

INTEGRATION OF AI TOOLS IN CURRICULUM DESIGN AND CONTENT DELIVERY

¹ANOLU, E., & ²EMOSOGA, J.A.

¹Department of Science Education and Instructional Technology; &

²Department of Educational Foundations and Management

Faculty of Education, Ambrose Alli University, Ekpoma

Email: anolueaster@aauekpoma.edu.ng; & josephemosoga@aauekpoma.edu.ng

Phone: 08068653908; & 09053590727

¹<https://orcid.org/0009-5078-5899>

Abstract

Artificial Intelligence (AI) is fundamentally transforming curriculum design and content delivery in educational institutions worldwide. This paper examined the integration of AI tools in curriculum design processes and content delivery mechanisms across various educational contexts. The study adopted a qualitative research design of desk review based on secondary sources, including academic journals, books, policy documents, and reports from reputable organizations. Findings revealed that AI tools are revolutionizing curriculum design by enabling modular content creation, personalized learning pathways, adaptive assessments, and efficient curriculum mapping, while also transforming content delivery through intelligent tutoring systems, conversational AI assistants, automated content generation, and dynamic feedback mechanisms. Research evidence from global higher education institutions demonstrates that faculty and students are increasingly adopting AI tools such as ChatGPT, NotebookLM, and other generative AI platforms for curriculum development and instructional delivery, though studies from developing contexts reveal a significant knowledge-practice gap where high awareness of AI tools contrasts with moderate actual usage. Critical barriers including inadequate training, poor infrastructure, limited funding, and weak policy support continue to impede widespread AI adoption in educational settings. The study concluded that AI is not replacing educators but augmenting their capabilities, enabling more efficient, personalized, and responsive curriculum design and content delivery. It recommended that educational institutions should embed AI literacy into teacher training programmes, develop ethical guidelines for AI use in curriculum development, and invest in infrastructure and professional development to ensure equitable access to AI technologies.

Keywords: *Artificial Intelligence, Curriculum Design, Content Delivery, Educational Technology, Personalized Learning*

Introduction

The rapid advancement of Artificial Intelligence (AI) has considerably reshaped the educational landscape. Traditionally rooted in static textbooks and one-size-fits-all instructional methods, education is now becoming more adaptive, personalized, and data-driven. AI technologies, including machine learning, natural language processing, and generative AI, are enabling faster content creation, predictive analysis, and intelligent decision-making in curriculum development (Holmes et al., 2019). Consequently, AI is reshaping not only how curriculum is designed but also how content is delivered to learners. Crompton and Burke (2023) observed that AI in higher education has become a significant field of study, with applications ranging from personalized learning to automated assessment and student support systems.

Artificial Intelligence refers to the development of computer systems that can perform tasks that normally require human intelligence, including learning, reasoning, problem-solving, perception, and language understanding (Russell & Norvig, 2021). In recent years, AI has moved from the laboratory into everyday life and educational settings. It powers learning management systems, recommends personalized learning resources, translates languages, and even assists with assessment and feedback. The same technologies that make these applications possible are now being applied to curriculum design and content delivery in educational institutions worldwide. According to Zawacki-Richter et al. (2022), AI applications in higher education are growing rapidly, particularly in areas such as personalized learning, assessment, and student support, though most applications remain in early stages of development.

The integration of AI into curriculum design and content delivery is happening at a time when education faces many complex challenges. Student diversity, varying learning paces, resource constraints, and the need for twenty-first-century skills all require innovative solutions. Curriculum design provides the framework for what students should learn, while content delivery determines how that learning occurs. AI offers a way to accelerate curriculum development, improve efficiency, and expand the boundaries of what is possible in educational design. According to Abbasi et al. (2025), AI has the potential to transform curriculum development by enabling educators to analyze vast amounts of data, identify patterns, and generate new knowledge at an unprecedented pace. Shalini (2026) further argued that AI offers unprecedented opportunities

for personalizing learning experiences, automating curriculum design, and deepening student engagement across K-12 schools, higher education, and vocational training.

However, the rapid adoption of AI in curriculum design and content delivery also raises important questions about its limitations and ethical implications. Issues such as data privacy, algorithmic bias, unequal access to technology, and the need for transparency and accountability have become central concerns for educators, researchers, and policymakers (Floridi et al., 2018). Timms (2022) noted that while AI offers significant potential for transforming education through intelligent tutoring systems and smart classrooms, careful attention must be paid to the ethical and practical challenges of implementation. Ekwevugbe (2025) found that while Nigerian teacher education programmes show relatively high awareness of AI tools, actual usage remains limited due to systemic challenges including lack of training, poor infrastructure, limited funding, and weak policy support. These developments highlight the need for a balanced examination of both the opportunities and challenges associated with AI in curriculum design and content delivery.

Objectives of the Study

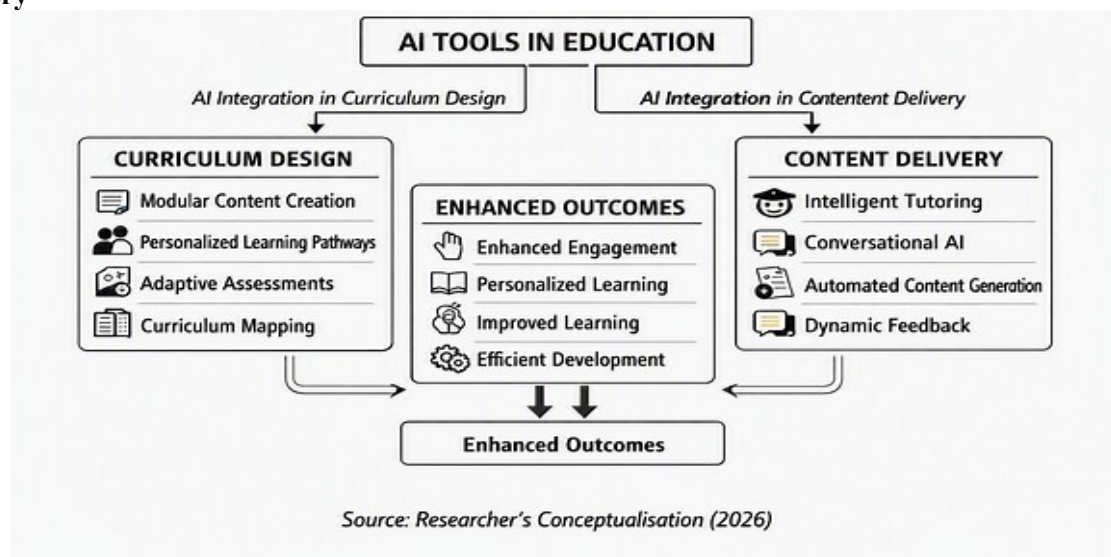
This paper examined the integration of AI tools in curriculum design and content delivery. Specifically, the study:

1. Examined how AI tools are transforming curriculum design processes in educational institutions
2. Assessed how AI tools are enhancing content delivery mechanisms
3. Identified the barriers and ethical considerations associated with the integration of AI tools into curriculum design and content delivery
4. Proposed strategies for the responsible and effective integration of AI tools into curriculum design and content delivery

CONCEPTUAL FRAMEWORK

Figure 1

Conceptual Framework for AI Integration in Curriculum Design and Content Delivery



The conceptual framework above shows the integration of AI tools in education, showing the relationship between AI tools and the two core areas of curriculum design and content delivery. The framework posits that AI tools enhance both curriculum design (through modular content creation, personalized learning pathways, adaptive assessments, and curriculum mapping) and content delivery (through intelligent tutoring, conversational AI, automated content generation, and dynamic feedback). These enhancements ultimately lead to improved outcomes including enhanced student engagement, personalized learning experiences, improved learning outcomes, efficient curriculum development, and reduced teacher workload. This framework is grounded in the Human-AI Collaboration Framework, which emphasizes that AI systems are designed to augment human capabilities rather than replace them (Holmes et al., 2019; Russell & Norvig, 2021).

Theoretical Framework

Human-AI Collaboration Framework

The Human-AI Collaboration Framework, rooted in the broader theories of human-computer interaction and socio-technical systems, provides the primary theoretical lens for this study. According to Holmes et al. (2019), the integration of AI into education and curriculum design should be viewed as a partnership between human

intelligence and machine intelligence, rather than a replacement of one by the other. This framework emphasizes that AI systems are designed to augment human capabilities, not to substitute them. In the context of curriculum design and content delivery, this means that AI tools can handle routine, repetitive, and data-intensive tasks, freeing educators to focus on creativity, critical thinking, and complex pedagogical decision-making. Russell and Norvig (2021) further argued that AI systems are most effective when they complement human skills, leveraging the strengths of both.

The framework is grounded in the recognition that human educators possess unique capabilities that AI cannot replicate, including emotional intelligence, contextual understanding, ethical reasoning, and the ability to inspire and motivate learners (Holmes et al., 2019). Conversely, AI excels at processing vast amounts of data, identifying patterns, generating content at scale, and providing consistent, personalized feedback (Russell & Norvig, 2021). The collaborative approach acknowledges that the most effective educational outcomes are achieved when these complementary strengths are combined. Timms (2022) introduced the concept of "educational cobots" collaborative robots that work alongside teachers to enhance learning experiences which aligns with this framework's emphasis on partnership rather than replacement. Shalini (2026) similarly argued that the future of education lies not in replacing human educators but in forging a collaborative partnership between artificial intelligence and pedagogical expertise.

SAMR + AI Framework

The SAMR + AI Framework, developed by Puentedura and adapted for AI integration, categorizes the impact of technology on learning into four levels: Substitution, Augmentation, Modification, and Redefinition (EDUCAUSE Review, 2026). This framework provides a structured approach to understanding how AI can be integrated into curriculum design and content delivery. At the Substitution level, AI replaces a traditional tool with no functional improvement, such as using AI to generate a lecture script that could have been written by a human. At the Augmentation level, AI replaces and improves function or efficiency, such as using AI to personalize learning materials for individual students. At the Modification level, AI enables a significant redesign of the task, such as using AI to create adaptive learning pathways that respond to student performance in real-time. At the Redefinition level, AI enables the creation of new tasks previously inconceivable, such as using AI to create interactive simulations that allow students to explore complex systems in ways that were not possible before.

The SAMR + AI Framework provides a practical tool for educators to evaluate and redesign their curriculum and instructional practices. The framework uses a five-step process: Step 1 involves reflecting on current practices and evaluating the impact of AI on the course. Step 2 involves selecting one instructional component for redesign. Step 3 involves identifying the Bloom's level of the component. Step 4 involves using the SAMR + AI Matrix to determine the desired impact of AI on the learning activity. Step 5 involves redesigning the activity and implementing changes (EDUCAUSE Review, 2026). This framework ensures that AI integration is intentional, pedagogically sound, and aligned with learning objectives. The framework also addresses the ethical considerations of AI integration, including the importance of maintaining learner engagement, performance improvement, instructional integrity, and measurable learning outcomes.

Methods

This study adopted a qualitative research design of desk review based entirely on secondary sources. This means the research did not collect new data through surveys, interviews, or experiments but instead relied on already existing information from scholarly literature, policy documents, and reports from reputable organizations. The data for the study were drawn from academic journals, books, conference proceedings, and reports published by institutions such as the National Science Foundation, the International Telecommunication Union, and the World Economic Forum. This approach is consistent with the methodology used by Zawacki-Richter et al. (2022) in their systematic review of AI applications in higher education, and by Crompton and Burke (2023) in their examination of AI in higher education. The study also draws on empirical findings from Ekwevugbe (2025), who investigated the use of AI technology in Nigerian teacher education programmes.

Discussion

AI Tools in Curriculum Design

AI is fundamentally redefining curriculum design through modular content creation, personalized learning pathways, and adaptive curriculum mapping. The traditional approach to curriculum design has been characterized by its linear, time-consuming nature, often requiring extensive collaboration among subject matter experts, instructional designers, and educators (Holmes et al., 2019). This conventional methodology, while effective for stable educational contexts, proves increasingly inadequate in addressing the diverse needs of contemporary learners. AI offers a paradigm shift by automating routine aspects of curriculum development while providing sophisticated data-driven insights that enable more responsive and adaptive curricula. Fang and Ren (2023) empirically demonstrated that AI-driven adaptive curriculum sequencing in vocational education

significantly improved learning outcomes by tailoring content to individual student needs, with their study showing effect sizes that underscore the transformative potential of AI in this domain.

The integration of AI into curriculum design is further evidenced by institutional case studies. Commonwealth University's Instructional Design and Technology program has embedded AI directly into the curriculum, adopting a dual approach that weaves AI literacy throughout existing courses while developing specialized offerings addressing AI's unique applications and implications (Commonwealth University, 2025). This strategic approach reflects a recognition that AI literacy is no longer optional for instructional designers but essential. The analytical significance of this case lies in its demonstration that effective AI integration requires systemic institutional commitment rather than isolated initiatives. Abbasi et al. (2025) conducted a comprehensive analysis of data from 2,000 faculty and student respondents across five continents, revealing that the effectiveness of AI-driven tools in personalizing learning experiences, enhancing student engagement, identifying individual needs, providing real-time feedback, improving teaching and learning materials, and promoting critical thinking is the primary driver of curriculum development.

However, the integration of AI into curriculum design faces significant systemic barriers. Ekwevugbe (2025) conducted a correlational survey of 315 respondents across Nigerian Colleges and Faculties of Education, finding that while awareness of AI tools is relatively high ($M = 3.55$), actual usage remains only moderate ($M = 2.96$), reflecting a significant knowledge-practice gap. Critically, the study identified lack of training ($M = 3.62$) and poor infrastructure ($M = 3.55$) as the most significant barriers, followed by limited funding and weak policy support. The correlation analysis revealed no significant relationship between awareness and impact ($r = .06$, $p > .05$) or usage and impact ($r = .04$, $p > .05$), but funding challenges were significantly associated with perceived effectiveness ($r = -.12$, $p < .05$). This finding is analytically significant because it demonstrates that awareness and usage alone are insufficient to drive meaningful curriculum transformation; systemic enablers, particularly funding and infrastructure, are critical mediating factors.

AI Tools in Content Delivery: An Analytical Examination

AI is transforming content delivery through personalized learning systems, intelligent tutoring, and automated feedback mechanisms. The traditional one-size-fits-all approach to content delivery has been widely recognized as inadequate for addressing the diverse learning needs of contemporary students (Holmes et al., 2019). Students who learn quickly become disengaged, while those who struggle fall further behind. AI offers a sophisticated solution by enabling adaptive content delivery that responds to individual student needs in real-time. Timms (2022) argued that intelligent tutoring systems and smart classrooms represent the next frontier in AI-enhanced education, with the potential to create more engaging and effective learning environments.

Intelligent tutoring systems exemplify the analytical power of AI in content delivery. These systems continuously assess student performance and provide tailored feedback, achieving learning outcome improvements of 30% to 50% compared to traditional instruction (Holmes et al., 2019). Luckin et al. (2016) demonstrated that AI-driven education promotes deeper engagement and improves critical thinking skills among learners. The analytical mechanism underlying this effectiveness is the system's ability to build a detailed profile of each student's strengths and weaknesses, adjusting the difficulty and type of problems accordingly. This adaptive capability represents a fundamental shift from the static, content-centred model of instruction to a dynamic, learner-centred approach. The integration of conversational AI assistants and chatbots represents another significant advancement in content delivery. A case study from Bocconi University demonstrated a novel pedagogical approach where students act as instructors to ChatGPT, turning the traditional teacher-student dynamic on its head. Students set up a conversation framework in which the AI responds as a learner on topics chosen by the students. The goal is not to get the machine to answer correctly but to stimulate active learning by having students guide, correct, and evaluate the AI's responses (Bocconi University, 2026). The significance of this approach lies in its leveraging of AI to promote metacognitive skills. Students must understand the content well enough to evaluate and correct the AI's responses, thereby solidifying their own learning. This represents an innovative application of the Human-AI Collaboration Framework, where AI serves as a tool for enhancing, rather than replacing, human cognitive processes.

The analytical evidence from a pilot study at Hawaii Pacific University provides compelling quantitative and qualitative data on AI's impact on content delivery. The study used three generative AI tools in sequence: NotebookLM for mapping learning outcomes across module, course, and program levels; ChatGPT for refining assessments and generating instructional video scripts; and Fliki, an AI-powered video creation platform, for producing short topic overview videos. Students in the Fliki sections responded more positively and more consistently across all measures, while faculty found that the AI-assisted process took considerably less time to build than traditional course design (Hawaii Pacific University, 2026). Shalini (2026) synthesized evidence from multiple studies, finding that thoughtful AI integration yields significant improvements in student engagement, assignment completion, retention, and learning outcomes, with effect sizes ranging from modest to substantial depending on institutional context. This variability in effect sizes is significant as it suggests that

AI's impact is mediated by contextual factors, including implementation quality, institutional support, and student readiness.

Table 1

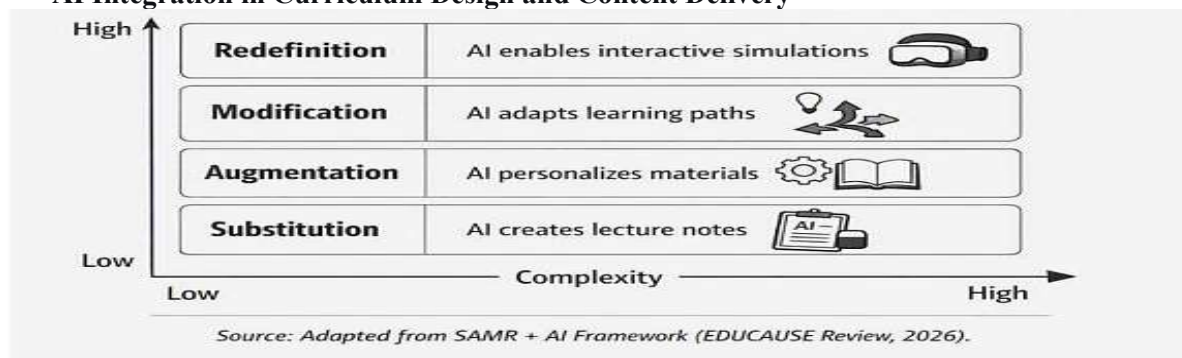
Applications of AI Tools in Curriculum Design and Content Delivery

Modular content creation	AI-supported content engineering pipeline for reusable micro-units
Curriculum mapping	NotebookLM for mapping learning outcomes across module, course, and program levels
Assessment design	ChatGPT for refining assessments and aligning with learning objectives
Adaptive curriculum sequencing	Fang and Ren (2023) AI-driven adaptive sequencing in vocational education
Intelligent tutoring	Adaptive learning systems that provide personalized feedback
Conversational AI	ChatGPT as a teaching assistant for interactive learning
Automated content generation	Fliki for producing topic overview videos from course materials
Dynamic feedback	AI-powered quizzes and adaptive practice tasks

Source: Researcher's Compilation from various studies reviewed

Figure 2

AI Integration in Curriculum Design and Content Delivery



The figure above illustrates the continuum of AI integration in education, from substitution (low complexity) to redefinition (high complexity). This visual representation helps educators understand where their current practices fall and what progression might look like. The SAMR + AI Framework (EDUCAUSE Review, 2026) suggests that meaningful transformation occurs at the Modification and Redefinition levels, where AI enables tasks that were previously impossible. The analytical implication is that institutions should aspire to move beyond simple substitution and augmentation to achieve truly transformative integration.

Table 2

SAMR + AI Framework in Curriculum Design

Level	Description	Example
Substitution	AI replaces a traditional tool with no functional improvement	Using AI to generate a lecture script that could have been written by a human
Augmentation	AI replaces and improves function or efficiency	Using AI to personalize learning materials for individual students
Modification	AI enables a significant redesign of the task	Using AI to create adaptive learning pathways that respond to student performance in real-time
Redefinition	AI enables the creation of new tasks previously inconceivable	Using AI to create interactive simulations that allow students to explore complex systems in ways that were not possible before

Source: Adapted from EDUCAUSE Review (2026)

Barriers and Ethical Considerations

Despite the demonstrated benefits of AI integration in curriculum design and content delivery, significant barriers persist. Data privacy concerns, algorithmic bias, unequal access to technology, and the need for transparency and accountability remain central challenges (Floridi et al., 2018). The AI4People framework

provides ethical guidelines for addressing these concerns, emphasizing transparency, accountability, and respect for human dignity (Floridi et al., 2018). Shalini (2026) identified persistent barriers including inadequate teacher training, privacy concerns, infrastructure costs, algorithmic bias, and issues of digital equity.

1. **Data Privacy:** AI systems require large amounts of data, potentially including personal information about students. The analytical concern is that without adequate protection, this data could be misused for discrimination or to deny opportunities. The International Telecommunication Union (2023) reported that only about 45% of schools in Nigeria have access to electricity, and even fewer have reliable internet connectivity, creating significant infrastructure constraints that compound privacy concerns.

2. **Algorithmic Bias:** AI systems trained on biased data perpetuate and amplify existing inequalities. The analytical challenge is that bias detection and mitigation require sophisticated technical and methodological approaches. Fessakis and Prantsoudi (2022) found that teachers' perceptions and attitudes significantly influence their adoption of computational thinking and AI-related pedagogies, suggesting that addressing bias requires attention to both technical and human factors.

3. **Teacher Professional Development:** The integration of AI requires new skills and competencies for educators. Ekwewugbe (2025) found that lack of training ($M = 3.62$) was the most critical challenge facing AI adoption in Nigerian teacher education. The analytical implication is that structured faculty development programmes are essential for effective AI integration. Zawacki-Richter et al. (2022) noted that most AI applications in education are still in early stages of development, and that more research is needed to understand how to effectively prepare educators for AI integration.

4. **Transparency and Accountability:** Many AI systems operate as "black boxes," making it difficult to understand their decision-making processes. This lack of transparency undermines trust and accountability. The analytical challenge is developing explainable AI systems that can be audited and held accountable. Shalini (2026) recommended that ethical dimensions be analyzed through the lens of responsible AI deployment, with policy recommendations for educators, administrators, and technology developers. Enoghase and Ogbeide (2025) found that student concerns about AI reliability highlight the importance of addressing accountability concerns in educational settings.

The Future of Curriculum Design and Content Delivery

The future of curriculum design and content delivery depends on the collaboration between humans and intelligent machines. AI is shifting the focus from rote learning to innovation, creativity, and critical reasoning. Educational systems are gradually emphasizing skills such as data literacy, interdisciplinary thinking, and ethical reasoning (Leon et al., 2025). The analytical evidence suggests that AI will play a pivotal role in shaping the next generation of curriculum designers and educators. Crompton and Burke (2023) found that AI in higher education is becoming increasingly prevalent, with applications ranging from personalized learning to automated assessment and student support systems.

The transformation of curriculum design requires moving from static, standardized content to dynamic, adaptive learning experiences. Abbasi et al. (2025) found that the effectiveness of AI-driven tools in personalizing learning experiences, enhancing student engagement, and identifying individual needs is driving curriculum development. Fang and Ren (2023) demonstrated how AI-driven adaptive curriculum sequencing can significantly improve learning outcomes in vocational education. The analytical implication is that curriculum design must become more responsive to individual learner needs and contexts.

The transformation of content delivery requires moving from passive reception to active engagement. Hawaii Pacific University (2026) demonstrated that generative AI, used thoughtfully and with clear institutional intent, can strengthen the coherence of an entire curriculum, support faculty in focusing on where they matter most, and create a more consistent, equitable experience for students. Timms (2022) argued that the future of AI in education lies in the development of "educational cobots" collaborative robots that work alongside teachers to enhance learning experiences.

Conclusion

Artificial Intelligence is fundamentally reshaping curriculum design and content delivery by enabling modular content creation, personalized learning pathways, adaptive assessments, and intelligent tutoring systems across the entire curriculum lifecycle. Evidence from institutional case studies demonstrates that generative AI, when thoughtfully applied, can strengthen curriculum coherence, support faculty efficiency, and create more consistent and equitable student learning experiences. However, significant barriers persist, particularly in developing contexts where high awareness of AI tools contrasts sharply with moderate actual usage, reflecting critical gaps in training, infrastructure, funding, and policy support. Addressing these challenges requires comprehensive strategies that tackle data privacy concerns, algorithmic bias, unequal access, lack of transparency, and the urgent need for teacher professional development through ethical frameworks, sustained investment, and a steadfast commitment to fairness and accountability. The integration of AI into

curriculum design and content delivery is not merely an option but a necessity for addressing the complexities of modern education; yet AI remains a tool that must be deployed wisely through the complementary combination of human expertise and machine intelligence, ensuring that technology serves to augment rather than replace the essential human elements of teaching and learning.

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