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Teaching Entrepreneurship with AI: A Review of Universities of Technology in South Africa

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ABSTRACT

As artificial intelligence (AI) becomes embedded in university education, it is fundamentally shifting educational practices, presenting personalized, data-driven, and scalable solutions that are reshaping pedagogical paradigms. While global interest in AI-enhanced instruction continues to grow, there is a dearth of research on its specific application within entrepreneurship education at South Africa's Universities of Technology (UoTs). Through a systematic literature review, this study examines how AI is being deployed to support entrepreneurship teaching in UoTs and identifying the associated pedagogical opportunities and institutional challenges. Drawing on a robust methodology, the review analyzed 124 academic publications between 2017 and 2024. Data was extracted from major academic databases, including Scopus, JSTOR, and Google Scholar, and synthesized using bibliometric mapping tools (Biblioshiny and VOSviewer) alongside thematic content analysis. The review uncovered a rapidly expanding but fragmented body of research, with key themes centered on AI-enabled experiential learning, student engagement, personalized feedback, and curriculum adaptation. However, significant challenges persist, including infrastructural limitations, a lack of faculty preparedness, and insufficient institutional strategies to scale AI integration meaningfully across UoTs. The data reveals AI's massive ability to drive innovation to enrich entrepreneurship education through experiential learning frameworks, particularly when guided by theories such as Experiential Learning Theory (ELT). Yet, for UoTs to fully realize this potential, a more cohesive approach is required-one that aligns policy, practice, and professional development with context-specific needs. This review offers strategic insights for educators, institutional leaders, and policymakers aiming to position South African UoTs at the forefront of AI-driven, innovation-led business education.

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INTRODUCTION

The swift evolution of artificial intelligence (AI) is essentially transforming teaching and learning systems globally, marking a paradigm shift in the ways knowledge is created, disseminated, and acquired. Contemporary AI applications, including adaptive learning platforms, virtual tutors, and language processing tools, are increasingly embedded within higher education curricula. These technologies are catalysing pedagogical innovation by enabling more personalised, data-informed learning experiences (Mhlanga, 2024). In the context of emerging economies such as South Africa, the strategic integration of AI in education is widely regarded as a critical lever for addressing persistent structural challenges, including skills deficits, limited resources, and the imperative for equitable access to quality learning opportunities (Khoza, 2022). Entrepreneurship education has emerged as a strategic priority for South Africa's Universities of Technology (UoTs). As institutions grounded in applied sciences and technological advancement, UoTs are uniquely positioned to develop graduates with practical entrepreneurial competencies essential for promoting socio-economic development, stimulating innovation, and addressing chronic youth unemployment (Chimucheka & Mandipaka, 2022). As a result, the integration of AI-driven pedagogies into entrepreneurship education represents both a timely and necessary innovation in advancing the transformative mandate of UoTs.

OBJECTIVES OF THE STUDY

Despite increasing global interest in AI-augmented entrepreneurship education, there remains a notable paucity of systematic, contextually grounded evidence on the adoption and pedagogical impact of AI in entrepreneurship teaching within South African UoTs. Existing literature is fragmented and often limited to isolated pilot projects or generalised analyses that fail to engage with the specific institutional, socio-economic, and infrastructural realities confronting UoTs (Chimucheka & Mandipaka, 2022). This evidentiary gap impedes informed decision-making, limits the scalability of promising interventions, and constrains the sector's ability to channel AI to its absolute maximum potential to enhance entrepreneurship education. This study, therefore, undertakes a systematic review of the application of AI in entrepreneurship education within South African UoTs. Specifically, the study is intended to tackle the following research question:

> *How is artificial intelligence being integrated into entrepreneurship education at South African Universities of Technology, and what are the associated opportunities and challenges for pedagogical innovation?*

By critically examining these dimensions, this study seeks to enrich scholarly dialogue and inform actionable, real-world strategies for AI-enhanced entrepreneurship education. It intends to offer actionable views for educational instructors, institutional leaders, and policymakers committed to strengthening the relevance, quality, and impact of entrepreneurship curricula amid the evolving demands of the Fourth Industrial Revolution (4IR).

METHODOLOGY

Research Design

A Systematic Literature Review (SLR) methodology is adopted in this study, integrating bibliometric and thematic analysis to critically investigate the connection of Artificial Intelligence (AI) and entrepreneurship education within South Africa's Universities of Technology (UoTs). The SLR approach provides a structured, replicable means to collate, evaluate, and synthesise existing research, thereby ensuring a thorough understanding of the current landscape (Azarian et al., 2023). The bibliometric analysis offers quantitative insights into the development of scholarly output in this domain, identifying key trends, influential authors, collaborative networks, and core publication venues (Kumar, 2025). Bibliometric mapping tools, such as Biblioshiny (via the Bibliometrix R package) and VOSviewer, are employed to visualise patterns in citations, keyword co-occurrence, and institutional collaborations.

Alongside this, a thematic analysis is conducted to extract and interpret the qualitative dimensions of the literature. This involves coding the selected studies to identify common themes, theoretical approaches, AI tools employed, pedagogical strategies, challenges, and emerging opportunities in the teaching of entrepreneurship through AI at UoTs. Thematic analysis enables a deeper exploration of how AI technologies are enhancing, transforming, or challenging entrepreneurship education within the specific context of South Africa's innovation-driven higher education institutions. By combining bibliometric and thematic analyses, this research design ensures a robust and multidimensional understanding of both the structural trends and the substantive pedagogical innovations shaping the field. It also highlights critical gaps and areas for future investigation, particularly in relation to curriculum development, digital capacity building, and educational equity in South African UoTs.

Data Sources and Search Strategy

This study employed a widespread rigorous screening of the three scholarly repositories, namely Scopus, JSTOR, and Google Scholar, selected for their extensive coverage of interdisciplinary scholarship in education, technology, and entrepreneurship. The search strategy was guided by specific keyword combinations such as "AI in entrepreneurship education" AND "South Africa" AND "universities of technology", "Artificial Intelligence" AND "entrepreneurship teaching" AND "South African higher education", and "AI adoption" AND "entrepreneurship curriculum" AND "UoTs South Africa". The review was limited to literature published between 2017 and 2024, ensuring that the analysis captured contemporary developments and emerging trends relevant to the field. The included publications were strictly English language to maintain reliability and avoid translation bias. An initial total of 312 records was retrieved from the database searches. After a thorough process of duplicate removal, 41 records were identified as duplicates and eliminated, leaving 271 distinctive records for the screening phase. For relevance, the titles and abstracts were then screened, during which 99 articles were excluded. Exclusions at this stage primarily related to studies focusing on primary or secondary education, investigations dealing with AI or entrepreneurship in isolation rather than at their intersection, or research conducted outside the South African higher education context. Further, articles were excluded for lack of empirical data, sufficient theoretical framing, or a direct focus on Universities of Technology (UoTs). Following this, 172 full-text articles were assessed for eligibility. A detailed review led to the exclusion of an additional 48 articles. These were excluded for various reasons, including a generic treatment of AI or entrepreneurship without linking them to pedagogy, insufficient engagement with the South African context, or a lack of focus on UoTs specifically. Consequently, 124 studies were involved in the final synthesis and subjected to bibliometric and thematic analysis. The use of rigorous inclusion and exclusion criteria has ensured that the final set of 124 studies provides a rich and credible foundation for the review. The entire selection process was steered following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Figure 1 presents a visual summary of the identification, screening, eligibility, and inclusion stages.

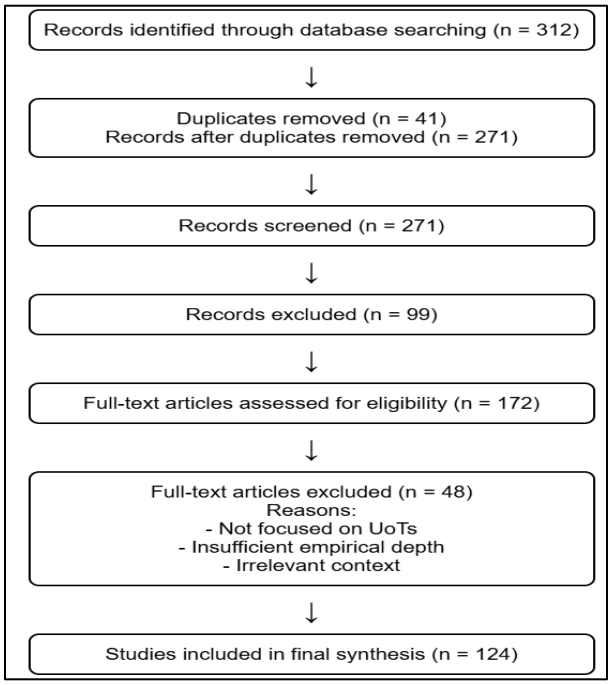

Figure 1. PRISMA Flow Diagram of Study Selection.

Data Analysis Tools

A combination of bibliometric and thematic analysis techniques was employed in this study to ensure a robust synthesis of the selected literature. For the bibliometric analysis, Biblioshiny (via the Bibliometrix R package) was utilised to extract and analyse publication trends, citation patterns, influential authors, and thematic developments. VOSviewer was also employed for network visualisation and keyword mapping, allowing for the identification of co-authorship structures and research hotspots within the field of AI in entrepreneurship education at South African Universities of Technology. For the qualitative synthesis, a thematic coding approach was adopted, enabling the systematic identification and analysis of patterns related to pedagogical practices, AI tools, challenges, and opportunities. The integration of these tools provided an all-inclusive understanding of the structural and conceptual components of the research landscape.

Main information

The systematic review covered a timespan from 2017 to 2024, capturing eight years of scholarly activity in the field of AI and entrepreneurship education. A total of 87 distinct sources, including journals, books, and conference proceedings, were identified. From these sources, 124 documents were included in the analysis, with an impressive yearly growth rate of 74.87%, indicating a rapidly growing interest in this research area. The documents had an average age of 2.59 years, indicating that the majority of the studies are relatively recent and highly relevant to contemporary discourse. On average, each document received 25.07 citations, suggesting a moderate level of academic impact. In total, 13,414 references were analysed across all documents, providing a comprehensive foundation for bibliometric exploration. Regarding content analysis, 634 Keywords Plus terms and 567 Author's Keywords were extracted, offering rich metadata for mapping thematic trends. In terms of authorship, the review included contributions from 359 authors. Sixteen (16) of these were liable for sole-authored texts, while the remainder participated in collaborative works. Overall, 17 single-authored documents were identified, with an average of 3.17 co-authors per text, demonstrating a strong drift towards collaborative research. Furthermore, 9.677% of the studies involved international co-authorships, highlighting a degree of global research engagement. Concerning

document types, the dataset predominantly comprised review articles, with 123 classified as reviews and 1 listed as early access, reflecting the systematic nature of the selected literature.

Table 1: Main information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2017:2024
Sources (Journals, Books, etc.)	87
Documents	124
Annual Growth Rate %	78.87
Document Average Age	2.59
Average citations per doc	25.07
References	13414
DOCUMENT CONTENTS	
Keywords Plus (ID)	634
Author's Keywords (DE)	567
AUTHORS	
Authors	359
Authors of single-authored docs	16
AUTHORS COLLABORATION	
Single-authored docs	17
Co-Authors per Doc	3.17
International co-authorships %	9.677
DOCUMENT TYPES	
Review	123
Review; early access	1

Most relevant affiliation

The bibliometric analysis of affiliations in Figure 2 revealed a concentration of research activity among several prominent South African universities, particularly in the field of AI applications in entrepreneurship education. The University of Johannesburg emerged as the most active institution, contributing 72 articles to the body of literature. This strong output reflects the university's leading role in driving AI research, innovation, and entrepreneurial teaching strategies, aligning closely with the increasing prominence on digitalization within South African higher education (Rakgoale, 2024). Following the University of Johannesburg, the University of the Witwatersrand recorded 32 contributions, while the University of Cape Town and the University of Pretoria followed closely with 30 and 29 publications respectively. These figures indicate a robust engagement with AI-driven educational practices among South Africa's traditional research-intensive universities. However, their work often focuses more broadly on higher education transformation (Zembylas, 2024), which underscores a notable gap regarding specific application within Universities of Technology (UoTs), the central focus of this review. In terms of institutions more directly aligned with the UoT mission, the Durban University of Technology contributed 18 articles, Tshwane University of Technology produced 10 articles, and Cape Peninsula University of Technology added 9 articles. While these numbers are comparatively lower than those of the traditional universities, they nevertheless demonstrate an emerging commitment to exploring the intersections between AI, entrepreneurship education, and practice-oriented learning frameworks at UoTs. This finding highlight both the growing interest and the significant potential for further scholarly development within the UoT sector in South Africa. Moreover, other contributors included the University of KwaZulu-Natal (26 articles), the University of the Western Cape (19 articles), and Stellenbosch University (12 articles), indicating that while research on AI and entrepreneurship is becoming more widespread, it remains predominantly concentrated within research-led universities. This suggests a critical opportunity for UoTs to further

assert leadership in applied AI education, particularly by tailoring their efforts towards entrepreneurship skills development in line with industry needs. In sum, the data reveals both a strong national interest in AI-enhanced education and a significant opening for South African UoTs to expand their scholarship and practical applications in this vital and rapidly evolving field.

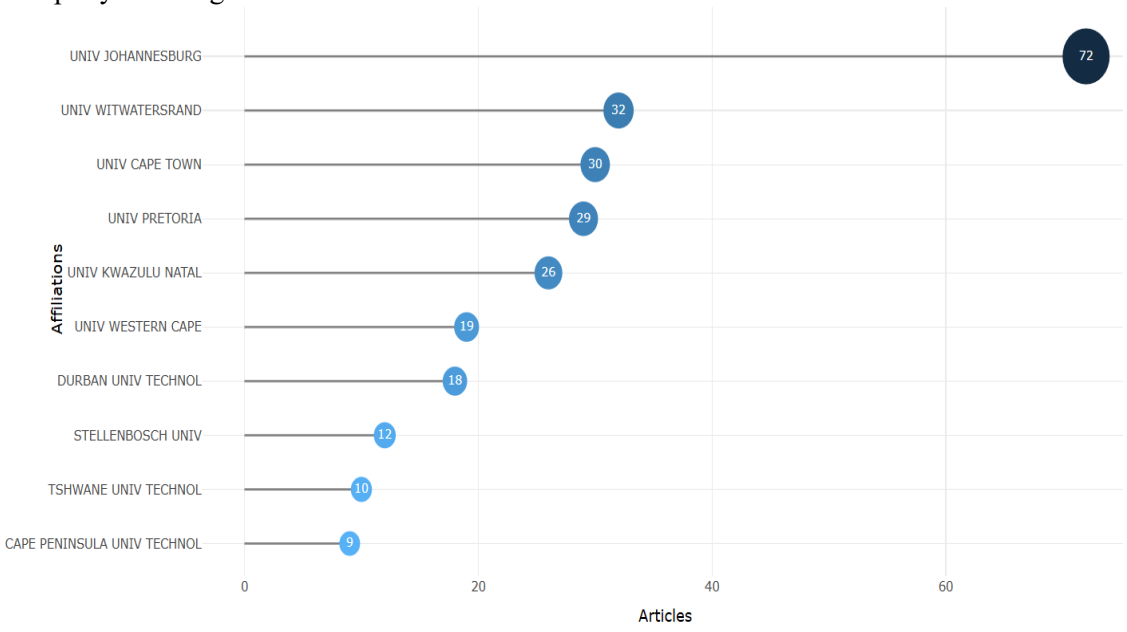

Figure 2. Most relevant affiliation.

Keyword Co-occurrence Map

The Keyword Co-occurrence Map presented in Figure 3 visualises the intellectual structure of research at the intersection of artificial intelligence and educational innovation, with particular reference to universities of technology in South Africa. The map reveals distinct clusters of keywords, each represented by different colours, indicating thematic concentrations and research directions. At the centre of the map, the term artificial intelligence prominently anchors the network, connecting densely with nodes such as machine learning, system, optimisation, and model. This central positioning highlights AI's pivotal role across multiple disciplines. In the setting of teaching entrepreneurship, this prominence implies that AI technologies are perceived as fundamental enablers of innovative educational practices within universities of technology (Bayaga, 2025). Surrounding artificial intelligence, the appearance of system, performance, and prediction hints at the focus on using AI-driven systems to enhance business education outcomes and entrepreneurial skills development. Clusters related to renewable energy and healthcare (seen in blue and light blue) show that AI research is thriving in these fields; however, the green cluster, with keywords such as South Africa, technology, education, and students, aligns more directly with the study's scope. This implies that the incorporation of AI into entrepreneurship education is often framed within broader socio-technical contexts, addressing regional challenges and educational needs specific to South Africa. The proximity of keywords like covid-19, skills, and adoption further implies an increased urgency to adopt AI in response to societal and educational disruptions.

Interestingly, the presence of teaching innovation is implicit through associated terms such as curriculum, skills, and technology adoption, which are closely clustered with education and students. This pattern reflects an emergent research interest in rethinking educational methods to incorporate AI as a catalyst for entrepreneurial teaching innovation. Furthermore, the keywords "business education" and "framework" connect within the red cluster, reinforcing the notion that structural approaches to integrating AI into business curricula are being explored. The presence of bibliometric and network analysis terms such as bibliometric analysis, framework, and trends suggests

that the field is still in a mapping and conceptual development phase. This indicates an opportunity for future studies to move beyond descriptive analysis and into more applied research that directly measures the impact of AI-driven interventions in entrepreneurship education. Overall, the map reflects a growing but still fragmented body of knowledge where entrepreneurship education, artificial intelligence, and teaching innovation are beginning to converge. However, it also points to a need for a more integrated research agenda that explicitly situates entrepreneurship teaching within the unique institutional contexts of South African universities of technology.

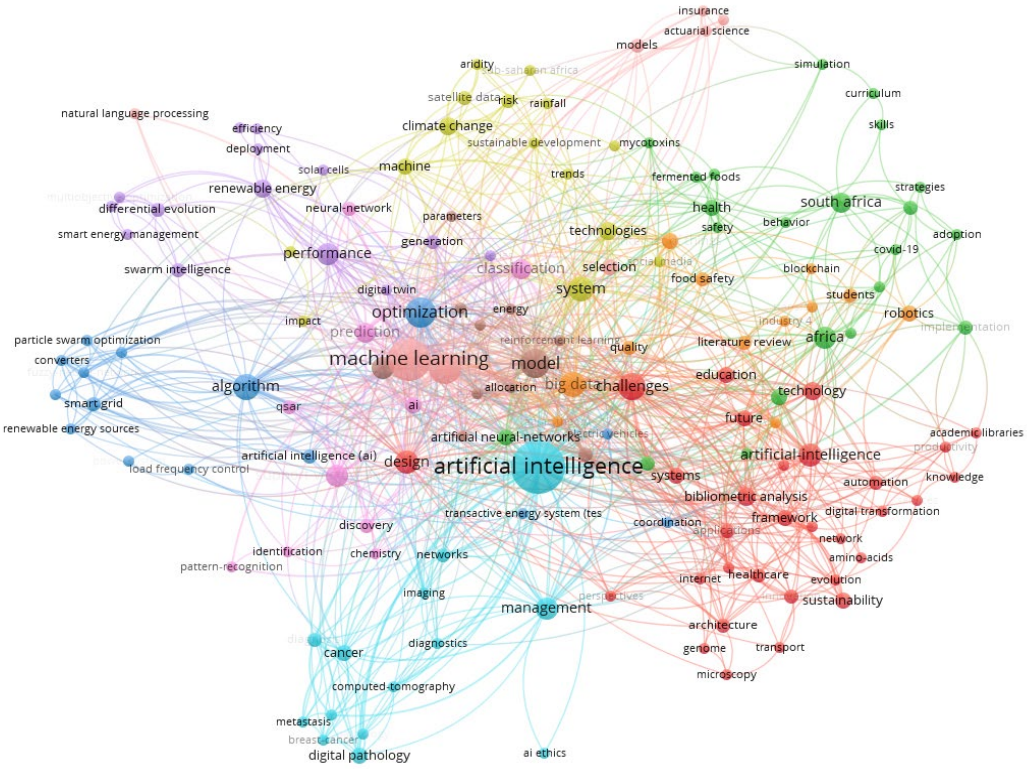

Figure 3. Keyword Co-occurrence Map (VOSviewer).

Thematic Map

The Thematic Map as shown in Figure 4, stipulates a strategic visualisation of the main research themes in the field, categorised by their relevance (centrality) and their development (density). The four equal parts, i.e., quadrants, namely, the Motor Themes, Basic Themes, Niche Themes, and Emerging or Declining Themes-allow for a nuanced interpretation of the structure and evolution of research concerning artificial intelligence, entrepreneurship education, and innovation in teaching. The Motor Themes quadrant, situated in the upper right, represents well-developed and highly focal areas of research. Here, keywords such as framework, future, and selection dominate. This reflects a strong focus on the strategic structuring of educational frameworks that integrate AI into entrepreneurship teaching, suggesting that universities of technology are increasingly concerned with building future-proof educational models. The presence of "future" signifies an emphasis on forward-looking pedagogical designs, aligning with the necessity to capacitate students with expertise for an AI-driven entrepreneurial landscape. In the Basic Themes quadrant (bottom right), terms like artificial intelligence, performance, model, optimisation, management, and technologies are clustered. These themes are foundational, indicating that AI application in business education, particularly regarding entrepreneurial teaching, is becoming an essential area of exploration. Their centrality but moderate development suggests that while these topics are critical, they are still evolving, offering opportunities for deeper

practical investigations, particularly in the South African university context. Occupying the Niche Themes quadrant (top left), the cluster featuring implementation, simulation, and skills points to specialised areas that are well-developed but less central to the broader field. This could imply that while AI-driven simulation tools and skill acquisition strategies are technically sophisticated, their integration into mainstream entrepreneurship education has not yet been fully realised in South African universities of technology. The Emerging or Declining Themes quadrant (bottom left) includes keywords like breast cancer, production, and quality, which appear relatively isolated and underdeveloped. Given the focus of this study, these themes are less relevant, likely representing peripheral biomedical applications of AI rather than educational innovations. However, the cluster of design, discovery, and generation nearby suggests potential cross-fertilisation opportunities for entrepreneurial ideation and innovation processes through AI, albeit still in the initial phases of development. It is important to note the proximity of challenges, system, algorithm, and networks straddling the boundary between Basic and Motor themes. This pattern indicates that addressing the challenges associated with deploying AI systems in education is becoming both a critical and increasingly sophisticated research direction. Overall, the thematic map demonstrates that while AI's role in entrepreneurship education is acknowledged as essential, much of the current research is still foundational, requiring more targeted strategies to foster teaching innovation within universities of technology, especially in the South African context.

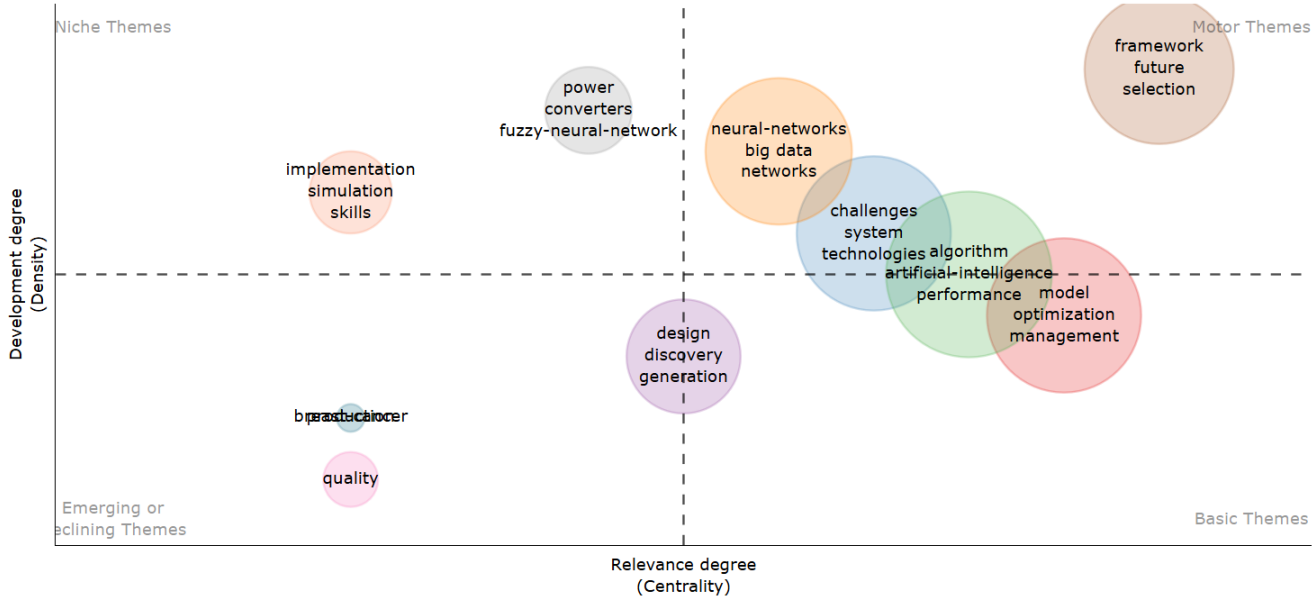

Figure 4. Thematic Map.

Three-Field Plot

Figure 5, i.e., the Three-Field Plot, visually maps the associations among three key elements: keywords (ID), source journals (SO), and authors' affiliations (AU_UN), offering significant contributions into the research dynamics underpinning the turf of artificial intelligence (AI) and entrepreneurship education at South African universities of technology. The dominant keywords, presented on the left-hand side include artificial intelligence, future, performance, model, optimisation, management, networks, and technologies. The strong emphasis on these keywords suggests that the research community is increasingly focusing on leveraging AI models and optimisation strategies to enhance business education and entrepreneurial training, particularly within the South African higher education segment (Opesemowo & Adekomaya, 2024). The recurring appearance of terms like framework and challenges further points to a growing critical analysis of integrating AI-based pedagogical models. In the centre, major journals such as Energies, Sustainability, IEEE Access, and Heliyon are prominently featured. These journals reflect a blend of engineering, technology, and broader sustainability perspectives, indicating an interdisciplinary approach to AI-

driven entrepreneurship education. Notably, journals such as the South African Journal of Libraries and Information Science and Cogent Education provide a direct educational context, highlighting efforts to bridge AI innovation with practical teaching strategies. On the right-hand side, several South African universities demonstrate significant research contributions, particularly the University of Johannesburg, University of Pretoria, University of the Western Cape, and University of Cape Town. Institutions traditionally classified as universities of technology, such as Durban University of Technology and Tshwane University of Technology, also feature prominently. This suggests an active, though still emerging, and engagement with AI applications to reimagine entrepreneurship education within the specific context of universities of technology in South Africa.

Interestingly, the strong linkages between keywords like artificial intelligence, framework, and future with journals such as Energies and Sustainability, and establishments such as the University of Johannesburg and University of Pretoria, illustrate how research in AI is being positioned not simply as a technical instrument but as a transformative educational innovation to drive future business leadership. However, universities of technology show comparatively fewer but strategically significant linkages, indicating a need for broader and deeper research initiatives to fully integrate AI into their entrepreneurial curricula. Overall, the three-field plot reveals that while South African universities are contributing to global AI educational research, the specific application towards entrepreneurship education at universities of technology remains a developing but promising area, with strong potential for future growth through interdisciplinary and applied research collaborations.

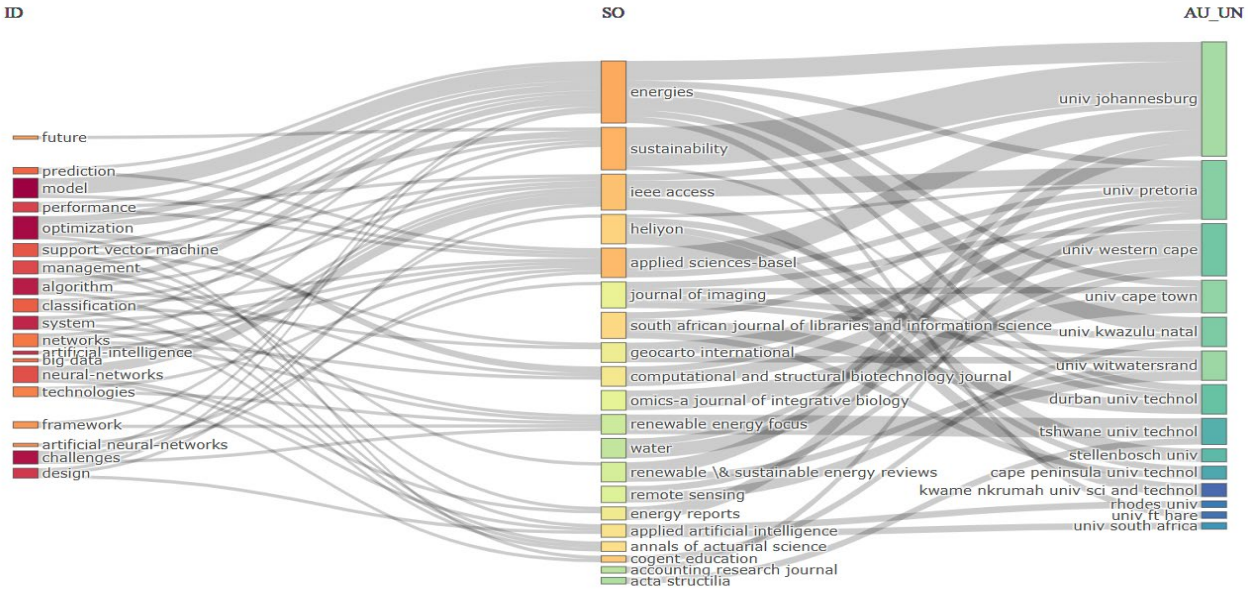

Figure 5. Three-Field Plot.

RESULTS

Publication Trends

The analysis of publication trends indicates a steady growth in research focused on the intersection of artificial intelligence and entrepreneurship education, particularly over the past decade. Early contributions in this field were largely theoretical, exploring conceptual frameworks and the potential of AI in education (Tarisayia, 2024). However, from 2020 onwards, there has been a noticeable rise in empirical studies, reflecting a global shift towards digital teaching methodologies, partially driven by the demands of remote learning during the COVID-19 pandemic (Xu & Ouyang, 2022; Wang et al,. 2024; Yusuf et al., 2025). Most research outputs originate from multidisciplinary

collaborations, bridging fields such as computer science, business studies, and education technology (Tayan et al., 2024; Khang et al., 2024; Khoa et al., 2025). Leading institutions contributing to this body of knowledge include the University of Johannesburg, University of Pretoria, and University of Cape Town. Although universities of technology, notably Durban University of Technology and Tshwane University of Technology, are involved, their representation remains relatively limited. This trend suggests that while South Africa's broader higher education segment is actively engaging with AI in education, focused efforts specifically within the context of universities of technology are still emerging.

AI Tools and Approaches in Entrepreneurship Teaching

The review reveals that a range of AI tools are being applied to entrepreneurship education, albeit in varying degrees of depth and scale. Simulations that model real-world business scenarios have been widely adopted to enhance experiential learning, allowing students to practice entrepreneurial decision-making in a risk-free environment (Ahuja, 2024). Intelligent tutoring systems, offering adaptive feedback and customized learning paths, are also gaining traction (Moleka, 2023). Furthermore, analytics tools are employed to monitor student engagement, assess entrepreneurial competencies, and predict learning outcomes (Gray & Perkins, 2019). Despite the growing awareness of these applications, the actual adoption levels of AI technologies at South African universities of technology remain modest. Pilot initiatives have been documented, such as AI-driven business simulation projects at the Durban University of Technology, which have shown positive outcomes in terms of student engagement and skill development. Nonetheless, comprehensive integration of AI into entrepreneurship curricula across UoTs is rare (Olaposi, 2021). Constraints such as limited funding, insufficient technical expertise among academic staff, and rigid curriculum structures inhibit widespread adoption (Mhlanga, 2024). Where implementation has occurred, students have benefited from enhanced opportunities for critical thinking, opportunity recognition, and strategic business planning, although these initiatives often remain isolated and project-specific rather than institutionally embedded (Moser, 2024).

Thematic Insights

Several key thematic insights emerge from the analysis of the reviewed literature. Enhancing engagement stands out as a critical advantage of AI use, with technologies such as gamified simulations and interactive learning platforms significantly increasing student motivation and participation rates (Renacido & Biray, 2025; Banik & Gullapelly, 2025). Students exposed to AI-enhanced environments often report a greater sense of relevance and immersion in entrepreneurial learning activities, which positively influences their learning outcomes (Wang & Huang, 2025). Another prominent theme is the personalization of learning (Musolin et al., 2024). AI tools allow educators to tailor content delivery based on individual learner profiles, accommodating diverse student needs and nurturing more inclusive learning settings (Shireesha & Jeevan, 2024). Assessment and feedback processes have also been positively influenced by AI applications, with automated systems providing immediate, detailed feedback that supports iterative learning and continuous improvement, essential in the development of entrepreneurial skills (Ekuma, 2024). However, staff training and resistance present persistent challenges. Numerous instructors lack the essential technical proficiency to successfully infuse AI into their teaching practices, and in some cases, there is resistance rooted in concerns over job security and the perceived complexity of AI technologies (Phokoye, 2024). Successful implementation of AI initiatives is often associated with strong institutional leadership, investment in professional development for academic staff, and strategic partnerships with technology providers (Nwachukwu & Ohalete, 2024). Conversely, barriers such as inadequate infrastructure (Tshona et al., 2025), high costs of AI adoption (McElheran et al., 2024), and skepticism about the relevance of AI to entrepreneurship education in the African context continue to impede progress.

Gaps and Underrepresentation

Despite the promising developments observed, significant gaps remain in the existing published scholarly work. One of the most pronounced is the limited number of studies focusing exclusively on universities of technology (Fitrianto, 2024). Given that UoTs are intended to lead applied, technology-driven education aligned with national development priorities, their marginal presence in this research area is notable. Furthermore, AI applications in entrepreneurship education are often implemented as supplementary tools rather than being systematically integrated into curriculum design (Olaposi, 2021). There is a distinct lack of strategic curriculum reform that embeds AI into the core structure of entrepreneurship programs, limiting the transformative potential of these technologies (Olaposi, 2021). Another critical gap is the minimal number of empirical evaluations conducted within the South African context (Monyela & Saba, 2024). Much of the available research is either conceptual or based on findings extrapolated from other global regions, thereby reducing the local applicability and relevance of the conclusions drawn. Addressing these gaps through robust, context-specific studies and curriculum innovation is crucial to realize the extensive capability of AI in enhancing entrepreneurship education within South African universities of technology.

DISCUSSION

Through this systematic review, the findings reveal that the integration of artificial intelligence (AI) into entrepreneurship education at South African Universities of Technology (UoTs) is progressing, yet remains uneven, fragmented, and often exploratory. Although UoTs are strategically positioned to foster applied, innovation-driven learning environments, particularly through experiential models, the embracing of AI technologies in these settings is still emerging. This mirrors broader universal trends in higher education, where AI is progressively leveraged to personalize learning, enhance feedback, and simulate real-world business environments (Wang et al., 2024; Yusuf et al., 2025). While international literature reflects substantial progress in embedding AI within entrepreneurship curricula, particularly across North America and Asia (Tayan et al., 2024), the South African UoT landscape reflects a nascent phase of development. Pilot projects and isolated implementations-such as AI-based business simulations and adaptive feedback tools-demonstrate positive impacts on student engagement and entrepreneurial competency (Ahuja, 2024; Khoza, 2022). However, the lack of institutionalized strategies and professional development mechanisms inhibits the scalability of these interventions across the UoT sector (Thelma & Ngulube, 2024; Chasokela, 2025).

The significant contribution of this study lies in its application of Experiential Learning Theory (ELT) as a critical lens. Kolb's (2015) model, which views learning as a continuous cycle comprising concrete experience, reflective observation, abstract conceptualization, and active experimentation, is highly compatible to the nature of entrepreneurship education. The reviewed literature affirms that AI tools-particularly simulations, performance dashboards, and intelligent feedback systems-can operationalize each phase of the ELT cycle (Khoza, 2022). AI enables students to simulate entrepreneurial decisions, reflect on real-time outcomes, generalize insights, and iteratively test new strategies in a low-risk, digitally mediated environment (Jan, 2024; Rosen, 2023). Nevertheless, the integration of AI into UoT pedagogy often lacks the design intentionality required to fully engage all phases of experiential learning. Poor contextualization, superficial feedback mechanisms, and limited alignment with local entrepreneurial ecosystems risk reducing AI to a technological add-on rather than a pedagogical catalyst (Khoza, 2022; Aguma, 2025). This observation is particularly critical in light of South Africa's educational disparities and digital divides, where many institutions still face infrastructural and capacity constraints (Aderibigbe et al., 2023; Mhlanga, 2024).

Furthermore, successful AI integration demands a cultural and institutional shift in teaching practice. As the findings indicate, many UoT educators lack sufficient training and confidence to design or facilitate AI-enhanced learning environments (Phokoye et al., 2024). This results in limited adoption or resistance to change, especially in

the absence of sustained professional development or strategic institutional support (Olaposi, 2021; Nwachukwu & Ohalete, 2024). Without addressing these foundational gaps, AI-driven innovation in entrepreneurship education risks deepening rather than bridging existing inequities. At a broader level, this study contributes to continuing discourse around the responsibility of higher education in meeting the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth). By embedding AI in entrepreneurship curricula, UoTs can play a fundamental role in building inclusive, digitally literate entrepreneurial ecosystems that stimulate local innovation and employment (Opesemowo & Adekomaya, 2024). However, doing so requires intentional curriculum reform, investment in infrastructure, and cross-sector collaboration to safeguard that digitalization is meaningful and equitably deployed.

In sum, the discussion affirms the potential of AI to support experiential entrepreneurship learning at UoTs but highlights that this potential is contingent on several interrelated factors: the quality of instructional design, institutional capacity, policy alignment, and pedagogical readiness. Moving forward, a locally responsive, theoretically grounded, and equity-driven approach is essential to safeguard that AI integration augments-not displaces-the transformative role of entrepreneurship education in the South African UoT sector.

IMPLICATIONS AND RECOMMENDATIONS

Stakeholder	Recommendations	Contribution / Questions for Future Research
For UoT Educators and Curriculum Developers	- Integrate AI tools such as business simulations, intelligent tutoring systems, predictive analytics, and personalised learning platforms to enhance practical entrepreneurship teaching. - Implement continuous professional development programmes to upskill faculty in digital pedagogies and AI literacy.	- How can AI be most effectively embedded into entrepreneurship pedagogy to support experiential learning? - What models of faculty training best promote sustained AI integration in entrepreneurship education at UoTs?
For Policymakers and Institutional Leaders	- Prioritise investment in AI-related infrastructure, including hardware, software, and technical support teams. - Foster collaborative innovation networks across universities of technology to share best practices, co-develop resources, and scale successful interventions.	- What policies best incentivise meaningful AI adoption in entrepreneurship education? - How can inter-institutional networks drive innovation without exacerbating inequalities between UoTs?
For Future Research	- Conduct empirical, contextually grounded case studies focusing on the implementation of AI tools in South African entrepreneurship education - Develop and apply evaluation frameworks that measure AI's pedagogical impact specifically within entrepreneurship teaching and learning environments.	- What empirical evidence exists for AI's impact on entrepreneurship learning outcomes in African UoTs? - How can AI's contribution to entrepreneurial competencies be systematically assessed over time?

CONCLUSION

The strategic incorporation of Artificial Intelligence (AI) tools into entrepreneurship education within Universities of Technology (UoTs) was examined in this study, with a particular emphasis on the roles of educators, policymakers, and future researchers. Drawing on a stakeholder-centred framework, the study proposed targeted recommendations aimed at enhancing experiential learning through AI-driven pedagogical innovations, supporting infrastructure development, and fostering collaborative institutional networks to facilitate knowledge exchange and scalable interventions. The findings advance the scholarly work on AI adoption in higher education by providing a

contextually grounded analysis that addresses the specific challenges and opportunities facing African UoTs. Moreover, the study contributes to policy discourse by identifying critical levers for incentivising meaningful AI integration in entrepreneurship education, and by outlining an agenda for future empirical research focused on pedagogical impact and competency development. In closing, this research underscores the potential for UoTs to take a leading stance in the evolution of AI-driven business education. Through strategic investments in AI literacy, institutional collaboration, and continuous curriculum innovation, UoTs can not only augment the quality and relevance of entrepreneurship education but also position themselves at the forefront of shaping digitally empowered entrepreneurial ecosystems across the continent.

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