ENTREPRENEURSHIP EDUCATION: ISSUES, CHALLENGES, AND OPPORTUNITIES IN THE ERA OF NEW TECHNOLOGIES IN NIGERIA

Usman Ladan Kurya, PhD[1]
shehulkm64@gmail.com, 08068046160

Asmau Salihu Yauri, PhD[1]
asmausalihu418@gmail.com, 08039766247

Modibbo Muhammed Buba, PhD[2]
mbmodibbo@mau.edu.ng, 08032233004
[1]Department of Entrepreneurship Education, School of Business Education,
Federal College of Education (Technical) Gusau
[2]Department of Vocational Education, Modibbo Adama University, Yola
Correspondence email address: shehulkm64@gmail.com, 08068046160

Abstract

Entrepreneurship education is increasingly expected to prepare learners not only to start and manage ventures but also to identify opportunities, create value, solve problems, and operate within rapidly changing digital environments. The expansion of digital technologies such as artificial intelligence (AI), digital platforms, mobile technologies and immersive virtual environments has consequently created new possibilities for the content, pedagogy, assessment, and organisation of entrepreneurship education. With this development, the ways in which entrepreneurship is taught and practiced are undergoing fundamental changes. This paper examines these developments with particular focus on Nigeria in comparison with developed-country contexts for improvement. It adopts a structured conceptual literature-review approach and thematically synthesises literature on entrepreneurship education and application of digital technologies. This paper conceptually explores challenges posed by the new technologies in teaching and learning entrepreneurship. The synthesis identifies five interconnected challenges: inadequate digital infrastructure and access, curriculum and competency misalignment, limited educator digital capability and institutional readiness, assessment and academic-integrity, and persistent digital inequality. The paper also highlights the opportunities created by digital technologies for virtual incubation, simulation-based learning, technology-assisted venture development such as AI-supported feedback and ideation, personalised learning, global collaboration and digital market access. The analysis is guided by Human Capital Theory, Experiential Learning Theory, and the Technology Acceptance Model. It further argues that Nigerian institutions should pursue context-sensitive and inclusive digital transformation rather than technology adoption for its own sake, combining infrastructure and access initiatives with curriculum development, entrepreneurship educators' capacity building, authentic assessment, responsible AI governance, and stronger engagement with entrepreneurial and industry ecosystems. It also pinpoints implications for instructional design, and policy directives, highlighting the importance of adaptive curricula and digital access.

Keywords: Entrepreneurship Education; Digital Era; New technologies, Artificial Intelligence; Generative AI; Large Language Models.

Introduction

The expansion of digital technologies such as artificial intelligence (AI), digital platforms, data-driven and mobile technologies, virtual and augmented reality, generative AI, big data, and immersive virtual environments has consequently created new possibilities for the content, pedagogy, assessment, and organisation of entrepreneurship education. The increasingly volatile

and interconnected nature of today's global economy has brought about changes that demand curriculum, pedagogical transformations because entrepreneurship is no longer confined to traditional business contexts but has become a multidimensional practice that thrives within dynamic ecosystems shaped by technological, social, and institutional forces. The emergence of the Fourth Industrial Revolution marked by artificial intelligence (AI), big data analytics, digital platforms, and immersive virtual learning environments has transformed how entrepreneurship is both practiced and taught (Ratten, 2020). Within this evolving landscape, entrepreneurship educators are tasked with integrating foundational entrepreneurial knowledge with digital competencies such as platform literacy, agile prototyping, and data-driven decision-making to prepare learners for new entrepreneurial realities (Ratten, 2020).

The COVID-19 pandemic further accelerated this transformation by forcing a rapid shift from traditional face-to-face, experiential teaching methods to digital platforms (Liguori & Winkler, 2021). While this transition ensured continuity in instruction, it also introduced challenges in the developing economic context. For example, Liguori and Winkler (2021) show how U.S. community college instructors relied on tools such as Zoom and pre-recorded lectures yet remained concerned about losing the experiential and hands-on elements central to entrepreneurship education. In the developing context, the challenges are diverse. In addition to the need for a pedagogical rethinking of how experiential learning can be effectively replicated or even enhanced through digital technologies, inadequate digital infrastructure and access, curriculum and competency misalignment, limited educator digital capability and institutional readiness, assessment and academic-integrity, and persistent digital inequality posed serious challenges that require urgent attention.

At the ecosystem level, digitalization is not merely a contextual adjustment but a transformative force in entrepreneurial practice. Nambisan (2017) argues that digital entrepreneurship, enabled by artifacts, infrastructures, and platforms, fosters scalability, generativity, and recombinability. These features allow for distributed entrepreneurial agency, experimentation, and ecosystem-level collaboration (Nambisan et al., 2017). Such dynamics directly influence how entrepreneurship education must evolve, as students are no longer only learning to manage physical ventures but must also navigate digital ecosystems characterized by fluid boundaries, platform interdependencies, and new value-creation logics.

Despite ongoing progress, significant disparities persist in the digital transformation of education systems. The pandemic highlighted gaps in infrastructure, uneven digital access, and varied levels of faculty preparedness (Ratten & Usmanij, 2021). These challenges are particularly pronounced in underserved communities, where inadequate connectivity and resource constraints hinder participation in digital learning environments. At the same time, innovative responses are emerging. Institutions worldwide are increasingly adopting simulation tools, digital incubation models, and AI-supported scaffolding that mimic or complement experiential learning in virtual contexts (Zhu & Luo, 2025). Such innovations point toward the potential of hybrid models that balance accessibility, flexibility, and experiential depth.

Anchored in Human Capital Theory (Becker, 1964), Experiential Learning Theory (Kolb, 1984), and the Technology Acceptance Model (Davis, 1989), this conceptual paper critically examines the challenges, opportunities, and implications of entrepreneurship education in the digital era. These theoretical foundations underscore the dual focus of entrepreneurship education: developing human capabilities, designing learning experiences that foster reflection and application, and leveraging technological acceptance to enhance engagement and outcomes.

This paper makes two main contributions. First, it synthesises insights from entrepreneurship, education and digital innovation literature to highlight the opportunities and challenges in integrating technology with entrepreneurship education. Second, it proposes a pathway toward responsive and inclusive models of entrepreneurship education that align pedagogy, technology, and practice. By doing so, it seeks to inform educators, policymakers, and researchers on how to

prepare entrepreneurs who are digitally competent, innovative, and resilient in the face of ongoing technological disruption.

The paper is presented as a conceptual exploratory review rather than a completed systematic review. It consists of eleven parts. This section forms the first part which is followed by a review of entrepreneurship education in the digital era in Nigerian context as the second part. The third section delves into theoretical framework and the fourth explained the methodology used. While section five is devoted to challenges, section six highlighted the opportunities presented by digital technologies in teaching and learning entrepreneurship. Section seven concentrates on way forward as strategies for ensuring effective entrepreneurship education in the digital technology era along with an integrated strategic model. While second to the last section discusses policy implications, the last section forms the conclusion.

Entrepreneurship Education in the Digital Era

Entrepreneurship education is witnessing series of changes resulting from introduction of new digital technological devices and tools. These changes have profound effects on curriculum contents and delivery, entrepreneurial practices and operational patterns. These developments necessitate acquisition of required entrepreneurial competencies in line with the current changes and technological developments.

Transformation of Entrepreneurial Competencies

Digital transformation has unleashed changes that alter the knowledge, skills, and capabilities required for contemporary entrepreneurial activity. Consequently, entrepreneurship education curricula in higher education and matching instructional pedagogies are undergoing a transformation from the traditional business school model to technology-driven model (Kazakeviciute et al., 2016; Rafiana, 2023). While the traditional entrepreneurship curricula commonly emphasises opportunity identification, business planning, marketing, accounting, finance, management, and venture development. These foundational competencies remain important; however, the increasing use of digital technologies has expanded the range of capabilities relevant to entrepreneurial processes. Currently, there is increasing focus on technology-enhanced entrepreneurship curricula, as advancements in educational technology have brought new inspiration and tools (Secundo et al., 2020, Udekwe & Iwu, 2024). As a result, entrepreneurship education increasingly needs to incorporate competencies relating to application of digital technological devices, tools, platforms for learners to acquire relevant skills and competencies to enable the practice of e-commerce, social-media marketing, data interpretation, online customer discovery, digital payments, remote collaboration, and the appropriate use of emerging technologies.

The introduction of GenAI in 2022 has brought in additional instructional pedagogies in teaching entrepreneurship education. For example, Yu et al. (2025), in a systematic review of 50 peer-reviewed articles published between 2019 and 2025, identified four major areas of GenAI-enabled entrepreneurship education: personalized and adaptive instruction, simulation-based entrepreneurial training, virtual incubation, technology-assisted venture development and AI-supported feedback and ideation. The implication of the current changes is not that technology training should replace foundational entrepreneurship knowledge. Rather, entrepreneurship curricula should combine established entrepreneurial competencies with technology-related capabilities that are relevant to contemporary entrepreneurial environments. Such an approach supports a broader competence model in which entrepreneurial judgement, opportunity recognition, problem solving, and value creation are complemented by appropriate technological skills and competencies (Nambisan, 2017). Technology should therefore be integrated into established entrepreneurial learning processes rather than treated as an independent educational objective. Students can use digital tools to investigate customer needs, analyse competitors, prototype products and services, analyse market information, communicate value propositions,

and test aspects of business models. When these activities are deliberately designed around action, reflection, experimentation, and revision, technology can support experiential entrepreneurial learning. The central learning objective should remain the development of entrepreneurial capability and value-creation capacity, with digital technology functioning as an enabling resource.

Entrepreneurship Education in the Digital Era in Nigeria

In Nigerian tertiary education, concerns about the practical orientation and functionality of entrepreneurship education also reinforce the need to connect curriculum content with the competencies required for meaningful entrepreneurial activity (Ereh et al., 2019). The effectiveness of entrepreneurship education in digital era depends not only on the availability of technologies but also on the capacity of institutions and educators to integrate those technologies into relevant learning activities.

The Nigerian situation also illustrates an important distinction between individual digital familiarity and institutional digital readiness. Young people may use smartphones, social-media platforms, and other digital services regularly, while educational institutions may continue to face limitations in providing reliable broadband, appropriate learning platforms, digital learning resources, simulation facilities, and systematic professional development for educators. Of course, digital transformation may occur alongside institutional infrastructure deficits, affordability constraints, uneven digital skills, and capacity limitations but the implication to entrepreneurship education is that prescribed and appropriate entrepreneurial learning objectives and content in the curriculum is disregarded. Then, regular use of consumer-oriented digital technologies should therefore not automatically be interpreted as evidence of the deeper digital competencies required for productive, ethical, and innovative entrepreneurship education. From this perspective, entrepreneurship-education policy should distinguish between informal digital participation, functional digital competence, and institutionally supported digital entrepreneurial capability (Nambisan, 2017; World Bank, 2019).

A technology-enabled entrepreneurship-education strategy should therefore be designed around the conditions under which learners can meaningfully access, understand, evaluate, and apply digital technologies. Such an approach shifts attention from informal digital participation toward inclusive access, educator capacity, pedagogical integration, and the development of entrepreneurial and digital human capital to ensure functional digital competence, and institutionally supported digital entrepreneurial capability (Nambisan, 2017).

3. Theoretical Foundation

The paper anchored three theoretical thoughts (i.e. Human Capital Theory (HCT), Experiential Learning Theory (ELT), and the Technology Acceptance Model (TAM)) that together explain how entrepreneurship education adapts within the context of digital transformation.

Human Capital Theory (HCT). HCT emphasises the role of education in developing knowledge, skills, and competencies that enhance individual productivity and entrepreneurial capacity (Becker, 1964). In entrepreneurship, human capital is central to shaping entrepreneurial intention, opportunity recognition, and venture success (Unger et al., 2011). In digital contexts, the scope of human capital expands to include digital literacy, technological adaptability, and innovative capacity, which have become indispensable for entrepreneurial competitiveness (Martin, McNally, & Kay, 2013).

Experiential Learning Theory (ELT). Kolb's (2015) framework highlights learning as a cyclical process of experience, reflection, conceptualisation, and experimentation. Entrepreneurship education has long relied on ELT to justify practice-oriented approaches such as case studies, business incubators, and simulations (Pittaway & Cope, 2007). In the digital era, this framework is being extended through immersive technologies like virtual reality (VR), augmented reality (AR), and AI-driven simulations, which enable learners to experiment with entrepreneurial decision-making in risk-free but authentic environments (Liguori & Winkler, 2020). These innovations increase interactivity, scalability, and global accessibility of entrepreneurship education.

Technology Acceptance Model (TAM). Developed by Davis (1989), TAM advocates that technology adoption depends on perceived usefulness (PU) and perceived ease of use (PEOU). Within entrepreneurship education, TAM provides a lens for understanding how students and educators engage with digital platforms, online incubation models, and AI-powered mentorship (Venkatesh & Bala, 2008). Studies indicate that when learners perceive technologies as enhancing creativity and reducing barriers to participation, adoption and integration are significantly more likely (Duan, et al., 2019).

Integration of the Three Theories

Collectively, these theories provide a multidimensional foundation for analyzing entrepreneurship education in the digital era. While, HCT underscores the importance of skills acquisition and employability, ELT emphasizes practice-based knowledge creation, and TAM highlights the psychological and behavioural factors influencing technology adoption. Their integration enables a holistic understanding of both the opportunities and challenges presented by technological transformation as it relates to entrepreneurship education.

The three theories, therefore, provide complementary but distinct explanations of technology-enabled entrepreneurship education. Human Capital Theory explains why education and training can develop knowledge, skills and attitudes that are relevant to productivity and entrepreneurial performance (Becker, 1964; Unger et al., 2011). Experiential Learning Theory explains how learners can develop and transform knowledge through experience, reflection, conceptualisation, and experimentation (Kolb, 1984), while entrepreneurship-education research highlights the importance of experiential and collaborative learning approaches (Pittaway & Cope, 2007). Technology Acceptance Model explains an important dimension of technology adoption by focusing on perceived usefulness and perceived ease of use (Davis, 1989). Nambisan's (2017) digital-entrepreneurship perspective complements these theories by explaining how digital technologies reshape entrepreneurial processes and opportunities. The resulting conceptual position is that technology does not automatically improve entrepreneurship education. Rather, effective digital entrepreneurship education depends on the interaction between human capability, experiential pedagogy, technology adoption, and the changing digital entrepreneurial environment. This integrated perspective places learners, educators, pedagogy, and institutional conditions not technology alone at the centre of digital transformation (Becker, 1964; Davis, 1989; Kolb, 1984; Nambisan, 2017; Unger et al., 2011).

Method

This paper adopts a structured conceptual literature-review approach to synthesise theoretical, conceptual, and empirical insights concerning entrepreneurship education and the role of digital technologies in contemporary entrepreneurial learning. The approach is considered appropriate because the purpose of the paper is to integrate perspectives from entrepreneurship education, application of new technologies such as generative AI in teaching and learning entrepreneurship, technology acceptance and adaptive learning. Accordingly, the review is interpretive and thematic rather than a systematic review or meta-analysis.

The literature was identified and organised around five broad domains: (1) entrepreneurship education; (2) digital entrepreneurship and digital transformation; (3) educational technology and experiential learning; (4) artificial intelligence, generative AI, and large language models in education; and (5) Nigerian and other developing-country contexts. These domains were selected to ensure that the conceptual discussion addressed both the theoretical foundations of entrepreneurship education and the contemporary technological environment in which entrepreneurial learning occurs.

The literature search and selection process was guided by relevance to the central focus of the paper. Search terms and combinations included “entrepreneurship education,” “digital entrepreneurship,” “digital transformation and entrepreneurship education,” “entrepreneurship

education and artificial intelligence," "generative AI and entrepreneurship education," "large language models and education," "experiential learning and entrepreneurship," "digital divide and higher education," and "Nigeria and digital entrepreneurship education." Relevant scholarly publications and authoritative institutional sources were considered where they directly addressed entrepreneurship education, digital entrepreneurship, technology-enabled learning, experiential learning, entrepreneurship ecosystems, technology adoption and digital inclusion. However, PRISMA systematic-review flow chart and screening process were not used. Instead, transparency in evidence-synthesis reporting advocated by Page et al. (2021) was adopted. That guided the selection of literature with conceptual relevance and scholarly credibility.

Foundational theoretical works were retained irrespective of publication year because their historical and theoretical significance is central to the framework of the paper. These include Becker's (1964) Human Capital Theory, Kolb's (1984) Experiential Learning Theory, and Davis's (1989) Technology Acceptance Model. Later theoretical and empirical contributions were selected where they extended or applied these perspectives to entrepreneurship, digital technologies, experiential entrepreneurship education, or generative AI. Nambisan (2017) was used to establish the digital-entrepreneurship perspective, Unger et al. (2011) to support the relationship between human capital and entrepreneurial success, and Pittaway and Cope (2007) to strengthen the experiential-learning perspective in entrepreneurship education.
Contemporary literature was given particular attention in relation to digital learning, artificial intelligence, generative AI, and technology-enabled entrepreneurship education because these areas are rapidly evolving. Bell and Bell (2023); Darnell and Gopalkrishnan (2024) were considered in relation to the emerging application of generative AI to entrepreneurship education, while Yu et al. (2025) provides recent systematic-review evidence concerning the developing research base on GenAI in entrepreneurship education. Miao & Holmes, (2023) was considered specifically in relation to responsible, ethical, human-centred, and appropriate use of generative AI in education and research. Nigerian and developing-country evidence was incorporated where it provided contextual information concerning digital access, infrastructure, skills, curriculum, and the implementation environment.

The resulting evidence was interpreted through the three principal theoretical perspectives adopted in the paper: Human Capital Theory (HCT), Experiential Learning Theory (ELT), and the Technology Acceptance Model (TAM). HCT was used to explain the importance of developing entrepreneurial and digital knowledge and skills (Becker, 1964; Unger et al., 2011). ELT was used to examine the role of experience, reflection, experimentation, and application in entrepreneurial learning (Kolb, 1984; Pittaway & Cope, 2007). TAM was used to explain the importance of perceived usefulness and perceived ease of use in the adoption of educational technologies (Davis, 1989). Nambisan's (2017) digital-entrepreneurship perspective provided an additional lens for understanding how digital technologies reshape entrepreneurial processes and opportunities.

5. Issues and Challenges in Entrepreneurship Education in the Era of New Technologies

Nigeria has opportunities for greater participation in digitally enabled economic activities, but persistent gaps in connectivity, affordability, digital skills, and supporting infrastructure continue to affect the extent to which individuals and institutions can benefit from these opportunities (World Bank, 2019). These conditions have direct implications for entrepreneurship education because access to technology is closely connected to learners' opportunities to acquire and apply digital competencies. The challenges associated with technology-enabled entrepreneurship education should therefore not be treated as merely technical problems. Differences in connectivity, affordability, device access, electricity, digital skills, and institutional capacity can influence who participates in technology-mediated learning, how consistently digital resources can be used, and the quality of learning experiences available to students.

Therefore, Nigerian context presents a paradox in the integration of technology with entrepreneurship education. On the one hand, the country has a vibrant youth population adopting digital tools for entrepreneurial activities; on the other, systemic barriers—ranging from outdated curricula and infrastructural deficits to socio-economic inequalities—continue to hinder effective digital transformation. Empirical studies in Nigeria point to a consistent misalignment between entrepreneurship education and the digital economy. For instance, research in Anambra State stresses the urgent need to embed digital skills such as e-commerce and fintech into the curriculum (Nwosu, 2024), while investigations at the National Open University of Nigeria identify constraints such as high internet costs, erratic power supply, and low digital literacy among educators despite significant benefits in development of entrepreneurial mindset and employability (Okafor & Bello, 2025). Similarly, affordability of devices, poor connectivity, and infrastructural inadequacies exacerbate the digital divide in low-income communities (Oduola, 2022; Adeoye & Babalola, 2025). Yet, digital competencies demonstrably enhance entrepreneurial intentions among Nigerian undergraduates (Ogunleye & Salami, 2023), underscoring the transformative potential of ICT when effectively integrated.

These challenges mirror largely on curriculum deficit - outdated, focused on traditional business planning with limited integration of emerging digital fields (Oguejiofor & Nwankwo, 2021; Sharma, 2018), limited application of modern pedagogical models such as Business Model Canvas (BMC), phobia to new technologies application like Generative AI, Large Language Models (LLMs), automated venture creation tools being used in contemporary entrepreneurship pedagogy and general lag in modern pedagogical practices, with an overreliance on lecture-based delivery and limited use of digital simulations or experiential methods (Bhebhe & Maphosa, 2016). By contrast, institutions in Europe and North America increasingly leverage hackathons, incubators, and digital simulations to mirror real-world entrepreneurship (Fayolle & Gailly, 2015). While countries in developing contexts such as Nigeria grapple with infrastructural deficits and inequitable access, countries in global north such as Sweden and Finland have achieved near-universal digital access, enabling inclusive entrepreneurship education (Andersson & Wictor, 2013).
Assessment and institutional readiness further widen the divide. In Nigeria, examinations remain the dominant assessment tool, ill-suited to measuring digital creativity and adaptability (Olamide & Olufunmilayo, 2019), whereas countries like Singapore, the United Kingdom, and the U.S. increasingly employ performance-based approaches such as prototype development and startup creation (Tan & Ng, 2006; Pittaway & Cope, 2007).

Scholars increasingly acknowledge that entrepreneurship education in the digital age is confronted with a complex set of challenges that constrain its capacity to foster innovation and enterprise development in the global south due to systemic barriers from operational and pedagogical implementation. A central concern lies in infrastructural deficiencies in forms of limited access to digital technologies, unreliable internet connectivity, unstable electricity etc. Availability of internet connectivity and Affordability of digital devices are the foundational prerequisites for integrating technology into teaching and learning processes. World Bank (2020) reports that in sub-Saharan Africa, more than a third of tertiary-level learners lack consistent internet access, creating a digital divide that undermines online and blended entrepreneurship education. In Nigeria, this infrastructural weakness is compounded by erratic power supply and the prohibitive cost of internet services, both of which frustrate the adoption of e-learning platforms for entrepreneurship training (Okebukola, 2021). In contrast, evidence from advanced economies such as Finland and South Korea demonstrates that when infrastructure is robust, digital entrepreneurship education can be seamlessly embedded into curricula, providing students with advanced tools such as virtual simulations and online incubation hubs (Lee & Trimi, 2018).

Beyond infrastructure, resistance to change within academic institutions emerges as another significant challenge. The integration of technology into entrepreneurship pedagogy often disrupts established routines and requires educators to develop new digital competencies. However,

research evidence suggests that many faculty members either lack the necessary skills or remain skeptical of the value of digital tools in entrepreneurship training. For example, Lawal (2017), Gupta and Bose (2019), found that a considerable proportion of instructors resisted adopting modern technological devices/tools and learning management systems and virtual classrooms due to a preference for conventional face-to-face delivery methods. Even in advanced nations Ratten and Jones (2021) report that in certain European institutions, traditional pedagogical practices continue to dominate, thereby limiting the potential of entrepreneurial simulations and virtual classrooms. This resistance, often rooted in cultural and institutional inertia, slows down the diffusion of innovative teaching practices and constrains students' exposure to digital entrepreneurial ecosystems.

Similarly, while universities in Nigeria face resource constraints that limit their capacity to build digital entrepreneurship ecosystems (Boateng, 2020; Ismail & Zain, 2015), institutions in developed countries benefit from stronger industry linkages and supportive ecosystems despite persisting equity gaps (Ratten, 2020). This comparative insight underscores the infrastructural gap as a critical determinant of effectiveness in entrepreneurship education. And the weaknesses are compounded by erratic power supply and the prohibitive cost of internet services, both of which frustrate the adoption of e-learning platforms for entrepreneurship training.

The assessment of entrepreneurial outcomes in technology-enhanced learning environments also presents considerable difficulties. Unlike traditional disciplines, entrepreneurship requires the evaluation of non-cognitive outcomes such as creativity, resilience, and opportunity recognition. Fayolle and Gailly (2015) argue that conventional written examinations are inadequate for measuring such complex competencies, advocating instead for experiential and project-based assessment mechanisms. Yet, many institutions continue to rely heavily on standardized testing formats. In Kenya, for example, attempts to integrate online business plan competitions as assessment tools encountered fairness concerns, as students with stronger digital literacy or superior internet access gained disproportionate advantages (Maina, 2020). The use of digital incubators and entrepreneurial simulations for assessment are financially demanding, rendering them inaccessible to resource-constrained universities in developing contexts (Rideout and Gray,2013). This indicates that although technology offers new avenues for assessment, its effectiveness is mediated by contextual realities of resource availability and institutional capacity.
Equity and inclusion represent further structural challenges in entrepreneurship education during the technological era. While digital platforms ostensibly expand access to entrepreneurial knowledge and training, they risk exacerbating pre-existing inequalities. Miao & Holmes (2023) reports that connectivity perpetuate unequal access to digital entrepreneurial learning opportunities, thereby reinforcing regional inequalities in entrepreneurial capacity building. Such exclusionary dynamics highlight the paradox of technological integration. While digital tools promise inclusivity and democratization, they often deepen structural inequities when not supported by deliberate policy interventions and targeted capacity-building programs that emphasises inclusiveness. Without such policy marginalized groups—particularly women, rural populations, and learners with disabilities—will be disproportionately excluded from technology-driven entrepreneurship initiatives. In many African contexts, female entrepreneurs encounter socio-cultural constraints and limited access to digital resources, further reducing their participation in entrepreneurship education (Adebayo & Kweku, 2021).

Taken together, these challenges reveal that the technological transformation of entrepreneurship education is not merely a technical or pedagogical issue but a systemic one, shaped by infrastructure, institutional culture, assessment practices, and issues of social equity. Addressing these obstacles requires multi-level strategies, including substantial investment in digital infrastructure, professional development for educators, the design of contextually appropriate assessment methods, and deliberate policies to ensure inclusivity. Without such reforms, the

potential of technology to enhance entrepreneurship education will remain unevenly realized across different socio-economic and cultural contexts.

In sum, the synthesis of the interconnected key challenges that constraints effective entrepreneurship education in the digital era in Nigeria brings to fore the following: inadequate digital infrastructure and access, curriculum and competency misalignment, pedagogy and leaners' evaluation, limited educator digital capability and institutional readiness, assessment and academic-integrity, and persistent digital inequality and exclusion. It is worth that while infrastructural weakness, curriculum misalignment, and inequitable access persist, opportunities exist in the form of youth digital orientation, ongoing policy reforms, and institutional incubation initiatives. Therefore, Nigeria needs to focus on adoption of innovative pedagogies and scaling digital innovations and works toward overcoming foundational gaps in infrastructure, inclusivity, institutional readiness, sustained curriculum reforms, capacity building for educators, equitable access to affordable digital infrastructure, and policies that empower disadvantaged groups to participate fully in technology-enabled entrepreneurship education.

6. Opportunities of Entrepreneurship Education in the Technological Era

Despite the structural and systemic challenges, the technological era presents immense opportunities to strengthen entrepreneurship education in Nigeria. Digitalisation brought in by new technology enhances entrepreneurship education in many ways. Most important of which include experiential learning, mentoring, and networking beyond the physical boundaries via virtual entrepreneurship ecosystems, global collaboration and access to digital market. The digital tools and devices facilitate and enable students to gain entrepreneurial skills in innovative ways. The most notable opportunities are digital incubation and virtual learning platforms, which expand access to incubation services and mentoring programmes beyond physical spaces. Virtual incubators and accelerators now provide students with online mentorship, funding advice, and networking opportunities. For example, the African Development Bank's (AfDB) Boost Africa program leverages digital platforms to connect young African entrepreneurs with investors and mentors (AfDB, 2020), while India's Atal Innovation Mission promotes digital incubation hubs across universities to foster startups in fintech and edtech sectors (Bose & Gupta, 2021). Similarly, MIT's Global Startup Labs uses online platforms to extend entrepreneurship education to emerging economies, bridging geographical divides (Eesley & Roberts, 2019). In addition, online collaboration and global networking have been enhanced by platforms such as Coursera, EdX, and Udemy, which allow students in Africa and Asia to access entrepreneurship courses designed by leading universities in the United States and Europe. Such cross-border collaboration fosters the exchange of ideas, multicultural problem-solving, and global market awareness (Ratten, 2020). For instance, Nigerian students participating in online hackathons with European peers have reported improvements in innovation and business model design (Olawale, 2021).

Artificial Intelligence (AI) further enriches entrepreneurship education by enabling personalized learning pathways. These personalized approaches ensure inclusivity and effectiveness across diverse learner profiles. Moreover, technology supports the expansion of experiential and simulation-based learning through immersive tools such as business simulations, virtual reality (VR), and gamification. In South Africa, VR-based entrepreneurship simulations have been introduced to train students in retail business management, allowing them to practice decision-making in risk-free environments (Mabunda & Fourie, 2021). Similarly, in the United States, platforms like SimVenture offer experiential entrepreneurship learning that enhances problem-solving and creativity beyond traditional lecture formats (Rideout & Gray, 2013). AI-powered adaptive learning platforms, such as those piloted in China, guide students through entrepreneurial simulations tailored to their skill levels (Zhang & Zhu, 2020), while Western institutions employ AI to support decision-making exercises that enhance critical thinking and

innovation capacity (Marques & Leal, 2021). Such tools replicate real-world entrepreneurial challenges, giving learners hands-on experience that conventional assessments cannot achieve.

Perhaps the most transformative opportunity lies in the access of entrepreneurship education. Digital platforms have reduced barriers, making entrepreneurial training more inclusive and accessible to marginalized groups. For instance, in Africa, mobile-based learning programmes such as MEST Africa provide entrepreneurship and coding skills to youth without access to formal university education (Adebayo & Kweku, 2021). Similarly, in Asia, mobile learning initiatives have empowered rural entrepreneurs in Bangladesh and India with digital literacy and market access (Rahman, 2019). Globally, the increased access to education ensures that entrepreneurship education contributes not only to individual empowerment but also to inclusive economic development.

Therefore, digital era has promoted by new technological devices, tools and skills have presented lot of opportunities that could enhance entrepreneurial learning. These include personalized and adaptive instruction, simulation-based entrepreneurial training, digital incubation experiential learning, mentoring, and networking beyond the physical boundaries via virtual entrepreneurship ecosystems promoting global collaboration and access to digital market, and the use of Artificial Intelligence and Generative AI aiding AI-Assisted Venture Creation etc. These have created additional opportunities for interaction, experimentation and mentoring for enhancing

7. Way Forward Ensuring Effective Entrepreneurship Education in the Technological Era

To advance entrepreneurship education in the technological era, several strategic measures are necessary. First, expanding affordable broadband access both on campuses and within surrounding communities is vital for reducing the digital divide that hinders participation in e-learning. Public–private partnerships can play a pivotal role in ensuring last-mile connectivity, particularly in underserved regions, as evidence from Sub-Saharan Africa shows improved engagement where internet access is affordable (World Bank, 2020, 2021). Alongside this, stabilizing electricity supply through renewable energy sources is critical, given that erratic power continues to disrupt online classes and virtual incubation hubs in Nigeria (Okebukola, 2021). Solar mini-grids and battery systems, already adopted in some African universities, could provide sustainable energy solutions.

Another priority is addressing the affordability barrier of student devices. Bulk procurement programmes and government-subsidized initiatives can significantly increase access to laptops and tablets, enabling students to effectively participate in online entrepreneurial training (World Bank, 2021). Complementing this is the establishment of national open digital libraries containing local case studies and indigenous business knowledge, which will reduce dependence on costly imported materials while making curricula contextually relevant (UNESCO, 2021). Similarly, universities should develop innovation and incubation hubs, equipped with mentorship programs and digital infrastructure, to foster experiential learning and strengthen start-up ecosystems (Lee & Trimi, 2018).

Capacity building for educators also requires urgent attention. Digital pedagogy training should be mandatory, equipping faculty with the skills to effectively use learning management systems and entrepreneurial simulations (Gupta & Bose, 2019). Beyond training, staff should be incentivized through grants, awards, and promotion pathways linked to digital teaching innovations, as these motivate adoption of new methods (Ratten & Jones, 2021). Furthermore, blended learning models offer a practical path for gradual transition, combining digital tools with in-person sessions to mitigate infrastructural challenges and resistance (Okebukola, 2021). Peer-learning communities among faculty members can also promote collaborative knowledge sharing, while structured change management frameworks ensure sustainable digital transformation.

In terms of assessment, experiential and project-based methods should replace traditional examinations, better reflecting entrepreneurial traits such as creativity, resilience, and opportunity

recognition (Fayolle & Gailly, 2015). Complementary approaches such as peer evaluations, e-portfolios, and community projects enhance inclusivity and provide richer measures of entrepreneurial growth (Rideout & Gray, 2013; Maina, 2020). Developing local case libraries will further strengthen contextual learning (UNESCO, 2021). Equally important is the deliberate inclusion of marginalized groups—particularly women, rural learners, and persons with disabilities—through targeted policies, digital stipends, and scholarships (Adebayo & Kweku, 2021). Considering the high mobile penetration in Africa, mobile-first platforms can also expand access in areas where broadband remains limited (Chen, 2020). Community-based digital training centers, connected to universities, could extend resources to non-traditional learners and reduce regional disparities (World Bank, 2020). Finally, national governments should align these reforms with broader digital transformation agendas, ensuring that entrepreneurship education is supported by enabling policy environments and ecosystem strategies, as seen in South Korea's success with integrated digital incubation programmes (Lee & Trimi, 2018).

8. Policy Implication

From a policy perspective, governments must prioritise infrastructure investment, particularly in broadband expansion, affordable internet, and reliable electricity, to reduce digital exclusion in entrepreneurial education (World Bank, 2020). Equally important are digital equity policies that bridge gender gaps and address rural–urban disparities in access to technological tools (GSMA, 2021). National innovation strategies, such as India's Atal Innovation Mission and Kenya's Ajira Digital Program, offer useful models for strengthening linkages between education, startups, and industry that Nigeria and other developing countries can adapt.

From a pedagogical perspective, entrepreneurship curricula need urgent redesign to incorporate digital tools including simulations, virtual reality (VR), and AI-enabled platforms—alongside traditional teaching methods (Ratten & Jones, 2021). Experiential learning should be emphasized through project-based and technology-mediated models such as digital hackathons, virtual incubators, and international collaborations like MIT Global Startup Labs. Equally, assessment practices must evolve beyond exam-based evaluations toward performance-driven measures such as startup prototypes, digital business plans, e-portfolios, and peer-reviewed innovation projects (Fayolle & Gailly, 2015). These approaches will ensure that entrepreneurship education reflects the realities of the digital economy and fosters skills relevant for innovation and resilience.

For practice and industry, stronger university–industry partnerships are essential to embed entrepreneurial learning within real-world ecosystems. Collaborations with technology hubs, accelerators, and corporate incubators can expose students to industry-led mentorship, funding pathways, and startup ecosystems (MEST Africa, 2020). Faculty and students alike must engage in continuous professional development to remain digitally relevant, while sustainable entrepreneurship should be encouraged through digital technologies that address climate change, financial inclusion, and other global challenges

Conclusion

The future of entrepreneurship education in Nigeria will be determined by the extent to which digital technologies are seamlessly embedded into curricula, pedagogy, and institutional practices. Persistent barriers such as infrastructural deficits, outdated curricula, and socio-economic inequalities must be deliberately addressed through strategic investments in affordable internet access, stable electricity, and inclusive access to digital tools. At the same time, building educator capacity, incentivizing digital teaching, and fostering innovation hubs will enhance entrepreneurial readiness. Anchoring this transformation within the frameworks of Human Capital Theory (HCT), Experiential Learning Theory (ELT), and the Technology Acceptance Model (TAM) provides a comprehensive roadmap. HCT highlights the role of digital literacy and technological adaptability as critical forms of human capital for entrepreneurial competitiveness. ELT emphasizes the need for immersive, experiential learning—now possible through Virtual Realities, Augmented Realities, and AI simulations—to cultivate reflective, practice-oriented

entrepreneurs. TAM, in turn, underscores the psychological and behavioural dimensions of technology adoption, showing that learner and educator perceptions of digital platforms are central to sustainable integration. By synthesizing these theoretical insights, entrepreneurship education can evolve into a digitally inclusive, contextually relevant, and future-ready system. When aligned with national digital transformation strategies, it will not only bridge the digital divide but also empower youth, generate employment, and accelerate sustainable economic development. Ultimately, entrepreneurship education in the technological era must transcend traditional models and embrace innovation as both a method and an outcome, ensuring its capacity to unlock the entrepreneurial potential of all learners.

References

Adebayo, T., & Kweku, A. (2021a). Bridging the digital gender divide in African higher education: Policy strategies for inclusivity. *Journal of African Digital Education, 6*(2), 45–59.

Adebayo, T., & Kweku, A. (2021b). Mobile-based learning and entrepreneurial empowerment in Africa: Evidence from MEST Africa. *Journal of African Business,22*(3),415–432. https://doi.org/10.1080/15228916.2020.1817652

Adeoye, M., & Babalola, K. (2025). Digital inclusion and entrepreneurship education in South-West Nigeria: Opportunities and barriers. *African Journal of Business Education, 12*(1), 113–129.

African Development Bank. (2020). AfDB Publications. https://www.afdb.org

Andersson, S., & Wictor, I. (2013). Innovative internationalisation in new firms: Born globals – the Swedish case. *Journal of International Entrepreneurship, 11*(2), 19– 35.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Bell, R., & Bell, H. (2023). Entrepreneurship education in the era of generative artificial intelligence. *Entrepreneurship Education, 6*, 229–244. https://doi.org/10.1007/s41959-023-00099-x

Bhebhe, S., & Maphosa, C. (2016). Barriers to effective integration of ICT in teaching and learning in higher education institutions. *Journal of Educational Technology, 5*(1), 1–12.

Boateng, R. (2020). Digital entrepreneurship and higher education in Africa: Challenges and pathways. *African Journal of Management Research, 27*(3), 56–72.

Bose, A., & Gupta, R. (2021). Atal Innovation Mission and digital incubation in India: A new model for entrepreneurial education. *International Journal of Innovation Studies, 5*(1), 23–34. https://doi.org/10.1016/j.ijis.2021.01.002

Chen, Y. (2020). Mobile-first learning in Asia: Expanding access to rural learners. *International Journal of Educational Technology, 15*(4), 221–237.

Darnell, J. A., & Gopalkrishnan, S. (2024). Entrepreneurship teaching exercises: Integrating generative AI. *Discover Education, 3*, Article 172. https://doi.org/10.1007/s44217-024-00261-0

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data—Evolution, challenges and research agenda. International Journal of Information Management, 48, 63–71. https://doi.org/10.1016/j.ijinfomgt.2019.01.021

Eesley, C., & Roberts, E. (2019). Entrepreneurship education in emerging economies: Lessons from MIT Global Startup Labs. *Journal of Technology Transfer, 44*(2), 615–640. https://doi.org/10.1007/s10961-017-9639-8

Ereh, C. E., Anthony, E. I., & Ikpo, P. A. (2019). Entrepreneurship education curriculum content: Beyond literacy and numeracy for functional education in tertiary institutions in Nigeria. *American Journal of Education and Learning, 4*(2), 191–199.

Fayolle, A., & Gailly, B. (2015). The impact of entrepreneurship education on entrepreneurial attitudes and intention: Hysteresis and persistence. *Journal of Small Business Management, 53*(1), 75–93. https://doi.org/10.1111/jsbm.12065

Global System for Mobile Communications Association (GSMA) *(2021). Mobile Gender Gap Report 2021*. https://www.gsma.com

Gupta, P., & Bose, I. (2019). Digital pedagogy and higher education in India: Faculty adoption of online platforms. *International Journal of Educational Development, 68,* 100–111.

Ismail, N., & Zain, M. (2015). Barriers to entrepreneurship education in Malaysian universities: An institutional perspective. *Asian Journal of Entrepreneurship, 6*(2), 34–51.

Kazakeviciute et al., 2016; Kazakeviciute, A., Urbone, R., & Petraite, M. (2016). Curriculum development for technology-based entrepreneurship education: A cross-disciplinary and cross-cultural approach. Industry and Higher Education, 30(3), 202–214. https://doi.org/10.1177/0950422216656050

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice-Hall.

Kolb, D. A. (2015). Experiential learning: Experience as the source of learning and development (2nd ed.). Pearson Education.

Lawal, B. (2017). Investigating the barriers to the successful integration of ICT in the Colleges of Education in Nigeria. Institutional-Based Research Report, Federal College of Education (Technical) Gusau.

Lee, S. M., & Trimi, S. (2018). Innovation for creating a smart future. *Journal of Innovation & Knowledge, 3*(1), 1–8.

Liguori, E., & Winkler, C. (2020). From offline to online: Challenges and opportunities for entrepreneurship education following the COVID-19 pandemic. Entrepreneurship Education and Pedagogy, 3(4), 346–351. https://doi.org/10.1177/2515127420916738

Mabunda, Z., & Fourie, J. (2021). Virtual reality-based entrepreneurship simulations in South African higher education. *African Journal of Business and Economic Research, 16*(2), 145–162. https://doi.org/10.31920/1750-4562

Maina, J. (2020). Hybrid models of entrepreneurship education: Lessons from Kenyan universities. *African Journal of Entrepreneurship, 9*(1), 77–93.

Marques, C., & Leal, C. (2021). Artificial intelligence in entrepreneurship education: Enhancing innovation and critical thinking. *Education and Information Technologies, 26*(3), 3361–3379. https://doi.org/10.1007/s10639-020-10402-5

Martin, B. C., McNally, J. J., & Kay, M. J. (2013). Examining the formation of human capital in entrepreneurship: A meta-analysis of entrepreneurship education outcomes. Journal of Business Venturing, 28(2), 211–224. https://doi.org/10.1016/j.jbusvent.2012.03.002

Meltwater Entrepreneurial School of Technology (MEST) Africa. (2020). Building Africa's next generation of entrepreneurs through training and incubation. *Meltwater Entrepreneurial School of Technology.* https://meltwater.org

Miao, F., & Holmes, W. (2023). *Guidance for generative AI in education and research*. UNESCO. https://doi.org/10.54675/EWZM9535

Nambisan, S. (2017). Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship. *Entrepreneurship Theory and Practice, 41*(6), 1029–1055. https://doi.org/10.1111/etap.12254

Nwosu, O. (2024). Redesigning business education for the digital economy: Evidence from Anambra State. *Nigerian Journal of Business Education, 11*(2), 88–103.

Oduola, J. (2022). Digital divide and entrepreneurship education in low-income communities in Nigeria. *Journal of Educational Technology in Africa, 10*(1), 23–37.

Oguejiofor, T., & Nwankwo, B. (2021). Entrepreneurship curriculum reform in Nigeria: Aligning with digital realities. *Journal of Business Education in Africa, 7*(2), 19–34.

Ogunleye, A., & Salami, K. (2023). ICT competencies and entrepreneurial intentions among undergraduates in South-West Nigeria. *African Journal of Entrepreneurship Research, 15*(1), 55–70.

Okafor, C., & Bello, Y. (2025). Embedding digital entrepreneurship in open universities: Evidence from Nigeria. *International Review of Research in Open and Distributed Learning, 26*(2), 1–18.

Okebukola, P. (2021). Renewable energy solutions for higher education in Nigeria: Overcoming electricity barriers. *Journal of Higher Education in Africa, 19*(3), 45–62.

Olamide, A., & Olufunmilayo, A. (2019). Rethinking assessment in Nigerian entrepreneurship education. *Nigerian Journal of Educational Research, 15*(2), 98–112.

Olawale, T. (2021). Cross-border collaboration and digital hackathons: Evidence from Nigerian university students. *African Journal of Entrepreneurship, 12*(2), 87–105. https://doi.org/10.1080/aje.2021.112

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, Article n71. https://doi.org/10.1136/bmj.n71

Pittaway, L., & Cope, J. (2007). Simulating entrepreneurial learning: Integrating experiential and collaborative approaches to learning. *Management Learning, 38*(2), 211–233. https://doi.org/10.1177/1350507607075776

Rafiana, N. N. (2023). Technopreneurship strategy to grow entrepreneurship career options for students in higher education. ADI Journal on Recent Innovation, 5(2), 110–126. https://doi.org/10.34306/ajri.v5i2.995

Rahman, M. (2019). Mobile learning and rural entrepreneurship: Lessons from Bangladesh and India. *Asian Journal of Innovation and Entrepreneurship, 8*(1), 53–70. https://doi.org/10.20885/ajie.vol8.iss1.art5

Ratten, V. (2020a). Coronavirus (COVID-19) and the entrepreneurship education community. Journal of Enterprising Communities: People and Places in the Global Economy. https://doi.org/10.1108/JEC-06-2020-0121

Ratten, V. (2020b). *Entrepreneurship and innovation education: Frameworks and cases.* Springer.

Ratten, V. (2020c). Online education and entrepreneurship: Cross-border perspectives. *Journal of Entrepreneurship in Emerging Economies, 12*(4), 543–559. https://doi.org/10.1108/JEEE-04-2020-1234

Ratten, V., & Jones, P. (2021a). Covid-19 and entrepreneurship education: Implications for advancing research and practice. The International Journal of Management Education, 19(1), 100432. https://doi.org/10.1016/j.ijme.2020.100432

Ratten, V., & Jones, P. (2021b). Entrepreneurship education: Current research and future perspectives. *International Journal of Management Education, 19*(1), 100–105. https://doi.org/10.1016/j.ijme.2020.100533

Ratten, V., & Usmanij, P. (2021). Entrepreneurship education: Time for a change in research direction? The International Journal of Management Education, 19(1), 100367. https://doi.org/10.1016/j.ijme.2020.100367

Rideout, E. C., & Gray, D. O. (2013). Does entrepreneurship education really work? A review and methodological critique of the empirical literature on the effects of university-based entrepreneurship education. *Journal of Small Business Management, 51*(3), 329– 351. https://doi.org/10.1111/jsbm.12021

Secundo, G., Rippa, P., & Cerchione, R. (2020). Digital Academic Entrepreneurship: A structured literature review and avenue for a research agenda. Technological Forecasting and Social Change, 157, Article 120118. https://doi.org/10.1016/j.techfore.2020.120118

Sharma, P. (2018). Entrepreneurship education in India: Navigating the digital transformation gap. *Indian Journal of Management, 11*(2), 15–24.

Tan, S., & Ng, C. (2006). A problem-based learning approach to entrepreneurship education. *Education + Training, 48*(6), 416–428.

Udekwe, E., & Iwu, C. G. (2024). The Nexus Between Digital Technology, Innovation, Entrepreneurship Education, and Entrepreneurial Intention and Entrepreneurial Motivation: A Systematic Literature Review. Education Sciences, 14(11), 1211. https://doi.org/10.3390/educsci14111211

Unger, J. M., Rauch, A., Frese, M., & Rosenbusch, N. (2011). Human capital and entrepreneurial success: A meta-analytical review. *Journal of Business Venturing, 26*(3), 341–358. https://doi.org/10.1016/j.jbusvent.2009.09.004

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2021). *Open Educational Resources (OER) and inclusive education in Africa.* UNESCO Publishing.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. Decision Sciences, 39(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

World Bank. (2019). *Nigeria digital economy diagnostic: A plan for building Nigeria's inclusive digital future*. World Bank.

World Bank. (2020). *Digital economy for Africa initiative: Ensuring affordable broadband.* World Bank.

World Bank. (2021). *Transforming education through technology: Case studies from Eastern and Southern Africa.* World Bank.

Yu, G., Ramayah, T., & Lin, Z. (2025). Toward understanding the role of generative AI in entrepreneurship education: A systematic review. *Computers and Education: Artificial Intelligence, 9*, Article 100470. https://doi.org/10.1016/j.caeai.2025.100470

Zhang, Y., & Zhu, W. (2020). AI-powered adaptive learning for entrepreneurship education in China. *Journal of Educational Technology Development and Exchange, 13*(2), 1–16. https://doi.org/10.18785/jetde.1302.01

Zhu, J., & Luo, L. (2025). Designing the future of entrepreneurship education: Exploring an AI-empowered scaffold system for business plan development. In 2025 5th International Conference on Artificial Intelligence and Education (ICAIE). IEEE. https://doi.org/10.1109/ICAIE64856.2025.11158485