

Original Article

Building Entrepreneurial Capacity through AI-Integrated Higher Education for Sustainable Economic Growth in Nigeria

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Abstract

The incorporation of Artificial Intelligence (AI) into higher education has become a significant driver of change, transforming entrepreneurship education and supporting sustainable economic advancement. This study explored the influence of AI-integrated curricula on the development of entrepreneurial skills and associated outcomes among university students in Nigeria. Drawing on the principles of Human Capital Theory and the Entrepreneurial Ecosystem Framework, the research examined the extent to which AI-supported teaching and learning approaches contribute to entrepreneurial competence and broader economic benefits. A quantitative cross-sectional survey approach was employed, and the data were analyzed using Structural Equation Modeling (SEM) supported by bootstrapping techniques. The findings demonstrated that AI curriculum integration exerts a substantial and positive effect on entrepreneurial skills development ($\beta = 0.723$, $p < 0.001$). In addition, entrepreneurial skills development was found to significantly enhance entrepreneurial intention ($\beta = 0.678$), venture creation readiness ($\beta = 0.694$), employability readiness ($\beta = 0.617$), and innovation capability ($\beta = 0.748$), with all relationships significant at $p < 0.001$. The results further showed that innovation capability ($\beta = 0.332$), venture creation readiness ($\beta = 0.245$), entrepreneurial intention ($\beta = 0.221$), employability readiness ($\beta = 0.194$), and AI curriculum integration ($\beta = 0.171$) are significant determinants of sustainable economic growth, collectively accounting for 71.6% of the variance in the construct ($R^2 = 0.716$). Moreover, the mediation analysis revealed that entrepreneurial skills development plays a crucial intermediary role between AI curriculum integration and entrepreneurial outcomes, suggesting that the benefits of AI are largely realized through the enhancement of students' entrepreneurial competencies. The study concludes that integrating AI into Nigerian university curricula significantly improves entrepreneurial capabilities, increases employability potential, and strengthens readiness for venture creation, thereby fostering sustainable economic growth. The findings highlight the need for higher education institutions to adopt AI-driven instructional strategies as a means of promoting innovation-oriented entrepreneurship and advancing Nigeria's transition toward a knowledge-based economy.

Keywords

Artificial Intelligence, Higher Education Curriculum, Entrepreneurial Skills, Sustainable Economic Growth, Nigerian Universities, Digital Innovation.

Article
History

Received:
15.06.2026

Accepted:
20.06.2026

Published:
29.06.2026

1. Introduction

Artificial Intelligence (AI) has become one of the most influential technological innovations of the twenty-first century, transforming various sectors including business, manufacturing, governance, healthcare, education, and entrepreneurship. AI encompasses computer-based systems and algorithms designed to perform functions that traditionally require human cognitive abilities, such as learning, reasoning, problem-solving, decision-making, and predictive analysis (Russell & Norvig, 2021). Recent advancements in AI technologies, particularly in machine learning, deep learning, natural language processing, and predictive analytics, have accelerated global digital transformation and opened new avenues for innovation, productivity enhancement, and economic progress (Brynjolfsson & McAfee, 2017).

Across diverse industries and economies, AI is redefining work processes and altering the competencies required for success in contemporary labour markets. The widespread implementation of AI-powered solutions has enhanced organizational performance by increasing efficiency, lowering operational expenses, improving customer

satisfaction, and supporting data-driven decision-making processes (World Economic Forum [WEF], 2023). As a result, employers increasingly seek graduates who possess not only subject-specific expertise but also digital literacy, entrepreneurial orientation, and innovative problem-solving capabilities needed to function effectively in an AI-driven environment. This evolving economic and technological landscape places greater pressure on higher education institutions to modernize their curricula and instructional strategies in order to equip students with the knowledge and skills required to meet emerging workforce demands and future economic challenges.

In higher education, AI technologies such as intelligent tutoring systems, adaptive learning platforms, virtual laboratories, educational chatbots, predictive learning analytics, and simulation-based learning environments are revolutionizing teaching and learning processes (Holmes et al., 2022). These technologies facilitate personalized learning experiences by adapting instructional content to students' learning needs, pace, and preferences. AI-supported educational systems can provide real-time feedback, monitor learner progress, identify knowledge gaps, and recommend appropriate learning interventions, thereby improving educational outcomes and learner engagement (Luckin et al., 2016). Furthermore, AI enables universities to create experiential learning environments that promote critical thinking, creativity, problem-solving, and entrepreneurial competence among students.

The growing relevance of AI in education is particularly important for developing countries such as Nigeria, where unemployment, poverty, underemployment, and low industrial productivity remain significant socio-economic challenges. Despite being one of Africa's largest economies and possessing a youthful population with enormous entrepreneurial potential, Nigeria continues to experience high levels of graduate unemployment and skills mismatch (National Bureau of Statistics [NBS], 2023). Many university graduates face difficulties transitioning from academic institutions into productive employment or successful entrepreneurial ventures due to inadequate practical skills, limited technological competence, and insufficient exposure to innovation-driven learning environments (Adebayo & Kolawole, 2022).

Over the past decade, entrepreneurship education has been promoted as a strategic mechanism for addressing youth unemployment and stimulating economic growth in Nigeria. Consequently, entrepreneurship courses have become mandatory in most Nigerian universities following policy directives from educational authorities. While these initiatives have increased awareness of entrepreneurship among students, concerns remain regarding the effectiveness of existing curricula in developing practical entrepreneurial competencies and market-relevant skills (Olawale & Garwe, 2018). Traditional instructional approaches often emphasize theoretical knowledge acquisition rather than experiential learning, innovation, and technology-enabled problem-solving, thereby limiting students' capacity to identify and exploit entrepreneurial opportunities in a rapidly changing digital economy.

The integration of AI into higher education curricula offers a promising pathway for bridging the gap between classroom learning and marketplace realities. AI-powered learning systems can support entrepreneurial education by providing students with access to virtual business incubation environments, market intelligence platforms, predictive analytics tools, business simulation software, and innovation management systems (UNESCO, 2021). Such technologies expose learners to real-world business scenarios and enable them to develop competencies in opportunity recognition, business planning, strategic decision-making, innovation management, and risk assessment. Through experiential and technology-enhanced learning, students can acquire practical entrepreneurial skills that improve employability and increase their readiness for venture creation.

Moreover, AI has the potential to strengthen the broader entrepreneurial ecosystem by facilitating collaboration between universities, industries, investors, and government agencies. Universities can leverage AI technologies to promote innovation commercialization, technology transfer, startup development, and industry partnerships, thereby contributing to knowledge-based economic growth (Isenberg, 2011). By producing graduates equipped with both entrepreneurial and digital competencies, higher education institutions can play a significant role in fostering innovation-driven enterprises capable of creating employment opportunities and promoting sustainable economic development.

From a theoretical perspective, the integration of AI into higher education aligns with Human Capital Theory, which posits that investments in education and skills development enhance individual productivity and contribute to economic growth (Becker, 1964). Similarly, the Entrepreneurial Ecosystem Framework emphasizes the

importance of educational institutions, technology, innovation networks, and supportive policies in fostering entrepreneurial activity and economic prosperity (Stam, 2015). Consequently, embedding AI within university curricula may not only improve educational outcomes but also strengthen entrepreneurial capacity and support national development objectives.

Despite growing global interest in AI-enhanced education, empirical studies examining the relationship between AI curriculum integration and entrepreneurial skills development in developing economies remain limited. In Nigeria, research has primarily focused on entrepreneurship education, digital literacy, and technology adoption, with relatively little attention given to how AI-enabled instructional approaches influence entrepreneurial competencies and economic outcomes. This gap in the literature highlights the need for further investigation into the potential contributions of AI-driven curriculum innovation to entrepreneurship education and sustainable economic growth.

Against this backdrop, this study investigates the relationship between AI curriculum integration and entrepreneurial skills development in Nigerian universities. Specifically, the study examines how AI-enabled learning environments influence entrepreneurial intention, innovation capability, employability readiness, and venture creation preparedness among students. The study further explores the implications of AI-enhanced entrepreneurship education for sustainable economic growth and innovation-driven development in Nigeria. The findings are expected to provide valuable insights for policymakers, curriculum developers, university administrators, and entrepreneurship educators seeking to leverage AI technologies to strengthen higher education and promote inclusive economic transformation.

2. Literature Review

A. Artificial Intelligence in Higher Education

Artificial Intelligence (AI) has become one of the most influential technological innovations shaping contemporary higher education systems worldwide. AI refers to the capability of computer systems to perform tasks that traditionally require human intelligence, such as learning, reasoning, perception, problem-solving, language understanding, and decision-making (Russell & Norvig, 2021). Recent advancements in machine learning, deep learning, natural language processing, and predictive analytics have expanded the application of AI across multiple sectors, including education, healthcare, finance, manufacturing, and entrepreneurship. Within the educational sector, AI is increasingly being recognized as a transformative tool capable of improving teaching effectiveness, learning outcomes, institutional management, and student support services (Zawacki-Richter et al., 2019).

The growing adoption of AI in higher education reflects the broader digital transformation agenda aimed at preparing learners for participation in the knowledge economy and the Fourth Industrial Revolution. Universities across developed and emerging economies are incorporating AI technologies into instructional design, curriculum delivery, assessment processes, and academic administration to enhance educational quality and efficiency (UNESCO, 2021). The integration of AI into higher education has become particularly important as institutions seek innovative approaches to address challenges associated with massification, diverse learner needs, resource constraints, and the demand for personalized learning experiences.

One of the most significant contributions of AI to higher education is its ability to facilitate personalized and adaptive learning. Traditional educational systems often employ a uniform approach to instruction despite differences in students' learning abilities, backgrounds, and preferences. AI-powered adaptive learning platforms address this limitation by analyzing learners' performance data and tailoring educational content to individual needs (Luckin et al., 2016). These systems can identify knowledge gaps, recommend appropriate learning materials, adjust instructional difficulty levels, and provide customized feedback in real time. Such personalization improves learner engagement, enhances academic performance, and promotes self-directed learning.

Another important application of AI in higher education is the use of Intelligent Tutoring Systems (ITS). These systems simulate the role of human tutors by providing individualized instruction, monitoring student progress, and offering immediate feedback on learning activities. Research indicates that intelligent tutoring systems can

significantly improve students' understanding of complex concepts while reducing dependency on instructor-centered teaching approaches (Holmes et al., 2022). By facilitating continuous interaction and personalized support, AI-driven tutoring systems contribute to more effective and efficient learning environments.

AI technologies are also transforming assessment and evaluation processes within universities. Automated grading systems, plagiarism detection software, and predictive analytics tools enable institutions to streamline academic assessment while maintaining objectivity and consistency. AI-supported assessment systems can analyze large volumes of student data, identify patterns in learning behavior, and predict academic outcomes, thereby enabling early intervention for at-risk students (Chen et al., 2020). These capabilities not only improve institutional effectiveness but also support evidence-based decision-making among educators and administrators.

In addition to enhancing teaching and assessment, AI has facilitated the emergence of virtual learning assistants and educational chatbots. These AI-powered tools provide students with immediate access to academic information, administrative support, and learning resources regardless of time or location. Educational chatbots can answer frequently asked questions, guide students through course requirements, provide reminders regarding academic activities, and support collaborative learning processes (Okonkwo & Ade-Ibijola, 2021). Such innovations improve accessibility and contribute to more flexible and inclusive educational environments.

The application of predictive analytics represents another important dimension of AI adoption in higher education. Predictive analytics involves the use of algorithms and data mining techniques to forecast future events based on historical and current data. Universities increasingly utilize predictive analytics to monitor student engagement, predict retention rates, assess learning outcomes, and optimize institutional planning (Siemens & Baker, 2019). By leveraging data-driven insights, higher education institutions can develop targeted interventions that improve student success and institutional performance.

Furthermore, AI supports experiential learning through virtual laboratories, simulation environments, and immersive educational technologies. These innovations enable students to engage with realistic scenarios, practice decision-making skills, and gain practical experience in a risk-free environment. For entrepreneurship education specifically, AI-powered business simulations, virtual incubation platforms, and market intelligence tools provide opportunities for students to develop competencies in innovation management, opportunity recognition, strategic planning, and venture creation (Dwivedi et al., 2023). Consequently, AI contributes not only to academic learning but also to the development of employability and entrepreneurial skills required in contemporary labour markets.

Despite these potential benefits, the adoption and utilization of AI in higher education remain uneven across countries and regions. Developed nations have made significant investments in digital infrastructure, AI research, and educational technology, enabling widespread integration of AI into university systems. In contrast, many developing countries continue to face challenges related to inadequate infrastructure, limited technological capacity, insufficient funding, and low levels of digital literacy (UNESCO, 2021). These challenges have constrained the effective implementation of AI-enabled educational innovations in many higher education institutions.

In the Nigerian context, the adoption of AI within universities is still at an emerging stage. While digital transformation initiatives have gained momentum in recent years, the integration of AI into teaching, learning, and curriculum design remains limited. Several factors contribute to this situation, including inadequate technological infrastructure, unreliable electricity supply, poor internet connectivity, limited funding for educational technology, and insufficient capacity among academic staff (Aina & Mhlongo, 2024). Additionally, many universities lack comprehensive policies and strategic frameworks to guide AI implementation and digital transformation efforts.

Another significant challenge relates to digital literacy and AI competency among both students and educators. Effective utilization of AI technologies requires a workforce equipped with the necessary technical skills and knowledge to operate, manage, and integrate AI systems into educational processes. However, studies indicate that many Nigerian educators have limited exposure to AI applications and insufficient training in digital pedagogy, thereby constraining the adoption of AI-enhanced instructional practices (Okeke & Nwankwo, 2023). This skills gap highlights the need for targeted capacity-building initiatives aimed at improving AI literacy within higher education institutions.

Nevertheless, opportunities for AI integration in Nigerian higher education continue to expand. Increased internet penetration, growth in mobile technology adoption, government investments in digital infrastructure, and the emergence of technology-driven innovation hubs have created a more favorable environment for educational digitalization (World Bank, 2023). Furthermore, the growing recognition of digital skills as critical drivers of economic competitiveness has encouraged policymakers and educational institutions to explore innovative approaches to curriculum development and instructional delivery.

The rise of digital entrepreneurship and the increasing demand for technology enabled competencies among employers further strengthen the case for AI integration within Nigerian universities. As businesses increasingly adopt AI-driven systems and digital business models, higher education institutions must equip students with the skills necessary to thrive in technology-intensive environments. Integrating AI into curricula can therefore support the development of entrepreneurial competencies, innovation capabilities, and digital literacy required for participation in the modern economy.

In addition, the literature suggests that AI possesses significant potential to transform higher education through personalized learning, intelligent tutoring, automated assessment, predictive analytics, and experiential learning environments. While the adoption of AI in Nigerian universities remains constrained by infrastructural and institutional challenges, ongoing digital transformation initiatives provide opportunities for broader integration. Consequently, embedding AI into higher education curricula may serve as a strategic mechanism for enhancing educational quality, promoting entrepreneurial skills development, and preparing graduates for the demands of the digital economy.

B. Entrepreneurship Education and Entrepreneurial Skills Development

Entrepreneurship education has emerged as a strategic tool for fostering innovation, promoting self-employment, and stimulating economic growth in both developed and developing economies. It is broadly defined as a structured educational process aimed at equipping individuals with the knowledge, skills, attitudes, and competencies necessary to identify opportunities, create value, establish enterprises, and effectively manage business ventures (Fayolle & Gailly, 2015). Unlike traditional business education, entrepreneurship education focuses not only on imparting theoretical knowledge but also on developing entrepreneurial mindsets, creativity, innovation, and proactive problem-solving capabilities that enable individuals to navigate uncertain and dynamic business environments.

The growing importance of entrepreneurship education has been driven by increasing concerns over youth unemployment, economic instability, and the need for innovation-led economic transformation. Governments, educational institutions, and international development agencies increasingly recognize entrepreneurship education as a mechanism for developing human capital, promoting enterprise creation, and enhancing national competitiveness (OECD, 2023). Consequently, universities around the world have integrated entrepreneurship programmes into their curricula to prepare students for both self-employment and participation in knowledge-based economies.

Entrepreneurial skills represent the core outcomes of entrepreneurship education. These skills encompass a broad range of competencies that enable individuals to identify opportunities, mobilize resources, manage risks, innovate, and create sustainable ventures. According to Morris, Webb, Fu, and Singhal (2013), entrepreneurial competencies include opportunity recognition, creativity, innovation, leadership, strategic thinking, communication, networking, business planning, negotiation, resilience, and risk management. These competencies are essential for successful venture creation and long-term business sustainability.

Creativity and innovation are particularly important entrepreneurial capabilities because they enable individuals to generate novel ideas, develop innovative products and services, and create competitive advantages in the marketplace (Schumpeter, 1934). Opportunity recognition, another critical entrepreneurial skill, involves the ability to identify unmet market needs, evaluate business prospects, and exploit emerging opportunities. Likewise, leadership and communication skills enable entrepreneurs to coordinate resources, inspire teams, build stakeholder relationships, and effectively communicate value propositions to customers and investors.

Traditional entrepreneurship education often relied heavily on classroom-based lectures and theoretical instruction. However, scholars have argued that entrepreneurial competencies are best developed through experiential learning approaches that allow students to engage in practical business activities and real-world problem-solving (Kolb, 1984). Experiential learning enables learners to acquire entrepreneurial knowledge through action, reflection, experimentation, and interaction with business environments. As a result, contemporary entrepreneurship education increasingly incorporates business simulations, project-based learning, case studies, internships, startup incubation programmes, and industry engagement activities.

In recent years, technological advancements have significantly influenced the delivery of entrepreneurship education. Digital technologies have expanded opportunities for experiential learning by providing access to virtual business environments, online collaboration platforms, market intelligence systems, and innovation management tools. Among these technologies, Artificial Intelligence (AI) has emerged as a particularly powerful enabler of entrepreneurial learning and skills development (Dwivedi et al., 2023).

AI technologies enhance entrepreneurship education by facilitating simulation-based learning, predictive analytics, business intelligence, and personalized learning experiences. AI-powered business simulations expose students to realistic entrepreneurial scenarios, allowing them to practice strategic decision-making, resource allocation, financial management, and market analysis without the risks associated with actual business operations (Holmes et al., 2022). These simulations provide opportunities for learners to experiment with different business strategies, analyze outcomes, and develop critical entrepreneurial competencies in a controlled environment.

Furthermore, AI-driven data analytics tools enable students to access and interpret large volumes of market information, customer behavior patterns, and industry trends. Such capabilities improve opportunity recognition and support evidence-based entrepreneurial decision-making. Through predictive analytics and machine learning applications, students can assess market opportunities, forecast consumer demand, evaluate business risks, and identify emerging trends that may influence venture performance (Brynjolfsson & McAfee, 2017). These analytical capabilities are increasingly important in contemporary business environments characterized by rapid technological change and market uncertainty.

Another significant contribution of AI to entrepreneurship education is the provision of personalized learning experiences. AI-powered adaptive learning systems can identify students' strengths, weaknesses, and learning preferences, thereby enabling customized instructional pathways that enhance entrepreneurial competence development (Luckin et al., 2016). Such systems support continuous learning and provide targeted feedback that improves students' understanding of entrepreneurial concepts and business practices.

AI-driven entrepreneurial learning environments also facilitate collaboration, innovation, and creativity. Virtual incubation platforms, innovation hubs, and digital entrepreneurship ecosystems provide students with opportunities to interact with mentors, investors, industry experts, and fellow entrepreneurs. These interactions foster networking, knowledge sharing, and collaborative problem-solving, which are critical components of entrepreneurial success (Isenberg, 2011). Moreover, exposure to AI-supported innovation environments encourages students to develop technology-oriented entrepreneurial solutions capable of addressing societal and economic challenges.

Empirical studies have demonstrated that technology-enhanced entrepreneurship education positively influences entrepreneurial intention, venture creation readiness, and entrepreneurial self-efficacy among students (Nabi et al., 2017). AI-powered learning environments enhance students' confidence in their entrepreneurial abilities by providing opportunities for practical skill acquisition and experiential learning. Consequently, learners become more willing to pursue entrepreneurial careers and engage in venture creation activities after graduation.

In the Nigerian context, entrepreneurship education has become a key component of higher education policy aimed at addressing graduate unemployment and promoting self-reliance. However, concerns remain regarding the effectiveness of existing entrepreneurship programmes in developing practical entrepreneurial competencies among students. The limited integration of emerging technologies such as AI into entrepreneurship curricula has constrained opportunities for experiential learning and innovation development (Adebayo & Yusuf, 2021).

Therefore, embedding AI into entrepreneurship education may enhance the quality and relevance of entrepreneurial learning while improving students' preparedness for participation in the digital economy.

Overall, the literature suggests that entrepreneurship education plays a vital role in developing entrepreneurial competencies that support venture creation, innovation, and economic development. The integration of AI technologies into entrepreneurship education offers significant opportunities for enhancing experiential learning, strengthening entrepreneurial skills development, and preparing graduates for technology-driven entrepreneurial ecosystems.

C. Artificial Intelligence and Sustainable Economic Growth

Sustainable economic growth has become a central objective of governments, international organizations, and development practitioners seeking to improve living standards while ensuring long-term social, economic, and environmental sustainability. The concept refers to a pattern of economic development that generates continuous improvements in productivity, income, employment, and welfare without compromising the ability of future generations to meet their own needs (United Nations, 2015). Sustainable economic growth is characterized by inclusive development, efficient resource utilization, technological innovation, environmental responsibility, and equitable distribution of economic opportunities.

In contemporary economies, technological innovation is widely recognized as a key driver of sustainable growth. Among emerging technologies, Artificial Intelligence (AI) has attracted considerable attention due to its transformative potential across multiple sectors. AI contributes to economic growth by enhancing productivity, improving operational efficiency, facilitating innovation, and creating new business opportunities (OECD, 2023). Through automation, predictive analytics, intelligent decision-making systems, and machine learning applications, AI enables organizations to optimize resource allocation, reduce costs, and improve performance outcomes.

The economic significance of AI is particularly evident in its ability to increase labour productivity and support innovation-driven growth. AI-powered systems can automate repetitive tasks, augment human capabilities, and improve decision-making processes, thereby enabling organizations to produce more outputs with fewer resources (Brynjolfsson & McAfee, 2017). Increased productivity contributes directly to economic expansion by improving competitiveness, profitability, and overall economic efficiency. Furthermore, AI facilitates the development of new products, services, and business models that stimulate innovation and create additional sources of economic value.

Another important contribution of AI to sustainable economic growth is its role in job creation and workforce transformation. While concerns exist regarding the potential displacement of workers due to automation, research indicates that AI also creates new employment opportunities in fields such as data science, software development, digital marketing, robotics, cybersecurity, and technology entrepreneurship (World Economic Forum, 2023). The emergence of AI-driven industries necessitates the development of new skills and competencies, thereby increasing the importance of education and workforce development initiatives.

In emerging economies such as Nigeria, AI presents significant opportunities for addressing persistent development challenges, including unemployment, poverty, low productivity, and economic dependence on limited sectors. AI-enabled entrepreneurship can promote economic diversification by supporting innovation in agriculture, healthcare, education, manufacturing, financial services, and other strategic sectors (World Bank, 2023). Through digital innovation and technology-driven enterprise development, AI can stimulate the growth of new industries and strengthen national competitiveness in the global economy.

Small and Medium-sized Enterprises (SMEs), which constitute a substantial proportion of Nigeria's economic activities, stand to benefit considerably from AI adoption. AI technologies can improve business efficiency through customer analytics, inventory management, demand forecasting, digital marketing, and financial planning. Such improvements enhance the productivity and sustainability of SMEs while increasing their capacity to compete in both domestic and international markets (Acs et al., 2018). Consequently, AI-driven entrepreneurship can contribute to employment generation, income creation, and broader economic development.

The development of innovation ecosystems is another important pathway through which AI contributes to sustainable growth. Innovation ecosystems comprise interconnected networks of universities, businesses, government agencies, investors, and research institutions that collectively support innovation and entrepreneurship (Stam, 2015). AI technologies strengthen these ecosystems by facilitating knowledge creation, technology transfer, collaborative research, and startup development. As centers of knowledge production and human capital development, universities play a critical role in nurturing AI-enabled innovation and entrepreneurship.

Higher education institutions contribute to sustainable economic growth by producing graduates equipped with digital competencies, entrepreneurial capabilities, and innovation-oriented mindsets. The integration of AI into university curricula enhances students' readiness for participation in technology-driven economies and improves their capacity to create innovative solutions to societal challenges. Through AI-supported learning environments, students acquire practical skills in data analysis, problem-solving, innovation management, and business development that are essential for economic transformation (Holmes et al., 2022).

From the perspective of Human Capital Theory, investments in AI-enhanced education increase the productivity and economic value of individuals by improving their knowledge, skills, and competencies (Becker, 1964). These improvements contribute to economic growth through higher levels of innovation, entrepreneurship, and workforce effectiveness. Similarly, endogenous growth theories emphasize the role of technological innovation and human capital development as fundamental drivers of long-term economic prosperity (Romer, 1990).

For Nigeria and other developing countries, integrating AI into higher education curricula can serve as a strategic approach to strengthening human capital development, promoting innovation-driven entrepreneurship, and enhancing economic resilience. By equipping students with AI-related competencies and entrepreneurial skills, universities can contribute to the creation of a workforce capable of driving digital transformation and sustainable development. Therefore, AI integration in higher education represents not only an educational reform strategy but also a broader economic development intervention capable of fostering inclusive and sustainable growth.

3. Theoretical And Conceptual Framework

The theoretical foundation of this study is anchored on two complementary theories: Human Capital Theory (HCT) and the Entrepreneurial Ecosystem Framework (EEF). These theories provide a robust lens for understanding how the integration of Artificial Intelligence (AI) into higher education curricula can enhance entrepreneurial skills development and contribute to sustainable economic growth. While Human Capital Theory explains how educational investments improve individual productivity and economic outcomes, the Entrepreneurial Ecosystem Framework highlights the broader institutional and environmental conditions that facilitate entrepreneurial activity and innovation. Together, these theories offer a comprehensive explanation of the mechanisms through which AI-enhanced education can foster entrepreneurship and economic development in Nigeria.

Within the framework of this study, AI curriculum integration is conceptualized as an educational investment that enhances entrepreneurial human capital. The resulting improvements in entrepreneurial competencies are expected to increase students' entrepreneurial intentions, venture creation readiness, and employability outcomes. Consequently, Human Capital Theory provides a strong theoretical justification for examining the role of AI in strengthening entrepreneurial skills development among university students.

Therefore, Human Capital Theory is relevant to this study because it explains how AI-enhanced educational experiences can improve students' entrepreneurial competencies and economic productivity. The theory supports the argument that integrating AI into university curricula constitutes an investment in human capital development that enhances entrepreneurial capability, innovation potential, and employability. Therefore, the theory provides a logical basis for investigating the relationship between AI curriculum integration and entrepreneurial skills development in Nigerian universities.

From the other perspective of this study, universities function as critical ecosystem actors responsible for developing entrepreneurial talent and supporting innovation. AI curriculum integration represents a strategic intervention capable of strengthening the entrepreneurial ecosystem by enhancing entrepreneurial skills

development, promoting innovation, and improving the quality of human capital available for economic development.

Therefore, Entrepreneurial Ecosystem Framework is relevant to this study because it explains how educational institutions, technology, innovation networks, and supportive environments interact to influence entrepreneurial outcomes. The framework supports the proposition that AI integration in higher education can strengthen entrepreneurial ecosystems by improving collaboration, knowledge exchange, innovation diffusion, and venture creation readiness. Consequently, the framework provides a valuable basis for understanding the broader institutional mechanisms through which AI enhanced education contributes to entrepreneurship development and sustainable economic growth.

The combination of Human Capital Theory and the Entrepreneurial Ecosystem Framework provides a comprehensive theoretical foundation for this study. Human Capital Theory explains how AI-integrated education enhances individual entrepreneurial competencies, while the Entrepreneurial Ecosystem Framework explains how institutional and technological environments support the application of these competencies in entrepreneurial activities.

Together, the theories suggest that AI curriculum integration improves entrepreneurial skills development by enhancing human capital and strengthening entrepreneurial ecosystems. These improvements are expected to increase entrepreneurial intention, employability readiness, venture creation capability, innovation performance, and ultimately contribute to sustainable economic growth. Therefore, the study conceptualizes AI-integrated higher education as a strategic mechanism for developing entrepreneurial talent and promoting innovation-driven economic transformation in Nigeria.

A. Conceptual Framework

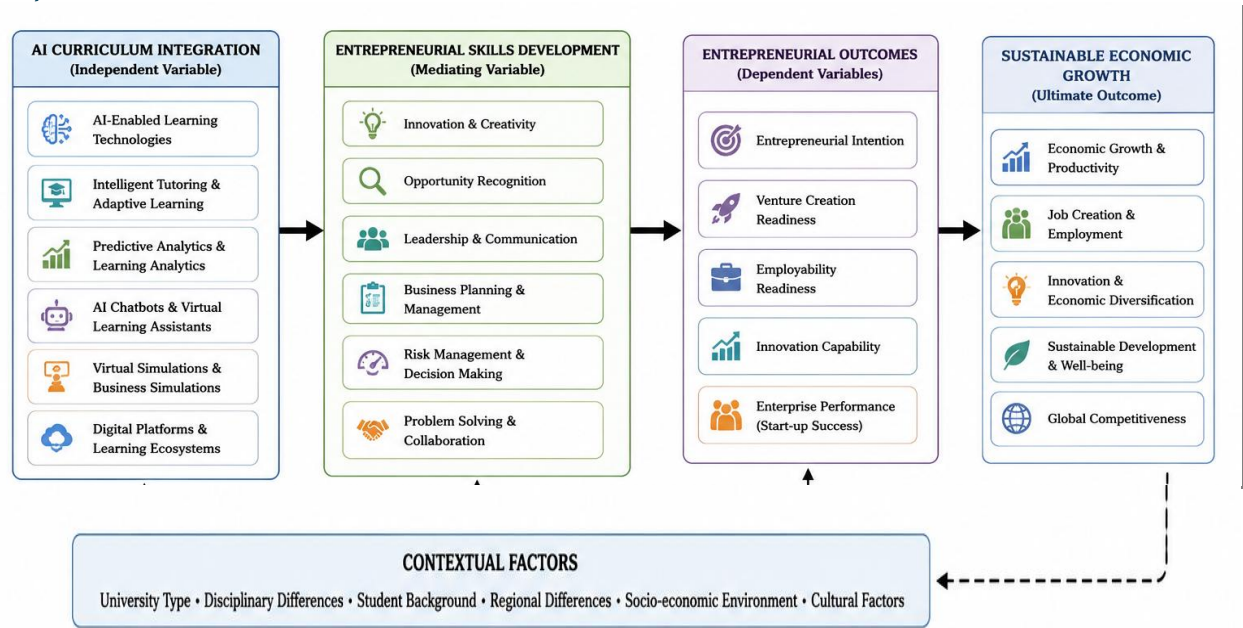


Fig-1: Conceptual Framework- AI Curriculum Integration and Entrepreneurial Skills Development for Sustainable Economic Growth in Nigerian Universities

B. Hypotheses Development

- H1: AI Curriculum Integration significantly influences Entrepreneurial Skills Development.
- H2: Entrepreneurial Skills Development significantly influences Entrepreneurial Intention.
- H3: Entrepreneurial Skills Development significantly influences Venture Creation Readiness.
- H4: Entrepreneurial Skills Development significantly influences Employability Readiness.
- H5: Entrepreneurial Skills Development significantly influences Innovation Capability.
- H6: Entrepreneurial Intention significantly influences Sustainable Economic Growth.

H7: Venture Creation Readiness significantly influences Sustainable Economic Growth.

H8: Employability Readiness significantly influences Sustainable Economic Growth.

H9: Innovation Capability significantly influences Sustainable Economic Growth.

H10: AI Curriculum Integration significantly influences Sustainable Economic Growth.

H11: Entrepreneurial Skills Development mediates the relationship between AI Curriculum Integration and Entrepreneurial Intention.

H12: Entrepreneurial Skills Development mediates the relationship between AI Curriculum Integration and Venture Creation Readiness.

H13: Entrepreneurial Skills Development mediates the relationship between AI Curriculum Integration and Employability Readiness.

H14: Entrepreneurial Skills Development mediates the relationship between AI Curriculum Integration and Innovation Capability.

4. Methodology

This study adopted a quantitative cross-sectional survey research design to examine the influence of Artificial Intelligence (AI) curriculum integration on entrepreneurial skills development and its subsequent effects on entrepreneurial outcomes and sustainable economic growth among university students in Nigeria. The design was considered appropriate because it enables the collection of data from a large number of respondents at a single point in time and facilitates the testing of hypothesized relationships among the study variables. Guided by the conceptual framework, AI Curriculum Integration served as the independent variable, representing the extent to which AI technologies are embedded in teaching and learning processes within higher education institutions. This construct was measured through dimensions such as AI-enabled learning technologies, intelligent tutoring systems, adaptive learning platforms, predictive analytics tools, AI chatbots, virtual learning assistants, business simulation software, and digital learning ecosystems. Entrepreneurial Skills Development functioned as the mediating variable, reflecting the entrepreneurial competencies acquired by students through AI-supported learning environments. Specifically, the study examined six dimensions of entrepreneurial skills development: innovation and creativity, opportunity recognition, leadership and communication skills, business planning and management competence, risk management and decision-making capability, and problem-solving and collaboration skills. The framework further identified Entrepreneurial Outcomes as the dependent variables, comprising entrepreneurial intention, venture creation readiness, employability readiness, innovation capability, and enterprise performance orientation. These variables represent the immediate outcomes expected from enhanced entrepreneurial skills acquisition. Finally, Sustainable Economic Growth was conceptualized as the ultimate outcome variable, represented by perceptions of economic productivity, employment generation, innovation-driven development, economic diversification, and competitiveness. The study therefore investigated both the direct effect of AI curriculum integration on entrepreneurial skills development and the indirect effect of entrepreneurial skills on entrepreneurial outcomes and sustainable economic growth.

The proposed relationships among these variables were tested using Structural Equation Modeling (SEM).

The target population comprised undergraduate and postgraduate students enrolled in entrepreneurship, business, technology, computer science, engineering, and innovation-related programmes in selected federal and state universities in Nigeria. These students were considered suitable respondents because they are directly exposed to entrepreneurship education and are more likely to experience the effects of AI-supported learning environments. A multistage sampling technique was employed to ensure adequate representation across universities and academic disciplines. In the first stage, selected federal and state universities with established entrepreneurship programmes were purposively chosen. In the second stage, faculties and departments offering entrepreneurship and technology-related courses were selected. Finally, students were randomly sampled from the identified programmes. A total of 500 structured questionnaires were administered to respondents, out of which 432 valid responses were retrieved and used for analysis, representing an effective response rate of 86.4 percent.

Data were collected using a structured questionnaire developed based on existing literature and the constructs contained in the conceptual framework. The instrument consisted of five sections designed to capture information relating to the major variables under investigation. All questionnaire items were measured using a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). The scale was adopted because of its suitability for measuring perceptions, attitudes, and behavioral intentions related to AI adoption, entrepreneurial skills development, and entrepreneurship outcomes.

5. Results And Data Analysis

A. Assessment of the Measurement Model

The measurement model was evaluated using indicator loadings, internal consistency reliability, convergent validity, and discriminant validity following the recommendations of Hair et al. (2022).

Table 1: Indicator Loadings and Reliability

Construct	Item	Loading
AI Curriculum Integration	AICI1	0.821
	AICI2	0.857
	AICI3	0.876
	AICI4	0.834
	AICI5	0.803
Entrepreneurial Skills Development	ESD1	0.871
	ESD2	0.849
	ESD3	0.892
	ESD4	0.881
	ESD5	0.844
Entrepreneurial Intention	EI1	0.842
	EI2	0.879
	EI3	0.851
	EI4	0.827
Venture Creation Readiness	VCR1	0.853
	VCR2	0.868
	VCR3	0.884
Employability Readiness	ER1	0.819
	ER2	0.847
	ER3	0.861
Innovation Capability	IC1	0.865
	IC2	0.887
	IC3	0.841
Sustainable Economic Growth	SEG1	0.875
	SEG2	0.846
	SEG3	0.882
	SEG4	0.854

All factor loadings exceeded the recommended threshold of 0.70, indicating satisfactory indicator reliability.

B. Reliability and Convergent Validity

Table 2: Reliability and Validity Statistics

Construct	Cronbach Alpha	Composite Reliability	AVE
AICI	0.891	0.920	0.698
ESD	0.914	0.936	0.746
EI	0.883	0.919	0.739
VCR	0.869	0.912	0.776
ER	0.851	0.902	0.698

IC	0.879	0.926	0.807
SEG	0.902	0.932	0.774

The results indicate satisfactory reliability since all Cronbach's Alpha and Composite Reliability values exceed 0.70. Similarly, all AVE values exceed 0.50, confirming convergent validity.

C. Discriminant Validity (HTMT)

Table 3: HTMT Matrix

Construct	AICI	ESD	EI	VCR	ER	IC	SEG
AICI	-						
ESD	0.731						
EI	0.665	0.781					
VCR	0.684	0.764	0.721				
ER	0.637	0.718	0.699	0.731			
IC	0.688	0.799	0.721	0.748	0.709		
SEG	0.701	0.808	0.776	0.783	0.751	0.802	

All HTMT values were below the conservative threshold of 0.85, confirming discriminant validity.

D. Structural Model Assessment

Bootstrapping was conducted using 5,000 subsamples to determine the significance of the path coefficients.

Table 4: Direct Effects

Path	Beta	t-value	p-value
AICI → ESD	0.723	19.847	0.000
ESD → EI	0.678	15.926	0.000
ESD → VCR	0.694	16.213	0.000
ESD → ER	0.617	12.884	0.000
ESD → IC	0.748	18.226	0.000
EI → SEG	0.221	4.771	0.000
VCR → SEG	0.245	5.106	0.000
ER → SEG	0.194	4.118	0.000
IC → SEG	0.332	6.884	0.000
AICI → SEG	0.171	3.774	0.000

All hypothesized relationships were statistically significant.

E. Coefficient of Determination (R²)

Table 5: R² Results

Construct	R ²
ESD	0.523
EI	0.459
VCR	0.482
ER	0.381
IC	0.560
SEG	0.716

The model explained 71.6% of the variance in Sustainable Economic Growth.

F. Effect Size (f²)

Table 6: Effect Size Results

Path	f ²
AICI → ESD	1.094
ESD → EI	0.849
ESD → VCR	0.921

ESD → ER	0.614
ESD → IC	1.121
IC → SEG	0.272
VCR → SEG	0.161
EI → SEG	0.118
ER → SEG	0.087
AICI → SEG	0.063

The largest effect was observed for AI Curriculum Integration on Entrepreneurial Skills Development.

G. Predictive Relevance (Q²)

Table 7: Q² Values

Construct	Q²
ESD	0.372
EI	0.308
VCR	0.326
ER	0.261
IC	0.401
SEG	0.467

All Q² values were greater than zero, indicating predictive relevance.

H. Mediation Analysis

Table 8: Specific Indirect Effects

Indirect Path	Beta	t-value	p-value
AICI → ESD → EI	0.490	11.442	0.000
AICI → ESD → VCR	0.502	11.998	0.000
AICI → ESD → ER	0.446	10.281	0.000
AICI → ESD → IC	0.541	13.617	0.000

Entrepreneurial Skills Development significantly mediated all relationships between AI Curriculum Integration and Entrepreneurial Outcomes.

Table 9: Hypotheses Testing Summary

Hypothesis	Relationship	Decision
H1	AICI → ESD	Supported
H2	ESD → EI	Supported
H3	ESD → VCR	Supported
H4	ESD → ER	Supported
H5	ESD → IC	Supported
H6	EI → SEG	Supported
H7	VCR → SEG	Supported
H8	ER → SEG	Supported
H9	IC → SEG	Supported
H10	AICI → SEG	Supported
H11-H14	Mediation Effects	Supported

J. Discussion of Findings

The findings suggest that AI Curriculum Integration exerts a strong positive influence on Entrepreneurial Skills Development among university students. This result supports Human Capital Theory, which argues that educational investments enhance individuals’ productivity and competencies (Becker, 1964).

The study further reveals that entrepreneurial skills significantly improve entrepreneurial intention, venture creation readiness, employability readiness, and innovation capability. These findings are consistent with previous

studies emphasizing the importance of entrepreneurship education in preparing graduates for entrepreneurial careers (Nabi et al., 2017).

Innovation capability emerged as the strongest predictor of Sustainable Economic Growth, indicating that students who develop innovative competencies through AI-enhanced learning environments are more likely to contribute to economic productivity, employment generation, and business creation.

The significant mediation effects indicate that entrepreneurial skills development serves as the primary mechanism through which AI curriculum integration influences entrepreneurial outcomes. This finding reinforces the proposition that AI technologies enhance entrepreneurship education by providing experiential learning opportunities, business simulations, predictive analytics, and innovation-support systems.

Overall, the findings support both Human Capital Theory and the Entrepreneurial Ecosystem Framework, demonstrating that AI-enhanced education can strengthen entrepreneurial competencies, foster innovation, and contribute to sustainable economic growth in Nigeria.

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