidence suggests that traditional teaching methods often fail to meet the dynamic demands of digital entrepreneurship, as they rely heavily on theoretical instruction and lack personalized, data-driven approaches (Chen et al., 2021). Further, empirical studies reveal that student in conventional entrepreneurship courses struggle with opportunity recognition, ideation, and translating theory into practice (Pettersen et al., 2019).

The integration of AI in education has been shown to address these gaps by offering personalized feedback, adaptive learning systems, and real-time data analytics (Chiu et al., 2023; Miao et al., 2021). Yet, entrepreneurship education presents unique complexities, its interdisciplinary nature and reliance on human creativity make full automation difficult (Roll & Wylie, 2016). Early research in AI-driven entrepreneurship learning (Vecchiarini & Somià, 2023; Dinger et al., 2024) demonstrates that AI can simulate entrepreneurial environments, reduce barriers to entry, and foster creativity through project-based learning and virtual incubators.

Despite these advancements, challenges persist in aligning AI tools with entrepreneurial pedagogies, addressing ethical considerations such as bias and data privacy, and ensuring equitable access across regions (Bell & Bell, 2023; Horvath & Steinberg, 2023). These limitations highlight the need for systematic synthesis of empirical evidence to understand how AI reshapes entrepreneurship education holistically, pedagogically, ethically, and institutionally.

3. Methodology

A systematic literature review was undertaken using the PRISMA approach to expand the knowledge base on the use of AI in entrepreneurship education. PRISMA was a successful instrument for ensuring evidence-based reporting requirements and promoting critical assessment (Ferdinansyah & Purwandari, 2021). The literature review focused on high-quality papers from renowned journals, sourced from two well-known databases, Web of Science (WoS) and Scopus, as they include a wide range of peer-reviewed journals (Wallace, 2021; Xia et al., 2018). Titles, abstracts, and keywords were searched using the search terms "Artificial Intelligence" OR "AI" AND "Entrepreneurship Education"; "AI applications" AND "Entrepreneurship". Figure 1 shows PRISMA model. A total of 1765 articles were identified from database searching, and the duplicate entries were eventually eliminated. The review adhered to inclusion and exclusion criteria to ensure the selection of high-quality and relevant studies on the use of AI in entrepreneurship education. The inclusion criteria considered only peer-reviewed journal publications to maintain academic rigor and credibility. The selected studies were published between 2019 and 2024, focusing on recent advancements and contemporary developments in the field to ensure relevance to current academic and practical contexts. Only articles written in English were included to maintain consistency in interpretation and analysis. Furthermore, the review concentrated on studies directly

addressing the application of AI in entrepreneurship education. Exclusion criteria were applied to sources such as book chapters, conference proceedings, reports, editorials, website links, and grey literature. These criteria ensured a focused and comprehensive selection of articles, providing a reliable foundation for systematic review.

These articles' titles, abstracts, and keywords were reviewed to eliminate irrelevant research that did not directly study AI in entrepreneurship education. This screening approach eliminated 276 publications, leaving a final selection of 32 articles for the detailed analysis of the study. This analysis was conducted in two phases: descriptive and thematic analysis. During the descriptive analysis phase, fundamental data from the chosen publications was evaluated, comprising annual changes in publication quantity. The thematic analysis technique was used to determine the main study areas within the topic (Krippendorff, 2018). The authors independently classified the articles into subject categories in this phase. Discussions were made to reach an agreement on the categorizations. The article's principal focus and advocacy determined its final classification for the articles addressing various themes.

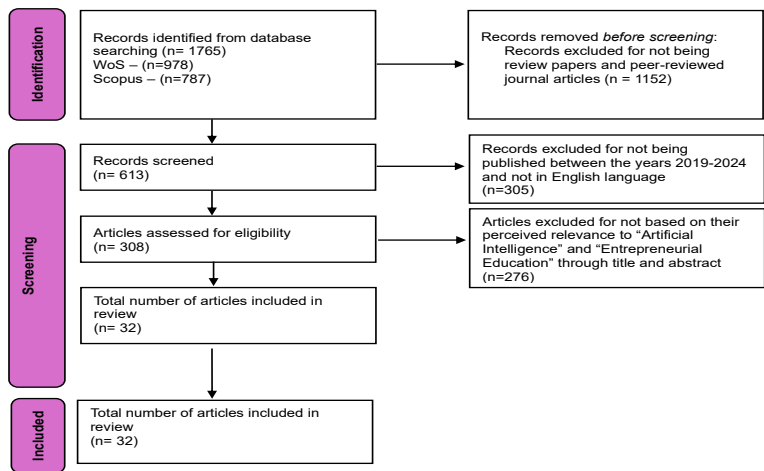


Figure 1: PRISMA model

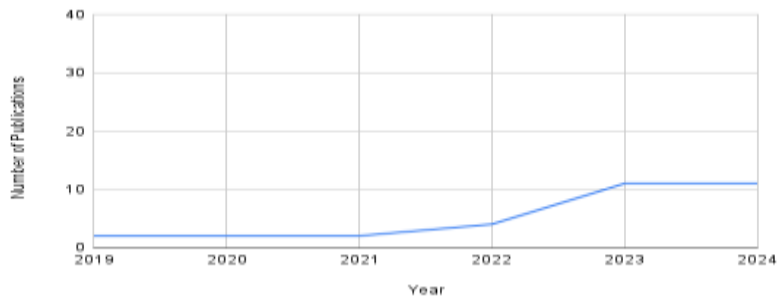


Figure 2: Number of papers published yearly from 2019 to 2024

Figure 2 depicts the annual distribution of published papers from 2019 to 2024. Since 2021, there has been a significant increase in the number of publications, indicating an

expanding scholarly interest and enhanced focus on the adoption of AI in entrepreneurship education across the field of academia.

4. Findings and Discussion

4.1. *AI as a Transformative Tool*

The transformative integration of AI into entrepreneurship education highlights its evolving role in fostering entrepreneurial competencies, empowering decision-making, and enhancing creativity, ideation, and innovation. AI catalyzes scaling entrepreneurial endeavors, aligning with broader objectives of equipping students with essential skills to navigate technology-driven markets (Batabyal et al., 2024.; Somià & Vecchiarini, 2024). By fostering innovation ecosystems, entrepreneurship ecosystems in higher education thrive when supported by robust institutional frameworks, resource-rich environments, and collaborative networks. These ecosystems facilitate collaboration among students, educators, and policymakers, fostering university start-ups and driving innovation. Government policies and cultural institutions further enhance digital ventures, particularly in the post-pandemic era, aligning with global trends in digital transformation and open innovation, creating environments conducive to entrepreneurial success (Maritz et al., 2022; Shan et al., 2023).

AI tools like ChatGPT and e-learning platforms significantly enhance entrepreneurial competencies, including creativity, opportunity recognition, and ethical and sustainable thinking. These tools simplify complex entrepreneurial processes, such as business plan development and idea generation, while enabling students to navigate entrepreneurial challenges with minimal prior experience. AI-driven e-learning tools ensure personalized and contextually relevant learning, equipping students with the adaptability and critical thinking required in modern entrepreneurial landscapes (Thottoli et al., 2025; Vecchiarini & Somià, 2023). Additionally, the integration of cognition-based frameworks, such as Metaverse technologies, enhances both teaching and learning processes, developing immersive and interactive digital environments that balance skill acquisition with sustained engagement (Hong et al., 2024; Pettersen et al., 2019).

Generative AI technologies further empower entrepreneurial decision-making by expediting tasks such as customer interviews, idea generation, and business model development. These technologies enhance entrepreneurial ideation by supporting personalized learning and fostering critical thinking. However, critical engagement with AI tools is essential to address concerns about their accuracy and reliability, emphasizing the importance of ethical and sustainable implementation in entrepreneurship education (Hammoda & Winkler, 2024; Vecchiarini & Somià, 2023). In addition, AI applications within Industry 4.0 paradigms, including IoT, augmented reality, and blockchain, showcase transformative impacts in opportunity identification, decision-making, and performance enhancement (Giuggioli & Pellegrini, 2023). The integration of AI within these contexts demonstrates its potential to simplify complex processes and foster innovation, while addressing challenges such as perceived behavioral control and entrepreneurial intentions (Dabbous & Boustani, 2023).

The integration of AI into entrepreneurship education underscores its transformative potential across various dimensions, including enhancing student ecosystems, fostering entrepreneurial competencies, and enabling personalized learning. These advancements align with the need for systemic changes in entrepreneurial education, ensuring equitable access to resources and opportunities. However, future research must address the ethical

challenges and barriers associated with AI adoption to fully leverage its potential in fostering inclusive and sustainable educational ecosystems (Audretsch et al., 2024).

4.2. AI-Driven Pedagogical Strategies in Entrepreneurship Education

Research indicates the evolving role of AI in shaping pedagogical strategies, particularly within entrepreneurship education, where it facilitates innovative learning experiences and strategy development. Starting from Liang and Bai (Liang & Bai, 2024), the study identified three dimensions of new dialogic spaces enabled by Generative AI: collaborative learning, knowledge connectivity, and theory-practice integration underscoring AI's potential as an active agent fostering deeper, multi-layered educational interactions.

Further, AI's integration into project-based and collaborative learning approaches highlights its transformative capacity. The alignment of project-based learning (PBL) methodologies with 21st-century skills acquisition, advocates for AI-supported PBL to enhance engagement in moral education and community development. Similarly, the challenge-based learning models, underscore the adaptability of AI-driven frameworks like "ETHAZI" for technical skills and collaborative education. These strategies collectively reveal how AI enhances pedagogical approaches by providing adaptive tools for hands-on, learner-centric environments (Almazroui, 2023; Williams, 2024).

Combinational creativity, practical applications, and multimodal interactions supported by AI foundation models have collectively emerged as transformative developments in entrepreneurial education. AI-driven tools, such as CombinatorX, have been shown to enhance ideation effectiveness and reduce labor-intensive efforts, refining creative processes and outcomes (Chen, Zhang, et al., 2024). Similarly, AI integration in Applied STEM Camps that combine entrepreneurship and fashion has increased student interest in STEM-related entrepreneurial careers by bridging theoretical concepts with practical applications and fostering inclusive, engaging experiences (Karpova et al., 2023). Additionally, AI's ability to facilitate multimodal human-computer interaction (HCI) through deep learning frameworks has demonstrated high success rates across diverse interactive inputs, creating immersive educational environments tailored to diverse learner needs (Alzubi et al., 2023). These advancements underscore AI's role in transforming creativity, practical learning, and interaction within entrepreneurship education.

Additionally, Digital transformation in entrepreneurship education centers has seen the integration of AI-driven platforms, as demonstrated by Secundo et al. (Secundo et al., 2020) in the Italian Contamination Labs (CLabs) network. Despite limited adoption of advanced digital tools, the strategic use of AI for communication and promotion has shown promise. These findings highlight opportunities for deeper AI implementation to enhance entrepreneurship education and outputs.

Collectively, these studies illustrate the diverse and impactful ways in which AI is redefining pedagogical strategies in entrepreneurship education. From fostering collaborative and project-based learning to enhancing creative ideation and multimodal interactions, AI offers transformative possibilities for educators and learners alike. These findings emphasize the need for continued exploration and integration of AI-driven strategies to ensure dynamic and inclusive learning environments.

4.3. Challenges and Ethical Considerations

The integration of AI into entrepreneurship education presents significant challenges and ethical considerations, particularly in addressing social equity, ethical accountability, and the

unintended consequences of technological innovation. Social classification mechanisms embedded within AI systems pose risks of perpetuating existing inequalities. These mechanisms can reinforce moral and social orders, disadvantaging vulnerable groups. Addressing these issues requires a critical examination of AI-driven social sorting dynamics, as this ensures equity and inclusivity in digital education environments (Horvath & Steinberg, 2023).

Broader societal implications of disruptive technologies further underscore vulnerabilities in ethics, sustainability, and policy within education. Disruptive changes in technology necessitate fostering resilience and adaptability in educational ecosystems to prevent the widening of societal divides. Rather than exacerbating inequities, these advancements should be aligned to promote fairness and inclusivity, requiring educators and policymakers to proactively address these dynamics (Moravec & Martínez-Bravo, 2023). At the same time, AI's integration into digital workplaces has brought challenges like work fragmentation and disconnects among team members. These issues necessitate empathetic facilitation, robust documentation, and alignment with shared goals to leverage technology's collaborative potential effectively (Brahma et al., 2021).

AI-driven entrepreneurship education also faces ethical challenges in teaching and assessment practices. Generative AI technologies present both opportunities and risks, requiring educators to balance fostering critical and practical entrepreneurial skills with mitigating potential drawbacks. Managing these technologies effectively ensures their alignment with inclusive and reflective learning objectives (Bell & Bell, 2023). Furthermore, IoT and creativity's interplay in enhancing SME performance highlights the complexities of integrating technology. While IoT improves creativity and market orientation, its impact on performance is nuanced, emphasizing the need to cultivate innovation alongside ethical consideration in technology integration (Wasim et al., 2024).

Collectively, these findings emphasize the need for a collaborative approach among educators, policymakers, and technologists to navigate the ethical complexities of AI-driven entrepreneurial education. Prioritizing equity, critical reflection, and ethical design can ensure that technological advancements contribute to transformative and socially responsible entrepreneurial ecosystems.

4.4. AI Ecosystems and Policy Implications

The integration of AI into entrepreneurship education has driven transformative changes, reshaping innovation ecosystems, and policy frameworks. These developments collectively underscore the importance of fostering collaboration, adaptability, and strategic approaches to ensure the successful implementation of AI in entrepreneurship education.

AI ecosystems play a pivotal role in enabling entrepreneurship education by addressing technological, organizational, and environmental factors. Compatibility, infrastructure, and regulatory environments are crucial for their success, requiring institutions to adopt frameworks that align with these elements. Regional innovation ecosystems, such as Montreal's AI ecosystem, highlight the potential of collaborative and sustainable advancements driven by bottom-up approaches and localized capabilities. These ecosystems demonstrate how regional strengths can be leveraged to enhance innovation and entrepreneurship, fostering a culture of collective progress and adaptability (Schwaecke et al., 2024; Sultana et al., 2023).

Policy frameworks serve as a backbone for the diffusion and acceptance of AI in entrepreneurial contexts. Coherent strategies and guidelines are essential for integrating AI into educational curricula effectively, addressing barriers such as legal requirements, inconvenience, and uncertainty. By fostering open, collaborative, and flexible environments, policy interventions enable entrepreneurs to embrace AI's potential, ensuring generativity and inclusivity in its application. This highlights the need for global alignment in policy strategies to bridge gaps and enhance the seamless adoption of AI technologies across educational and entrepreneurial domains (Ortega-Mohedano, 2024; Schwaeke et al., 2024; Upadhyay et al., 2022).

In practice, AI has facilitated innovative pedagogical approaches that empower students in entrepreneurial education. Project-based learning, supported by AI, enables learners to navigate digital entrepreneurship with minimal prior experience, lowering barriers to entry while equipping them with critical skills. This integration strikes a balance between human creativity, critical thinking, and AI-driven efficiencies, ensuring a holistic learning experience. Such approaches prepare students to address real-world entrepreneurial challenges, emphasizing the importance of adaptability and resilience in the face of technological advancements (Dinger et al., 2024).

The relationship between AI ecosystems and competitiveness further highlights the transformative potential of AI in achieving sustainable development goals. Technological, social, and environmental innovations mediated by AI enhance entrepreneurial success, reinforcing the importance of awareness, knowledge, and strategic implementation. These elements are critical for fostering business competitiveness and sustainability, ensuring that AI contributes meaningfully to long-term goals and societal progress (Senadjki et al., 2023).

Collectively, these findings reveal the interconnectedness of AI ecosystems, policy interventions, and educational strategies in driving entrepreneurial growth. Addressing systemic challenges through comprehensive and context-specific approaches can unlock AI's full potential. By fostering collaboration among educators, policymakers, and entrepreneurs, these efforts will create ecosystems that promote innovation, competitiveness, and sustainability, equipping future leaders to navigate an evolving technological landscape.

4.5 Gaps and Limitations

The reviewed literature reveals significant gaps in understanding the long-term impact of AI on entrepreneurship education. Few empirical studies assess AI's influence on entrepreneurial mindset development or venture creation outcomes. Most existing research remains conceptual, with limited cross-cultural comparisons or longitudinal data. Furthermore, the ethical implications of AI use, particularly concerning data governance, inclusivity, and bias mitigation, remain underexplored. Future studies should adopt mixed-methods and comparative frameworks to address these gaps and build evidence-based models for AI integration in entrepreneurship education.

5. Conclusion and Future Research Directions

This systematic literature review focused on the use of AI in entrepreneurship education, drawing from 32 articles published between 2019 and 2024. The findings reveal a notable increase in scholarly attention to AI in this field, particularly since 2021, highlighting the growing recognition of AI's potential in enhancing educational practices. The thematic analysis identified four key themes: AI as a transformative tool, AI-driven pedagogical strategies in entrepreneurship education, challenges and ethical considerations, and AI

ecosystems and policy implications. This review serves as a valuable resource for scholars and practitioners aiming to navigate the evolving landscape of AI in entrepreneurship education, offering both a synthesis of current trends and a roadmap for future research to advance this rapidly growing field.

Customizing AI tools for individualized learning, adaptive systems for skill development, and the changing role of educators in AI-enhanced instruction are some potential topics for future study on AI in entrepreneurial education. Future researchers should explore how AI addresses issues of global accessibility, adapts to various cultures, and encourages entrepreneurial attitudes like creativity and perseverance. The main concerns include longitudinal studies on AI's long-term effects on sustainability, entrepreneurial success, multidisciplinary cooperation, and AI's role in encouraging creativity across domains. To guarantee fair and responsible AI integration in education, more research is required into how AI may be used to evaluate competencies, provide access to international networks, promote sustainable practices, and handle ethical and legal issues.

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