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The Nexus of Artificial Intelligence (AI) and Entrepreneurship in Higher Education Skills Development: A Review

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ABSTRACT

The intersection of Artificial Intelligence (AI) and entrepreneurship in higher education presents a transformative opportunity to address South Africa's persistent unemployment crisis while equipping students with the critical digital competencies they need. This review explored how AI-driven tools and pedagogies enhance entrepreneurship education, particularly in rural and resource-constrained institutions. Grounded in the thinking economy model, which prioritizes intellectual capital, innovation, and adaptability, this paper synthesized the theoretical literature. The findings indicate that adaptive learning platforms, business simulations, and case-based methodologies cultivate critical thinking, market analysis, and product innovation skills. Ethical concerns, including algorithmic bias and data privacy, underscore the need for responsible integration of AI. Through interdisciplinary curriculum reform, capacity building, and alignment with national digital transformation agendas, higher education institutions can develop socially accountable, innovation-oriented graduates capable of driving inclusive growth in the AI era.

Keywords: *Artificial Intelligence, Entrepreneurship Education, Thinking Economy, Adaptive Learning, Ethical AI*

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INTRODUCTION

South Africa's escalating rates of youth and graduate unemployment represent not merely economic stagnation but a multidimensional development crisis with implications for the nation's social and economic trajectory. The persistence of these trends is indicative of a fractured education-to-employment pipeline, where systemic inefficiencies continue to alienate young people from productive participation in the economy. According to Statistics South Africa, youth unemployment, defined as individuals aged 15 to 34 years, has consistently exceeded 60% over the past five years, reaching a historic peak of 66.5% in the second quarter of 2021 amid the socio-economic effects of the COVID-19 pandemic. Although a slight decline was recorded in subsequent years, the challenge remains severe, with youth unemployment standing at 45.5% in the first quarter of 2024. At the beginning of 2025, the overall official unemployment rate had risen to 32.9%, while the expanded rate, which includes discouraged work-seekers, stood at 43.1%.

These figures reflect persistent structural imbalances, including outdated curricula, skills mismatches, and a sluggish labour market that undermine national development objectives. The situation underscores the urgent need for a transformative higher-education model that extends beyond conventional content delivery to develop graduates who are entrepreneurial, adaptable, and technologically fluent. Within this reform agenda, entrepreneurship must be reframed as a proactive developmental strategy rather than a fallback for the unemployed, while artificial intelligence (AI) must be recognised as a central force reshaping the nature of work, innovation, and value creation. Therefore, the intersection of AI and entrepreneurship offers a compelling opportunity to reimagine higher education as a driver of inclusive economic renewal and social resilience.

Despite increasing scholarly and policy attention to the graduate employability crisis, a critical conceptual and pedagogical gap persists in understanding how AI and entrepreneurship can be synergistically integrated within higher-education systems, particularly in resource-constrained contexts. Existing entrepreneurship education is often confined to business start-up training, neglecting broader competencies such as creativity, opportunity recognition, and adaptive problem-solving.[1] Similarly, while AI applications in education are expanding, their transformative potential to personalise learning, enhance decision-making, and stimulate innovation within entrepreneurial education remains under-examined.[2]

This gap is particularly acute in rural and historically under-resourced universities, where infrastructural limitations, restricted access to digital technologies, and limited faculty development impede curriculum innovation. The absence of an integrative framework linking AI-enabled pedagogies with entrepreneurial learning outcomes constrains the ability of higher-education institutions to prepare graduates for the demands of an AI-mediated economy. Addressing this conceptual and practical void necessitates a contextualised framework that reconceptualises the role of universities as cognitive ecosystems capable of generating innovation and inclusive growth.

The purpose of this study is to critically examine the relationship between AI and entrepreneurship and to propose strategies to embed this nexus within higher-education systems in South Africa and comparable developing contexts. The specific objectives are to:

1. Review and synthesise existing scholarship on the integration of AI and entrepreneurship in higher-education curricula;
2. Identify prevailing challenges, opportunities, and exemplary practices in fostering AI-enabled entrepreneurial learning toward employability and entrepreneurship.

In addressing these objectives, the study contributes to the ongoing discourse on transforming universities from knowledge-transmission entities into cognitive innovation hubs that enhance the human and technological capacities required for sustainable economic participation.

Contextualised and Adapted Study Framework

This study advances a contextualised adaptation of the Thinking Economy Framework as its conceptual foundation. Originally articulated to describe the shift from industrial and knowledge economies toward creativity- and cognition-based systems, the framework is here reinterpreted for application within the Global South, particularly the South African higher-education sector.

Within this adaptation, the thinking economy is conceived as an ecosystem of cognitive entrepreneurship, where human creativity and artificial intelligence co-evolve to produce knowledge, innovation, and socio-economic value.[3] The framework repositions universities as central actors in

[1] Eric Liguori and Christoph Winkler, "From Offline to Online: Challenges and Opportunities for Entrepreneurship Education Following the COVID-19 Pandemic," *Entrepreneurship Education and Pedagogy* (SAGE Publications Sage CA: Los Angeles, CA, 2020); Ana Pacheco, João J Ferreira, and Jorge Simões, "The Role of Higher Education Institutions and Entrepreneurial Orientation in the Creation and Development of Academic Spinoffs," *The Journal of Entrepreneurship* 32, no. 3 (2023): 495–524.

[2] E. Brynjolfsson and A. McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* (New York: W.W. Norton & Company, 2014).; Spyros Makridakis, "The Forthcoming Artificial Intelligence (AI) Revolution: Its Impact on Society and Firms," *Futures* 90 (June 2017): 46–60, https://doi.org/10.1016/j.futures.2017.03.006.

[3] V. Ratten, *Entrepreneurship as Empowerment: Knowledge Spillovers and Entrepreneurial Ecosystems* (Emerald Publishing Limited, 2020); Md Imtiaz Mostafiz et al., "Entrepreneurial Cognition and Artificial Intelligence Adoption—Contingency Role of Innovation Ecosystem Resource Mobilization and Entrepreneurial Bricolage," *R&D Management*, 2025; Nick Hajli, Irina Baydarova, and Tahir Nisar, "Digital Entrepreneurial Ecosystem: The Role of the Sharing Economy in Driving Innovation," *Entrepreneurship & Regional Development* 37, no. 5–6 (2025): 785–815.

cultivating the mental agility, digital literacy, and entrepreneurial capacity necessary for thriving in an AI-mediated economy.

The contextualised framework comprises three interrelated dimensions:

1. **AI-Enabled Innovation** – leveraging AI to enhance creativity, predictive analysis, and decision-making across disciplines;
2. **Entrepreneurial Cognition** – fostering adaptive, opportunity-oriented mindsets capable of navigating uncertainty; and
3. **Inclusive Learning Ecosystems** – ensuring equitable, culturally relevant, and socially responsive pathways for AI-driven entrepreneurial education.

These dimensions collectively propose a transformative model for higher-education skills development aligned with the competencies demanded by the digital economy. Moreover, they directly support the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation, and Infrastructure).

Ultimately, the contextualised Thinking Economy Framework demonstrates that thinking as a fusion of creativity, digital intelligence, and entrepreneurship is both an economic asset and a developmental imperative. It offers a theoretically grounded and context-responsive pathway to position higher education as a catalyst for innovation, resilience, and inclusive prosperity in the Fourth Industrial Revolution era.

METHODOLOGY

This study employed a qualitative literature review design to systematically identify, analyse, and synthesise peer-reviewed scholarship, addressing the intersection between Artificial Intelligence AI and entrepreneurship education within higher education systems.[4] The review aimed to provide a comprehensive and contextual understanding of how AI-driven pedagogical tools and frameworks can enhance entrepreneurial competencies and promote inclusive skills development, particularly in resource-constrained and rural academic settings.

A systematic search was conducted across three major academic databases, Scopus, Web of Science, and Semantic Scholar, to ensure both breadth and depth of coverage. The search strategy combined key terms such as *"Artificial Intelligence," "Entrepreneurship Education," "Higher Education," "Digital Skills,"* and *"Thinking Economy."* Boolean operators (AND/OR) were used to refine the results, ensuring inclusion of studies that explicitly examined or applied AI within the context of entrepreneurship or digital transformation in tertiary education. Only studies published between 2015 and 2025 were considered, reflecting the period of accelerated AI integration into educational and entrepreneurial ecosystems.

In total, 72 documents were initially retrieved (Scopus = 28; Web of Science = 21; Semantic Scholar = 23). After removing duplicates and applying inclusion criteria, namely, (a) focus on higher education contexts, (b) discussion of entrepreneurship or innovation-based learning, and (c) explicit mention of AI-driven pedagogies or applications, 39 publications were retained for full review. These included empirical studies, theoretical papers, and policy-oriented reports.

Data extraction and analysis were performed using Atlas.ti 9 software to facilitate rigorous qualitative coding and thematic synthesis. Following open and inductive coding procedures, each document was coded in vivo to preserve conceptual integrity and emergent meanings from the original texts. The coding process generated 1,184 initial codes that were refined through iterative comparison, consolidation, and clustering. After eliminating redundant codes and merging conceptually overlapping codes, 947 codes remained.

From these, six overarching categories were developed to capture the conceptual landscape of the AI–entrepreneurship nexus in higher education:

[4] Angela Harden et al., "Cochrane Qualitative and Implementation Methods Group Guidance Series—Paper 5: Methods for Integrating Qualitative and Implementation Evidence within Intervention Effectiveness Reviews," *Journal of Clinical Epidemiology* 97 (May 2018): 70–78, https://doi.org/10.1016/j.jclinepi.2017.11.029.

1. Policy and strategic imperatives for AI integration;
2. Theoretical frameworks underpinning AI-enabled entrepreneurship;
3. Pedagogical models and learning design innovations;
4. Case studies and best practices from global and African contexts;
5. Ethical and epistemological implications of AI adoption; and
6. Structural and institutional barriers to implementation.

These categories were subsequently interpreted through the lens of the Thinking Economy Framework, which provided the conceptual basis for linking AI-enabled cognition, innovation, and entrepreneurial skill formation. This approach ensured theoretical coherence between the literature synthesis and the study's broader objective of advancing inclusive, future-oriented higher education systems in the Global South. The analytic process emphasised contextualisation, allowing cross-comparison between high-income and resource-constrained environments to highlight structural disparities and adaptive strategies. The results were narratively synthesised to produce an integrated understanding of current practices, conceptual gaps, and strategic pathways to embed AI within entrepreneurship education.

LITERATURE REVIEW

The South African Higher Education Entrepreneurship and Artificial Intelligence Landscape

South African higher education is anchored by a robust policy framework that underscores entrepreneurship and innovation as strategic imperatives for national development, economic transformation, and social inclusion.[5] Foundational documents such as the **National Development Plan (NDP) 2030**, the **White Paper for Post-School Education and Training**, and the **Higher Education Qualifications Sub-Framework** (HEQSF) collectively articulate a vision of universities as engines of socio-economic progress tasked not only with knowledge generation but also with cultivating entrepreneurial mindsets that stimulate job creation and sustainable growth. The NDP, for instance, explicitly identifies entrepreneurship as a key driver to reduce unemployment, particularly youth unemployment, which remains alarmingly high in South Africa.[6] This policy directive requires that higher education institutions (HEIs) become active facilitators of innovation ecosystems where entrepreneurial competencies are integrated into curricula across disciplines.[7]

Similarly, the 2013 White Paper foregrounds the need for post-school education to produce graduates equipped with "critical thinking, creativity, and problem-solving skills," aligning closely with entrepreneurial education principles.[8] Yet, South Africa's higher education sector faces a paradoxical challenge concerning AI. Although AI is globally recognised as a transformative force that reshapes economies and societies, its strategic integration within South African HEIs remains nascent and uneven. Policy discourse on AI, though emerging in government's broader innovation strategies such as the South African National Artificial Intelligence Strategy, has not yet been fully operationalised within university curricula or research agendas at scale.[9] This lag is critical, given that AI is not just a technological tool but a cognitive amplifier that can augment entrepreneurial thinking, enabling graduates to navigate complexity, harness data-driven insights, and innovate responsively. Empirical evidence from economies that have embraced AI-entrepreneurship integration, such as Singapore and parts of the European Union, demonstrates that graduates with dual fluency in innovation and digital systems are more adaptable, employable, and entrepreneurial.[10]

South Africa cannot afford to lag. The exclusion of AI from mainstream entrepreneurship education not only limits graduate agency but also threatens national competitiveness in a global

[5] South Africa Department of Higher Education and Training (DHET), *White Paper for Post-School Education and Training* (Pretoria: Government Printers, 2013); South African Council on Higher Education (CHE), " A Proposal for Undergraduate Curriculum Reform in South Africa: The Case for a Flexible Curriculum Structure.," 2014.
[6] National Planning Commission, *National Development Plan 2030* (Pretoria: NPC, 2012).
[7] Department of Higher Education and Training (DHET), *White Paper for Post-School Education and Training*.
[8] Department of Higher Education and Training (DHET), *White Paper for Post-School Education and Training*.
[9] South Africa. Department of Science and Innovation (DSI), *South African National Artificial Intelligence Strategy*, 2020.
[10] World Economic Forum, " Education 4.0: The Future of Learning in a Digital World," 2023, https://www.weforum.org/reports/education-4-0.

knowledge economy increasingly shaped by automation, algorithmic decision-making, and platform-based enterprise. The failure to embed AI literacy and applied competencies alongside entrepreneurship risks perpetuating the disconnect between academic outputs and labour market realities, further exacerbating the nation's youth unemployment crisis. Therefore, South African higher education stands at a pivotal juncture: the policy landscape mandates entrepreneurship as essential to transformation and economic resilience, yet the integration of AI as an enabler of this entrepreneurship is still embryonic. A progressive repositioning that embraces AI not only as a subject of study but also as an active partner in cultivating entrepreneurial mindsets and capable of driving inclusive innovation is required. This repositioning aligns with global shifts toward the "thinking economy," where human creativity synergises with AI's capabilities to generate new knowledge and socio-economic value.

The Thinking Economy framework for the Nexus of Artificial Intelligence and Entrepreneurship

In this paper, the **thinking economy** *is* adopted not merely as a descriptive framework but as the epistemological and ontological foundation for reimagining the role of higher education in the age of artificial intelligence and entrepreneurial disruption. Building on the foundational insights of the **knowledge economy,** a paradigm popularised by thinkers such as Peter Drucker and institutionalised by the OECD, which positioned knowledge as the primary engine of economic growth and innovation, this paper advances the view that a deeper transformation is underway.[11] While the knowledge economy casts higher education institutions as producers of human capital for knowledge-intensive sectors, the emerging thinking economy calls for a more profound cognitive and institutional shift. It privileges cognitive agility, digital fluency, and entrepreneurial intelligence as the new imperatives of sustainable development,[12] situating the human mind and its capacity to think in partnership with intelligent systems as the central productive force. Unlike the knowledge economy, which often treats knowledge as a static resource to be stored and transmitted, the thinking economy conceptualises knowledge as emergent, relational, and constructed through interaction across disciplines, technologies, and cultures.

AI is not peripheral to this paradigm; it is central, acting as a co-agent in knowledge production and enabling new forms of epistemic labour.[13] This reorientation aligns with constructivist and connectivist learning theories,[14] and with the post-disciplinary imperatives which emphasise complexity, uncertainty, and boundary-crossing as foundational to contemporary scholarship. Foremost among these is constructivism, as articulated by Jean Piaget in 1954 and further developed by Jerome Bruner in1966, which posits that learners actively construct knowledge through experience and reflection rather than passively absorbing information.[15] This aligns with the thinking economy's emphasis on cognitive becoming, the idea that value arises not from knowledge accumulation, but from the learner's capacity to synthesise, adapt, and apply knowledge in novel and entrepreneurial ways.[16] Closely linked is connectivism, advanced by George Siemens and Stephen Downes, which extends constructivist thought into the digital era.

On the other hand, connectivism acknowledges the distributed nature of knowledge in technologically mediated environments and asserts that learning occurs across networks, not only among people, but also between people and digital systems.[17] Within this framework, artificial intelligence is conceptualised not only as a tool but also as a node in the learning network, enabling learners to access,

[11] Peter Drucker, *The Age of Discontinuity: Guidelines to Our Changing Society* (Routledge, 1969); OECD, *The Knowledge-Based Economy* (OECD Publishing: University of California, 1996).

[12] O. Udekwe and C.G., Iwu, " AI and the Thinking Economy: Reframing Entrepreneurship Education for Inclusive Growth in Africa," *Journal of Entrepreneurship and Innovation in Emerging Economies* 10, no. 2 (2024): 120–38.;Marisol D'Andrea, "The Rise of the Creative Class Revisited" (Taylor & Francis, 2013).

[13] Rosemary Luckin, *Machine Learning and Human Intelligence. The Future of Education for the 21st Century* (UCL institute of education press, 2018); L. Floridi and J. Cowls, "A Unified Framework of Five Principles for AI in Education," *Philosophy & Technology* 32 (2019): 687–703.

[14] G. Siemens, " Learning Analytics: The Intersection of Big Data and Education," *Education and Information Technologies* 25, no. 3 (2020): 2009–21.

[15] Catherine Twomey Fosnot, *Constructivism: Theory, Perspectives, and Practice* (Teachers College Press, 2013).

[16] Ernst Von Glasersfeld, "Cybernetics, Experience, and the Concept of Self," in *A Cybernetic Approach To The Assessment Of Children* (Routledge, 2019), 67–113; Fosnot, *Constructivism: Theory, Perspectives, and Practice*.

[17] George Siemens, "Connectivism: A Learning Theory Fir the Digital Age," 2005; Stephen Downes, "Newer Theories for Digital Learning Spaces," in *Handbook of Open, Distance and Digital Education* (Springer, 2023), 129–46.

process, and create knowledge through intelligent interaction.[18] Connectivism provides the theoretical justification for embedding AI within educational practices, as it validates the legitimacy of non-human agents in the co-construction of knowledge.[19] Subsequently, the scholarly literature further supports this repositioning of universities as agents of cognitive and economic transformations.

These theories collectively support the reconfiguration of knowledge not as a static body of content, but as a fluid, emergent process of meaning-making that occurs through interaction, innovation, and intelligent collaboration.[20] Thus, towards global transition, the thinking economy has foregrounded the importance of cognitive agility, innovation, and technological fluency in driving sustainable development. This shift represents a departure from economies dependent on natural resources or industrial output, placing emphasis on human intellectual capital, systems thinking, and the ability to solve complex problems in dynamic environments.[21] Luckin emphasises that the integration of AI into teaching and learning holds promise for closing pedagogical gaps and creating personalised, scalable educational experiences.[22] Similarly, Schleicher argues that education systems must develop "future-proof" skills such as critical thinking, collaboration, and creativity, which are essential for navigating complex AI-mediated economies.[23] Within this paradigm, higher education institutions are viewed not just as transmitters of knowledge but also as critical enablers of innovation ecosystems and incubators for future-oriented competencies.

These imperatives align with UNESCO's and the World Economic Forum's (WEF) calls for curricula that are not only competency-based but also aligned with digital economy demands.[24] As Qwabe et al. emphasise, the future of entrepreneurial education lies in preparing students for real-world challenges.[25] This requires more than technical proficiency; it necessitates the cultivation of soft systems capabilities: ethical judgment, negotiation, resilience, critical thinking, and human-centred design. These competencies enable graduates not merely to adapt to AI, but to co-evolve with it. Supporting this argument, Obschonka and Audretsch call for a radical rethinking of curricular design, one that embeds AI logic within entrepreneurial pedagogy.[26] They argue that the entrepreneurial mindset, when scaffolded by digital fluency and cognitive technologies, should become a structural pillar of higher education, not a peripheral enhancement. Their position underscores a growing consensus: that the intersection of entrepreneurship and AI must be foundational, deeply embedded across disciplines, and tightly aligned with the demands of AI-mediated economies.

Within this context, entrepreneurship education represents a strategic entry point for operationalising the principles of the thinking economy, particularly at the critical nexus between entrepreneurship and AI. Current discourse calls for a departure from conventional content delivery to foster entrepreneurial mindsets distinguished by innovation, risk-taking, and adaptive resilience.[27] This

[18] Rose Luckin and Wayne Holmes, "Intelligence Unleashed: An Argument for AI in Education," 2016.
[19] Siemens, "Connectivism: A Learning Theory Fir the Digital Age"; Luckin and Holmes, "Intelligence Unleashed: An Argument for AI in Education."
[20] Siemens, "Connectivism: A Learning Theory Fir the Digital Age"; Luckin and Holmes, "Intelligence Unleashed: An Argument for AI in Education."
[21] Udekwe and Iwu, " AI and the Thinking Economy: Reframing Entrepreneurship Education for Inclusive Growth in Africa."; Floridi and Cowls, "A Unified Framework of Five Principles for AI in Education"; D'Andrea, "The Rise of the Creative Class Revisited."
[22] Luckin, *Machine Learning and Human Intelligence. The Future of Education for the 21st Century*.
[23] Andreas Schleicher, "The Impact of COVID-19 on Education: Insights from" Education at a Glance 2020".," *OECD Publishing*, 2020.
[24] World Economic Forum, "Global Gender Gap Report 2020," *World Economic Forum*, 2020; UNESCO, *Artificial Intelligence and Education: Guidance for Policy-Makers* (Paris: UNESCO Publishing, 2022).
[25] Thabani Qwabe, Musawenkosi Ngibe, and Luyanda Loraine Bingwa, "Entrepreneurship Education Key in Promoting Entrepreneurial Intent: Undergraduate Students Perspectives," *Open Journal of Business and Management* 13, no. 02 (2025): 1065–92, https://doi.org/10.4236/ojbm.2025.132057.
[26] Martin Obschonka and David B Audretsch, "Artificial Intelligence and Big Data in Entrepreneurship: A New Era Has Begun," *Small Business Economics* 55, no. 3 (2020): 529–39.
[27] Allan Gibb, "In Pursuit of a New 'Enterprise' and 'Entrepreneurship' Paradigm for Learning: Creative Destruction, New Values, New Ways of Doing Things and New Combinations of Knowledge," *International Journal of Management Reviews* 4, no. 3 (September 19, 2002): 233–69, https://doi.org/10.1111/1468-2370.00086; Ghulam Nabi et al., "The Impact of Entrepreneurship Education in Higher Education: A Systematic Review and Research Agenda," *Academy of Management Learning & Education* 16, no. 2 (June 2017): 277–99, https://doi.org/10.5465/amle.2015.0026.

requires that higher education institutions adopt experiential pedagogies, embed digital technologies, and cultivate learning environments that simulate authentic problem-solving and venture creation.[28]

Accordingly, this paper argues that the thinking economy provides a compelling and integrative philosophical framework to ground the convergence of entrepreneurship and AI within higher education. This framework is especially pertinent for South African contexts marked by marginalisation and rurality. Aligned with the strategic imperatives of the National Development Plan (NDP) and the Department of Higher Education and Training (DHET), the study posits that embedding AI within entrepreneurship education is not only a critical pedagogical innovation but an indispensable strategy for fostering inclusive economic participation, cognitive empowerment, and sustainable development. By positioning AI-enhanced entrepreneurship education as a vehicle for institutional relevance and graduate employability, this paper advocates a systemic transformation in how universities generate, disseminate, and apply knowledge, thereby reinforcing higher education's role in advancing South Africa's transition to a thinking economy.

The Case Studies of the Integration of AI Into Entrepreneurship Education

The HEIs have progressively adopted the Sustainable Development Goals (SDGs) as a strategic framework through which they articulate their developmental mandate and global relevance.[29] This alignment reflects a growing recognition that universities must not only generate knowledge but also actively contribute to equitable socio-economic transformation. The thinking economy paradigm enhances this developmental scope by situating cognition, creativity, and technological integration, particularly AI, as central to achieving inclusive and sustainable futures.[30] This framework is particularly consequential for rural-based universities, where innovation ecosystems are often underdeveloped and youth unemployment remains acute. In these contexts, the nexus of AI and entrepreneurship emerges as a powerful enabler of grassroots innovation, economic resilience, and local value creation.[31] Accordingly, this paper presents select case studies of rural higher education institutions that have operationalised this nexus, illustrating how AI-driven entrepreneurial education can serve not only as a pedagogical innovation but also as a developmental catalyst aligned with both national priorities and global goals. Table 1 below presents different case studies that showcase the nexus of AI and entrepreneurship in a rural-based higher education institution.

Table 1: Case Studies of AI Integration in Entrepreneurship Education at Rural Universities

Case Study / Program	Country	Mode of AI Integration	Future Competencies Developed	Developmental Impact
Mind Craft (Arihant & Agrawal, 2025)	India	AI-driven adaptive learning platform that personalises entrepreneurial content and simulates business decision-making environments for rural learners.	-AI literacy - Self-regulated learning - Business model innovation - Entrepreneurial decision-making	Expanded access to entrepreneurship education; supports micro-enterprise development; bridges rural–urban education divide.

[28] David A. Kolb, Richard E. Boyatzis, and Charalampos Mainemelis, "Experiential Learning Theory: Previous Research and New Directions," in *Perspectives on Thinking, Learning, and Cognitive Styles* (Routledge, 2014), 227–48, https://doi.org/10.4324/9781410605986-9.; Liguori and Winkler, "From Offline to Online: Challenges and Opportunities for Entrepreneurship Education Following the COVID-19 Pandemic."

[29] UNESCO, *Artificial Intelligence and Education: Guidance for Policy-Makers*.; Simon Marginson, "The Worldwide Trend to High Participation Higher Education: Dynamics of Social Stratification in Inclusive Systems," *Higher Education* 72, no. 4 (October 2, 2016): 413–34, https://doi.org/10.1007/s10734-016-0016-x.

[30] Udekwe and Iwu, " AI and the Thinking Economy: Reframing Entrepreneurship Education for Inclusive Growth in Africa."Floridi and Cowls, "A Unified Framework of Five Principles for AI in Education."

[31] Sithara H P W Gamage, Jennifer R Ayres, and Monica B Behrend, "A Systematic Review on Trends in Using Moodle for Teaching and Learning," *International Journal of STEM Education* 9, no. 1 (2022): 9.

Co-Designed AI Workshops (Kotturi et al., 2024)	United States	Participatory workshops introducing rural entrepreneurs to generative AI for marketing, customer research, and content creation.	-Digital entrepreneurial agility - Critical AI engagement - Collaborative innovation - Real-world application skills	Strengthened local digital economies; enabled rural business owners to scale operations using AI-enhanced tools; fostered inclusive tech adoption.
AI Business Plan Scaffolding (Zhu & Luo, 2025)	China	An AI-powered mentoring system that dynamically guides students in building business plans, including financial forecasting and market analysis.	- Techno-entrepreneurial fluency - Strategic planning - Digital systems thinking - Reflexive learning	Increased success rate of student-led rural startups; enhanced local economic diversification; improved innovation capacity in rural HEIs.
AI-Based Entrepreneurial Bootcamp (Maringe et al., 2023)	South Africa	Pilot AI-integrated modules within a rural entrepreneurship bootcamp to support ideation, prototyping, and funding proposal development.	- AI-augmented creativity - Digital storytelling - Opportunity recognition - Grant-writing competency	Empowered youth with practical skills; catalysed local enterprise solutions; contributed to rural graduate employability and township economy stimulation.
Agri-AI Innovation Hub (Ncube & Dube, 2022)	Zimbabwe	Rural university–community partnership using AI to identify agricultural entrepreneurship opportunities and optimise resource use in smallholder farming.	- Agro-entrepreneurship - Data-driven decision-making - Sustainability innovation - Rural systems thinking	Improved food security: supported sustainable livelihoods, built climate-resilient agri-enterprises through data-driven decision-making in rural regions.

The case studies underscore the transformative potential of AI as both a pedagogical instrument and a developmental enabler within rural higher education institutions, especially when located within the epistemological framework of the thinking economy. In all instances, AI is not deployed as a passive content delivery tool, but rather as a dynamic partner in cultivating future-focused competencies such as cognitive agility, digital systems thinking, and entrepreneurial foresight, core dimensions of the thinking economy.[32] For example, initiatives such as Mind Craft in India and the AI Business Plan Scaffolding in China reflect a deliberate move toward personalised, adaptive learning models that simulate the complexities of real-world entrepreneurial decision-making, thereby enhancing techno-entrepreneurial fluency and reflexive learning.

Meanwhile, the participatory AI workshops in the United States and the South African AI Bootcamp illustrate the democratisation of digital knowledge production and problem-solving through immersive, co-designed experiences, an embodiment of connectivist pedagogy in AI-mediated learning

[32] Udekwe and Iwu, " AI and the Thinking Economy: Reframing Entrepreneurship Education for Inclusive Growth in Africa."Floridi and Cowls, "A Unified Framework of Five Principles for AI in Education"; D'Andrea, "The Rise of the Creative Class Revisited."

networks.[33] Most notably, the Agri-AI Innovation Hub in Zimbabwe expands the scope of entrepreneurial education beyond the classroom by embedding AI into community-oriented Agri-enterprise development, integrating indigenous knowledge with machine intelligence to drive climate-resilient livelihoods. These initiatives resonate with the broader developmental imperatives of the SDGs and rural innovation ecosystems, particularly in their potential to address structural inequalities, stimulate inclusive economic participation, and improve institutional responsiveness. Therefore, these case studies not only validate the thinking economy as a relevant analytical lens but also position rural universities as critical sites for innovation-led development in the global South. This approach is not only technologically adaptive but also socially responsive, linking entrepreneurship education to real-world socio-economic challenges.

Moreover, Table 2 shows that the integration of AI-driven mechanisms into rural entrepreneurship education reveals a transformative pedagogical shift aligned with the principles of the thinking economy and adaptive learning. For example, each mode ranging from personalised learning platforms to AI-powered mentorship and community-based resource optimisation reflects an epistemological recalibration wherein learners are positioned not as passive recipients of knowledge but as active agents in iterative, decision-driven learning environments. The adaptive AI platforms that tailor entrepreneurial content and simulate real-world business scenarios exemplify the thinking economy's emphasis on critical reasoning, opportunity recognition, and cognitive agility. Participatory workshops and bootcamp modules embody experiential and situated learning, fostering a co-constructed knowledge space that promotes self-directed innovation and context-relevant problem-solving. Furthermore, AI-enhanced mentorship systems and predictive analytics for agricultural entrepreneurship not only scaffold learners' developmental trajectories but also exemplify adaptive learning by responding dynamically to individual needs, contextual constraints, and evolving market trends.

Collectively, these modes of integration reimagine the curriculum as a living system, fluid, contextually intelligent, and oriented towards future-proofing rural learners for participation in knowledge economies. This alignment underscores the imperative for higher education institutions to transcend static curriculum models and invest in flexible, tech-enabled ecosystems that foster entrepreneurship as both a skillset and a mindset rooted in adaptability, critical inquiry, and locally embedded innovation. These models provide a modelling framework with actionable insights for rural universities in South Africa.

Also, it illustrates how AI can serve as both a pedagogical innovation and a developmental lever, enabling institutions to fulfil their expanded mandate as outlined in the NDP 2030 and the DHET's strategic agenda**.** It provides a compelling blueprint for aligning academic programming with the goals of the NDP 2030 and the DHET**'s** strategic vision, positioning AI not merely as a teaching tool but as a catalyst for socio-economic resilience and innovation-led development. AI-driven platforms support personalised learning through adaptive systems, allowing students to receive customised feedback and navigate content at their own pace.[34] By embedding AI within entrepreneurship ecosystems through responsive curricula, interdisciplinary collaboration, and innovation, South Africa's rural universities can transcend resource limitations, democratise access to opportunity, and reposition themselves as engines of inclusive growth and 21st-century employability.

Moreover, this becomes increasingly pertinent in further enhancing the value and significance of community engagement, a pillar of higher education that is often undervalued or underestimated. Integrating alternative forms of entrepreneurship, such as social, cultural, or cognitive entrepreneurship, can enrich and deepen the impact of community engagement, optimising its transformative potential and broadening its epistemological and developmental relevance. Furthermore, the case studies offer practical insights into overcoming persistent barriers that often hinder meaningful engagement with communities and industry. These barriers, often rooted in infrastructural limitations, transport constraints, and the scarcity of time and spatially related resources, pose significant challenges to sustained collaboration. The convergence of artificial intelligence and entrepreneurship, however, introduces an enabling framework that mitigates these structural impediments. This nexus functions as a counteractive mechanism,

[33] Siemens, "Connectivism: A Learning Theory Fir the Digital Age"; Luckin, *Machine Learning and Human Intelligence. The Future of Education for the 21st Century*.

[34] Yanqing Duan, John S Edwards, and Yogesh K Dwivedi, "Artificial Intelligence for Decision Making in the Era of Big Data–Evolution, Challenges and Research Agenda," *International Journal of Information Management* 48 (2019): 63–71.

transforming traditional disablers into opportunities for more efficient, scalable, and context-sensitive engagement.

In this regard, the challenge of resource limitations may be rendered less prohibitive; however, institutions of higher learning bear a critical responsibility to cultivate adaptive curricula and pedagogical approaches that respond to evolving societal and technological demands. This requires the intentional creation of enabling environments and institutional systems that are conducive to innovation, interdisciplinarity, and community-oriented praxis. Such responsiveness is not merely operational but epistemological, requiring a reconfiguration of knowledge systems that centres relevance, inclusivity, and contextual responsiveness within higher education.

The Ethical Mitigation Strategies for the Nexus of AI In Entrepreneurship

While the integration of AI into higher education offers undeniable pedagogical and developmental advantages, particularly in expanding access, personalisation, and efficiency, it simultaneously presents profound epistemological and ethical complexities that must not be overlooked. Central to this debate is the concern that AI, in its current and emerging forms, may inadvertently displace rather than augment human cognitive agency, creativity, and moral reasoning. The tension arises between two dominant discourses: one that champions AI as the inevitable present and future of knowledge production and educational innovation, and the other that questions the authenticity, ownership, and epistemic credibility of machine-generated output. Within this dialectic, the ideological and practical dimensions of entrepreneurship education face a pivotal inflexion point.

Entrepreneurship, traditionally rooted in human intuition, risk-taking, value-driven innovation, and socio-cultural responsiveness, risks being reduced to algorithmic predictions and mechanistic processes if not critically framed within humanistic and context-aware paradigms. As higher education institutions grapple with how best to integrate AI, there is an urgent need to ensure that this integration does not compromise the development of critical thinking, ethical judgment, and the authenticity of learner-driven ideation. Rather than replacing human intellect, AI should be harnessed to amplify it, serving as a tool for adaptive co-creation rather than deterministic automation.

Furthermore, it must be taken into account that AI poses ethical risks, such as algorithmic bias, job automation, and surveillance.[35] For instance, AI systems may reinforce existing socio-economic inequalities if they are not carefully designed and audited. Thus, institutions must adopt frameworks that ensure responsible AI use, particularly in entrepreneurship education, where students are trained to be future employers and innovators. Asad et al., stressed that integrating ethical considerations into AI-enabled education significantly shapes students' sustainable entrepreneurial intentions.[36] Universities such as the University College London (UCL) and the Swiss Federal Institute of Technology Zurich (ETH Zurich) have led the way by embedding modules in algorithmic ethics, fairness, and data governance into technology curricula.[37] Table 2 presents the most common challenges associated with AI integration in education, along with their corresponding mitigation strategies.

Table 2: Ethical Challenges and Mitigation Strategies of AI Integration in Entrepreneurship Education

Ethical Challenge	Implications	Mitigation Strategies	Study
Algorithmic bias in AI-driven educational tools	Marginalised students may receive unfair evaluations or recommendations, reinforcing educational inequalities.	Use fairness-aware algorithms; ensure diverse, representative datasets for AI training; conduct regular bias audits in educational tools.	Porayska-Pomsta et al., 2024

[35] Brynjolfsson and McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*.

[36] M. Asad, S. Khan, and R., Patel, " Integrating Ethical Considerations into AI-Enabled Entrepreneurship Education and Its Impact on Sustainable Entrepreneurial Intentions," *International Journal of Entrepreneurship Education* 19, no. 2 (2025): 103–21.

[37] B.D. Mittelstadt, "Ethics of AI in Technology Curricula: Embedding Modules on Algorithmic Ethics, Fairness, and Data Governance," *AI & Society* 34 (2019): 555–63.

Lack of transparency in AI decision-making in learning platforms	Students and educators may distrust AI-generated feedback or recommendations, hindering adoption and learning outcomes	Develop explainable AI models tailored for education; provide clear user guides and transparency reports; involve educators and students in system design	Bulut et al., 2024
Insufficient integration of AI ethics in entrepreneurship curricula	Students may lack critical awareness of AI's societal impact, risking unethical entrepreneurial decisions	Embed ethics modules focusing on AI fairness, data governance, and social responsibility; promote classroom discussions on ethical dilemmas	Asad et al., 2025
Bias and discrimination are perpetuated through AI educational tools	Disadvantaged learners may be unfairly filtered out or under-supported, limiting equal access to opportunities	Adopt multidisciplinary AI development teams, including ethicists and educators; implement institutional policies ensuring fairness and accountability	Ferrer et al., 2020
Lack of AI ethics training for educators and developers	Educators may be ill-prepared to critically assess or responsibly implement AI in teaching	Introduce comprehensive AI ethics training for faculty and educational technology developers; emphasise ethical responsibility in professional development	Borenstein & Howard, 2020

Table 2 presents some of the AI-based challenges alongside their respective possible mitigations. Although not exhaustive, the table provides a snapshot of generic yet critical issues that could hinder progress in the digital transformation of higher education. In response to these challenges, one key recommendation is the deployment of explainable AI models specifically tailored to educational contexts. These models, accompanied by user-friendly guides, transparency reports, and designed through participatory processes that involve both educators and students, can play a pivotal role in democratising access to AI-driven tools. Such transparency not only enhances trust in technological systems but also fosters an entrepreneurial ethos within learning environments: one that encourages clarity, co-creation, and iterative innovation. In this sense, AI systems function not merely as instructional aids but as catalysts for cognitive entrepreneurship**,** enabling learners to think critically, adapt creatively, and co-design solutions to emergent educational challenges.

Moreover, embedding AI ethics modules into the curriculum focusing on fairness, data governance, and social responsibility signals a forward-thinking pedagogical shift. These modules nurture ethical reflexivity among students and faculty, equipping graduates to become not only informed users but also ethical agents in the evolving AI landscape. The inclusion of classroom dialogues on ethical dilemmas further mirrors the entrepreneurial learning process, wherein navigating uncertainty and making value-driven decisions are essential. To institutionalise this transformative vision, universities must invest in multidisciplinary AI development teams that comprise ethicists, educators, social scientists and technologists. This inclusive design approach ensures that AI innovation is contextually relevant, ethically grounded, and pedagogically aligned. When supported by institutional policies that enforce fairness and accountability, AI transitions from being a detached technological tool to becoming a co-evolving partner in advancing educational equity and innovation.

Lastly, introducing comprehensive AI ethics training for faculty members and educational technology developers forms a critical foundation for sustainable adoption. By framing ethical literacy as an integral part of professional development, institutions affirm their responsibility to shape socially just and inclusive AI futures. Overall, this holistic, fairness-driven, and ethically infused strategy aligns with the entrepreneurial values of responsiveness, resilience, and social accountability, positioning AI as both a diagnostic lens and a developmental lever in reimagining future-ready, equitable higher education systems.

Uneven Adoption of Entrepreneurship and AI In Higher Education

Although this paper foregrounds the challenges and opportunities of AI integration, there exists a more subtle yet deeply entrenched complexity within higher education, the paradox of entrepreneurship education. Despite its growing prominence in policy discourse and institutional strategies, the adoption of entrepreneurship education remains highly uneven across universities, shaped by divergent institutional philosophies, pedagogical traditions, resource disparities, and national education frameworks.[38] On the one hand, entrepreneurship is widely celebrated as a driver of innovation, employability, and socio-economic transformation; on the other, its educational implementation is constrained by traditional disciplinary boundaries and academic structures that often resist its inherently experiential and transdisciplinary nature.[39]

Historically, entrepreneurship education has oscillated between two pedagogical poles: viewing entrepreneurship either as an innate trait accessible only to the inherently gifted or as a rigid process taught through conventional methodologies such as lectures, business plan development, and case study analysis.[40] These approaches, while imparting foundational knowledge, often privilege cognitive abstraction over experiential immersion, thus undermining the cultivation of dynamic competencies such as opportunity recognition, adaptive thinking, and iterative problem-solving.[41] Furthermore, such traditional models tend to reinforce a theoretical orientation that is misaligned with the unpredictable, nonlinear realities of entrepreneurial action.

The Paradox of Entrepreneurship Education in Higher Education

Compounding this paradox is a growing disciplinary tension: in some academic domains, entrepreneurship is either viewed as alien to the core epistemology of the field or, conversely, presumed to be naturally embedded in professional practice. This ambiguity creates resistance or conceptual confusion about how entrepreneurship should be meaningfully integrated into specific curricula. The question then arises not merely of inclusion, but of structure, whether entrepreneurship education should be designed as a formal, credit-bearing component or offered through non-credit-bearing, co-curricular engagements. These curricular tensions highlight the broader institutional challenge of repositioning entrepreneurship not as an isolated or instrumental skillset, but as an epistemic orientation that intersects with disciplinary knowledge in complex, context-dependent ways.[42] Some institutions, particularly elite business schools, embrace a more integrated and experiential approach to entrepreneurship education. In contrast, many public, rural, or under-resourced universities continue to treat entrepreneurship as an elective or co-curricular activity with limited pedagogical innovation.

Table 3 illustrates the institutional divergences in the structuring, offering, and delivery of entrepreneurship education across various higher education contexts. This divergence underscores the persistent lack of curricular standardisation, reflecting not only epistemological tensions within and

[38] A Fayolle and D T Redford, *Handbook on the Entrepreneurial University*, Elgar Original Reference (Edward Elgar, 2014), https://books.google.com.gh/books?id=jxCgAgAAQBAJ.

[39] Gibb, "In Pursuit of a New 'Enterprise' and 'Entrepreneurship' Paradigm for Learning: Creative Destruction, New Values, New Ways of Doing Things and New Combinations of Knowledge"; Luke Pittaway and Jason Cope, "Entrepreneurship Education," *International Small Business Journal: Researching Entrepreneurship* 25, no. 5 (October 1, 2007): 479–510, https://doi.org/10.1177/0266242607080656.

[40] H.M. Neck and P.G., Greene, " Entrepreneurship Education: Known Worlds and New Frontiers," *Journal of Small Business Management* 49, no. 1 (2011): 55–70.

[41] Einar A Rasmussen and Roger Sørheim, "Action-Based Entrepreneurship Education," *Technovation* 26, no. 2 (2006): 185–94.

[42] Martin Lackéus, "Entrepreneurship in Education: What, Why, When, How" (OECD publishing Paris, 2015); Nabi et al., "The Impact of Entrepreneurship Education in Higher Education: A Systematic Review and Research Agenda."

between disciplines but also the influence of institutional histories, strategic priorities, and national education policies. Some institutions adopt a modular approach, embedding entrepreneurship as a standalone, credit-bearing course, while others incorporate it as a non-credit-bearing co-curricular or extra-curricular initiative. These discrepancies reveal a deeper uncertainty about whether entrepreneurship should be treated as a core academic discipline, a transversal skillset, or an applied competence to be cultivated outside formal assessment structures.[43]

Table 3: Comparative Overview of Entrepreneurship and AI Adoption in Higher Education Institutions

Institution Type	Mode of Entrepreneurship Delivery	AI Integration Status	Barriers to Adoption	Notable Examples
Traditional Research Universities	Theory-heavy: lectures, case studies, business planning	Minimal to moderate (mainly research-focused)	Curriculum rigidity, faculty silos	University of Cape Town, University of Nairobi
Technology Institutes	Interdisciplinary, hackathons, and applied projects	High (simulation, ML, predictive analytics)	High cost of AI tools, need for continuous training	Massachusetts Institute of Technology (MIT), Indian Institute of Technology
Polytechnics / Technical and Vocational Education and Training (TVET) Colleges	Vocational, enterprise centres, microbusiness incubation	Low to minimal (focus on practical trades)	Infrastructure, digital illiteracy, and limited funding	TVET colleges in Ghana, Kenya, Philippines
Private/Elite Institutions	Innovation hubs, transdisciplinary learning, and startup incubators	High (metaverse, digital twins, AI ethics modules)	High fees, access inequality	Wharton, Woxsen University, NYU Stern
Rural/Public Universities	Entrepreneurship taught as an elective or part of the general education curriculum.	Minimal (sporadic or no use of AI in teaching)	Lack of devices, bandwidth, and curriculum development support	Many institutions in sub-Saharan Africa & Southeast Asia

Moreover, Table 3 provides insight into how AI is beginning to emerge as an integrated element within entrepreneurship curricula, though its inclusion also varies significantly. In some cases, AI is explicitly positioned as a tool for entrepreneurial innovation, digital transformation, and opportunity recognition, introduced through specialised modules or interdisciplinary collaboration between computer science and business faculties. In other contexts, AI is only implicitly referenced, if at all, thus missing

[43] Nabi et al., "The Impact of Entrepreneurship Education in Higher Education: A Systematic Review and Research Agenda."

the opportunity to foreground its growing significance in shaping entrepreneurial ecosystems and future labour markets.[44]

The Dual-Layered Divergence of Entrepreneurship in the Integration Of AI

This dual-layered divergence, in the institutional conceptualisation of entrepreneurship and the integration of AI, reveals a broader pedagogical and philosophical challenge. Institutions that fail to adopt a coherent framework for embedding AI within entrepreneurship education risk not only falling behind in preparing graduates for AI-driven economies but also perpetuating fragmented learning experiences. Conversely, institutions that proactively integrate AI into entrepreneurship pedagogy signal a shift to more future-responsive curricula, ones that equip students not just with technical proficiency but with the critical and ethical capacities to navigate AI-enabled entrepreneurial landscapes.[45] Therefore, Table 3 serves as a diagnostic tool to understand the uneven terrain of entrepreneurship education and the emergent, yet inconsistent, role of AI therein. It invites a critical rethinking of how curriculum design can be harmonised to ensure both disciplinary relevance and future-oriented agility, where entrepreneurship and AI are not parallel strands but co-constructed domains of practice and knowledge.

In this paper, the argument advances the position that the nexus between AI and entrepreneurship should be understood not only as a site of innovation, but also as a space marked by complexity that must be strategically navigated rather than simply reduced. While AI holds transformative potential for entrepreneurship education using generative AI models, predictive analytics, and immersive simulation environments, its integration into higher education systems remains uneven and dependent on institutional readiness. This unevenness becomes even more pronounced when AI is introduced into learning environments that lack the foundational digital infrastructure, faculty capacity, or policy alignment necessary to support innovation-driven pedagogy.

The convergence of AI and entrepreneurship thus reveals a deep structural divide within global higher education systems. Well-resourced institutions, digitally mature, and strategically oriented toward innovation, such as the Wharton School in the United States and Woxsen University in India, have successfully embedded AI into entrepreneurship curricula. These institutions facilitate real-time simulations, adaptive learning pathways, and decision-making environments that emulate real-world entrepreneurial volatility.[46] Their pedagogical frameworks reflect constructivist and experiential learning theories, emphasizing active participation, contextual relevance, and reflective practice.[47]

However, such models remain the exception rather than the norm. Across much of the global higher education landscape, particularly in regions such as sub-Saharan Africa and Southeast Asia, entrepreneurship education remains theoretically robust but technologically underdeveloped. Institutions in these contexts often face significant barriers, including inadequate infrastructure, limited access to AI tools, and rigid curricular structures that are not conducive to interdisciplinary innovation.[48] Faculty resistance rooted in unfamiliarity with AI technologies or reinforced by entrenched disciplinary silos further inhibits the adoption of integrated, future-focused pedagogical models. In many cases, AI is introduced as an isolated add-on rather than integrated holistically throughout the educational experience. Furthermore, entrepreneurship is still frequently confined to business schools, rather than being cultivated as a cross-disciplinary competency relevant to students across all academic domains.

National policy frameworks and funding ecosystems play a critical mediating role in determining where and how AI and entrepreneurship intersect. Countries such as Finland, the United Arab Emirates, and Singapore have implemented coordinated national strategies that link innovation, higher education reform, and targeted investment in AI infrastructure. These environments create fertile ground for

[44] Brynjolfsson and McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*.
[45] Luckin and Holmes, "Intelligence Unleashed: An Argument for AI in Education."
[46] Wharton School, "AI Integration in Entrepreneurship Curricula: Real-Time Simulations and Personalized Learning Paths," 2024, https://www.wharton.upenn.edu; J. Wang, " Integrating AI-Driven Experiential Learning Models in Entrepreneurship Education," *Computers & Education* 190 (2025): 104602.
[47] D. A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development* (Englewood Cliffs, NJ: Prentice-Hall, 1984).
[48] H. Mtegha and M. Kanyangale, "Challenges of AI Integration in Entrepreneurship Education in Sub-Saharan Africa," *African Journal of Educational Technology* 7, no. 2 (2021): 150–67; X. Li and Y. Shen, " Digital Readiness and Entrepreneurship Education: A Case Study in Southeast Asia," *Asia-Pacific Journal of Education* 41, no. 2 (2021): 175–90.

embedding AI in entrepreneurship curricula. In contrast, in much of the Global South, entrepreneurship education remains largely focused on employability or self-reliance, rather than innovation and value creation. In the absence of integrated policy strategies, institutions are left to navigate these transitions in a fragmented and often resource-constrained manner.

Therefore, the convergence of AI and entrepreneurship is not solely a technological evolution; it is a systemic challenge that demands a rethinking of curriculum design, institutional culture, faculty development, and equitable access to technological tools. Resolving the paradox of entrepreneurship education requires a paradigmatic shift: from viewing entrepreneurship as a peripheral, business-oriented offering to embedding it as a core pedagogical ethos that fosters agency, creativity, and reflexivity across all disciplines. As AI technologies continue to redefine the future of work and knowledge production, higher education institutions must not only reimagine the content of entrepreneurship education but also fundamentally transform its form**,** delivery mechanisms**,** and institutional legitimacy within the broader academic landscape.

Strategies Towards the Integration of Artificial Intelligence (AI) Into Entrepreneurship Education

Table 4 below presents a guide framework for the integration of AI into entrepreneurship education that requires deliberate, theory-informed institutional strategies that transcend traditional teaching methods. The following are the core strategies, associated pedagogical models, and their scientific justifications (see Table 4):

Table 4: Institutional Strategies for AI-Enhanced Entrepreneurship Education Guide Framework

Strategy	**Pedagogical Approach**	**Justification**
1. Embed AI Tools in Experiential Learning Models	Experiential Learning (Kolb, 1984); Constructivist Pedagogy	Simulations and AI labs enable risk-free experimentation, mirroring real entrepreneurial environments; they support active learning and decision-making.
2. Develop Interdisciplinary AI-Entrepreneurship Modules	Interdisciplinary and Problem-Based Learning (PBL)	Encourages holistic problem-solving and innovation by combining AI technical skills with entrepreneurial thinking; reflects the complexity of tech-driven ventures.
3. Scaffold Entrepreneurial Learning Through AI-Personalized Feedback	Adaptive Learning: Vygotsky's ZPD	AI-driven feedback aligns with learners' developmental levels, enabling tailored support and enhanced cognitive engagement.
4. Institutionalize AI Ethics and Innovation Mindsets	Critical Pedagogy: Ethical and Reflective Learning	Fosters socially responsible entrepreneurs aware of the ethical implications of AI use; aligns with sustainability and digital justice principles.
5. Establish AI-Entrepreneurship Incubators and Digital Sandboxes	Situated Learning; Communities of Practice (Lave & Wenger, 1991)	Immerses students in authentic entrepreneurial ecosystems; promotes peer learning, mentorship, and real-world problem-solving.
6. Build Faculty AI Competency and Cross-Training Frameworks	Transformative Learning (Mezirow, 1997)	Faculty development ensures pedagogical alignment, tech fluency, and institutional readiness for curricular reform and delivery.

As shown in Table 4, guiding the integration of AI into entrepreneurship education requires deliberate, theory-informed institutional strategies that surpass traditional pedagogical conventions. The

table presents a framework that identifies core strategies, aligns them with relevant pedagogical models, and provides scientific justifications for their adoption. This framework is not intended as a one-size-fits-all solution; rather, it provides a flexible and context-sensitive baseline from which institutions and disciplines can begin to design responsive, future-oriented curricula. Positioned within the broader aspiration of advancing the thinking economy, the framework serves as a strategic anchor for operationalising the nexus between AI and entrepreneurship education.

By delineating both conceptual and practical entry points, the framework supports institutions in navigating philosophical, pedagogical, and operational decisions on AI integration. It allows for differentiated approaches ranging from experiential, constructivist learning models to AI-augmented decision-making environments based on institutional capacity, disciplinary focus, and socio-economic context. Moreover, it prompts institutions to critically reflect on their educational values and epistemological orientations, ensuring that the adoption of AI tools and methods is not only instrumental but also ethically grounded and pedagogically meaningful.

RECOMMENDATIONS

The HEIs should adopt clear institutional frameworks that align entrepreneurship education with Artificial Intelligence (AI) integration, ensuring coherence with national strategies such as the NDP 2030 and the DHET transformation agenda. Universities, particularly those in rural or resource-constrained contexts, must prioritise digital infrastructure, AI literacy, and faculty development to enable equitable access to AI-driven entrepreneurial learning environments. Entrepreneurship education must integrate AI-driven simulations, adaptive learning platforms, and data analytics to develop students' critical thinking, innovation, and problem-solving skills aligned with the Thinking Economy Framework. HEIs must embed AI ethics into entrepreneurship curricula and ensure that all AI tools are transparent, fair, and contextually appropriate. Faculty should receive continuous training in AI ethics and governance to promote socially responsible innovation. Universities should create AI-enabled innovation hubs or digital sandboxes that link teaching, research, and community engagement, serving as incubators for student-led start-ups and locally relevant innovations. Government, academia, and industry should collaborate to create a unified AI and Entrepreneurship Skills Development Strategy, enabling policy coherence, funding support, and the exchange of best practices across institutions.

CONCLUSION

The integration of Artificial Intelligence into entrepreneurship education is a promising response to South Africa's unemployment crisis, particularly in rural and underserved communities. By fostering digital skills, entrepreneurial thinking, and ethical awareness, higher education institutions can prepare graduates equipped to lead an innovation-driven economy. This paper further argues that the adoption of AI-driven, experiential, and adaptive learning models presents an urgent opportunity to transform entrepreneurship pedagogy, especially in under-resourced and rural university contexts, toward more learner-centred, skills-intensive, and context-responsive models. However, this potential is contingent upon several critical enablers that shape institutional readiness and delivery of equity. By foregrounding these institutional and contextual dynamics, this paper advances the argument that AI is not merely a technological adjunct but also a strategic and transformative enabler of entrepreneurial competencies that require coherent integration into pedagogy, curriculum, and policy frameworks.

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