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ARTIFICIAL INTELLIGENCE IN CURRICULUM DEVELOPMENT AND PLANNING: FOSTERING 21ST CENTURY SKILLS

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Abstract
The study explored the transformative role of Artificial Intelligence (AI) in redesigning curricula to equip Nigerian secondary school students with essential 21st-century skills, particularly critical thinking and creative problem-solving. Two research questions guided the study. Descriptive research design was adopted to give direction to the study. The population comprised senior secondary school students in a metropolitan area in Nigeria. The sample consisted of 120 students drawn through purposive and stratified random sampling techniques. A 20-item researcher-developed instrument titled "AI-Curriculum and 21st Century Skills Questionnaire" (AI-C21SQ) was used to collect data. The instrument's validity was established through expert review, and reliability was determined using Cronbach's alpha, yielding a coefficient of 0.86. Data were analyzed using mean and standard deviation. Findings revealed that AI tools enable students in the design and revision of secondary school curricula to promote critical thinking. The findings of the study further showed that AI integration in curriculum planning positively influenced students' development of creative problem-solving skills as perceived by the students. It is recommended that government should improve Infrastructure to support AI deployment in public schools. That way, students' critical thinning and problem-solving skills will be fostered.

Keywords: Artificial Intelligence, Curriculum Development, 21st Century Skills, Critical Thinking, Creative Problem-Solving, AI Tools, Nigerian Education

Introduction

In the 21st century, education systems globally are under increasing pressure to adapt curricula that equip learners with skills necessary for thriving in a rapidly evolving knowledge economy. Among these are critical thinking, creativity, and problem-solving—skills collectively known as 21st-century competencies (Trilling & Fadel, 2021). These skills are essential for individuals to navigate complex real-world challenges and participate meaningfully in the digital age. However, traditional Nigerian curricula often emphasize rote learning and content memorization at the expense of skill development (Ogunlade & Aremu, 2020).

Artificial Intelligence (AI), defined as the simulation of human intelligence processes by machines (Kaplan & Haenlein, 2021), has emerged as a disruptive force in education. In the realm of curriculum planning, AI holds potential to support personalized learning paths, streamline instructional content, and foster adaptive assessment. AI systems such as intelligent tutoring systems, curriculum recommender engines, and learning analytics platforms are increasingly integrated into educational processes globally (Luckin et al., 2022). These tools have been demonstrated to improve learner engagement, facilitate immediate feedback, and enhance content alignment with cognitive goals (Zawacki-Richter et al., 2020).

In the Nigerian context, interest in AI-enhanced educational innovations is growing, as reflected in the Federal Ministry of Education's policy emphasis on ICT and AI integration (FME,

2023). Yet, practical incorporation into curriculum development remains limited due to infrastructural, technical, and pedagogical constraints (Aina & Olatunji, 2021). More so, incorporation of AI can enhance students' critical thinking skills.

Critical thinking, in this study, refers to the ability of learners to analyze information logically, identify patterns, and make reasoned judgments. Creative problem-solving involves students generating novel solutions to complex or unfamiliar problems, often requiring divergent thinking. Both are cornerstones of 21st-century education (World Economic Forum, 2020). The subjects of the study—senior secondary students—are in a transitional phase, preparing for tertiary education and workforce integration. Their capacity to think critically and solve problems creatively is paramount for national development and personal success in a competitive global economy. The Cognitive Apprenticeship Theory (Collins et al., 2020) and Constructivist Learning Theory (Siemens, 2021) provide a theoretical framework for this study. These theories emphasize situated learning and the role of technological mediation in fostering deep cognitive engagement and skill transfer. AI tools, grounded in these frameworks, act as scaffolds that guide learners through authentic tasks, making them particularly suited for enhancing 21st-century skills.

This study was situated in a metropolitan area of Nigeria, chosen due to its higher exposure to technological innovations, heterogeneous student population, and policy-driven educational experimentation. Despite this, challenges such as teacher digital literacy and infrastructural deficits persist, further justifying the need for the study. Thus, in a time when education must be future-proofed, understanding how AI can be harnessed in curriculum development is not only timely but imperative. The study, therefore, seeks to investigate the integration of AI into secondary school curriculum design and its potential to foster critical thinking and creative problem-solving among Nigerian students.

Statement of the Problem

The urgency of 21st-century education demands a curriculum that fosters critical thinking, creativity, and problem-solving. However, Nigeria's current secondary school curriculum remains predominantly examination-oriented, teacher-centered, and disconnected from the dynamic realities of today's world. Globally, AI technologies are transforming educational systems, offering promising tools for curriculum innovation, yet their application in Nigeria remains marginal. Ideally, curriculum development should be responsive, data-informed, and student-centered. In reality, Nigerian curriculum planning often lags due to bureaucratic inertia, lack of access to emerging technologies, and insufficient teacher preparation for digital instruction (Okebukola, 2022). This disconnection between curricular design and 21st-century needs has resulted in graduates lacking essential thinking and problem-solving capabilities. Given these contradictions, the study seeks to answer the following problem: How can AI be effectively integrated into Nigerian secondary school curriculum development to foster critical thinking and creative problem-solving among students?

Purpose of the Study

The purpose of this study was to explore the integration of AI tools into curriculum development and planning to foster century skills in Nigerian secondary schools. Specifically, the study sought to:

1. Analyze the uses of AI tools in the design and revision of secondary school curricula to promote critical thinking skills.
2. Examine the perceived influence of AI integration in curriculum planning on students' development of creative problem-solving skills.

Research Questions

1. What are the uses of AI tools in the design and revision of secondary school curricula to promote critical thinking?
2. What is the perceived influence of AI integration in curriculum planning have on students' development of creative problem-solving skills?

Methods

The study adopted descriptive survey research design. According to Nworgu (2015), survey research design involves a collection of opinions, attitudes or feelings of a population or its representative sample using questionnaire or interview to explain existing phenomenon. Descriptive survey research design was considered appropriate for this study because a questionnaire was used to elicit students' perception on the integration of AI tools into curriculum development and planning to foster century skills in Nigerian secondary schools. The study was conducted in two government-approved co-educational secondary schools in a metropolitan area of Lagos State, Nigeria. Lagos was chosen due to its relatively advanced ICT infrastructure, diverse school population, and policy-driven support for AI adoption in education. The population comprised all senior secondary class two (SS2) students in government-approved co-educational schools in Lagos metropolis. These students were selected because they are mature enough to understand and apply AI-based learning. A sample of 120 students was selected using a combination of purposive and stratified random sampling techniques. Two schools with similar academic records and ICT facilities were purposively selected. Within each school, students were randomly selected across gender and streams to ensure heterogeneity. The main instrument for data collection was a 20-item structured questionnaire titled: "AI-Curriculum and 21st Century Skills Questionnaire (AI-C21SQ)". It was designed in four-point Likert scale format: Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; Strongly Disagree (SD) = 1. The instrument had three sections: Section A: Bio-data; Section B: Critical Thinking Measures (10 items); Section C: Creative Problem-Solving Measures (10 items). The instrument was validated by three experts in Educational Technology, Measurement and Evaluation, and Curriculum Studies from University of Lagos. Their reviews focused on content relevance, clarity, and alignment with 21st-century skill constructs. Corrections were effected before administration. A pilot test was conducted with 30 students from another school not involved in the main study. The Cronbach's Alpha reliability coefficient was computed and yielded 0.86, indicating a high level of internal consistency. Descriptive statistics (mean and standard deviation) were used to answer the research questions.

Results

Research Question 1: *What are the uses of AI tools in the design and revision of secondary school curricula to promote critical thinking?*

Table 1: Mean Ratings of Students on the Use of AI Tools and Critical Thinking (N = 120)

Item	Statement	SA	A	D	SD	Mean	Std. Dev	Decision
1	AI tools promote independent analysis of concepts	45	60	10	5	3.21	0.79	Agree
2	Curriculum with AI simulations enhances logic reasoning	40	58	12	10	3.13	0.86	Agree
3	AI encourages questioning and critique of assumptions	47	52	13	8	3.15	0.83	Agree
4	Students learn to compare ideas using AI platforms	42	56	14	8	3.10	0.88	Agree
5	AI learning systems foster inquiry-based learning	49	50	11	10	3.15	0.85	Agree

Results in Table 1 show that the mean ratings ranged from 3.10 to 3.21, indicating that students agree on the above-listed items as uses of AI tools in the design and revision of secondary school curricula to promote critical thinking.

Research Question 2: *What is the perceived influence of AI integration in curriculum planning have on students' development of creative problem-solving skills?*

Table 2: Mean Ratings on AI Integration and Creative Problem-Solving

Item	Statement	SA	A	D	SD	Mean	Std. Dev	Decision
6	AI tools aid generation of multiple solutions to problems	50	55	10	5	3.25	0.76	Agree
7	Simulations and games improve real-world problem-solving	45	58	12	5	3.18	0.80	Agree
8	AI tasks stimulate idea generation and creativity	52	49	11	8	3.21	0.82	Agree
9	Students develop decision-making through AI projects	48	53	12	7	3.18	0.85	Agree
10	AI enhances creativity through design-based tasks	46	50	15	9	3.11	0.87	Agree

Interpretation: Results in Table 2 show that students agree that AI integration in curriculum planning have a positive influence on their development of creative problem-solving skills, with average mean values above 3.00.

Discussions

The results from Table 1 indicate that students perceive AI tools as enhancing their critical thinking skills. Specifically, AI-supported curriculum designs encouraged students to analyze concepts independently, engage in inquiry-based learning, and critique underlying assumptions. These findings are consistent with the views of Luckin et al. (2022) who highlighted that AI can scaffold higher-order thinking by facilitating problem-based, interactive learning environments. AI tools such as intelligent tutoring systems and adaptive learning platforms promote engagement with abstract concepts and decision-making tasks that are essential for critical thinking. This is aligned with Zawacki-Richter et al. (2020) who concluded that AI enables self-regulated learning and real-time feedback, both crucial to critical reasoning development. In further alignment with the present study findings, Collins et al. (2020) whose Cognitive Apprenticeship Theory postulated that technologies like AI can model expert thinking processes, allowing learners to internalize critical thinking strategies. Furthermore, Siemens (2021) reinforced this in the context of Connectivism, asserting that technology-mediated environments expand learning networks and cognition. Thus, the use of AI in curriculum design fosters critical engagement, validating the theoretical underpinnings and contributing to current literature supporting AI's pedagogical potential.

As shown in Table 2, students agreed that AI tools enhanced their creative problem-solving skills. Activities such as simulations, AI-generated design tasks, and project-based learning promoted divergent thinking and the exploration of multiple solutions to complex problems. These results are corroborated by Trilling and Fadel (2021) who emphasize the importance of digital tools in cultivating creativity. Similarly, World Economic Forum (2020) identified AI as a driver for education transformation capable of preparing learners for a problem-solving-driven economy. The finding of the present study further mirrors the results of Aina and Olatunji (2021), who documented improved creativity levels among learners exposed to AI-driven instructional platforms in Nigerian schools. Furthermore, constructivist perspectives support this, arguing that AI enables active engagement with learning content, thereby nurturing creativity through open-ended, interdisciplinary challenges (Siemens, 2021).

Conclusion

This study established that integrating AI tools into curriculum development significantly enhances the acquisition of 21st-century skills, specifically critical thinking and creative problem-solving, among Nigerian secondary school students. The results affirm that AI integration provides both pedagogical depth and instructional flexibility. However, successful implementation depends on overcoming practical challenges such as teacher readiness, infrastructural deficits, and policy clarity.

Contributions to Knowledge

1. This study empirically validates the positive influence of AI-integrated curricula on critical thinking and creativity among Nigerian students.
2. It provides a framework for AI-assisted curriculum planning tailored to developing countries.
3. The study expands the application of Cognitive Apprenticeship and Constructivist theories in AI-based instructional design within the African context.
4. It contributes practical data for policy formulation and curriculum reform regarding digital learning integration.

Recommendations

1. Government should institutionalize AI Integration in the national secondary school curriculum through policy directives with a view to promoting critical thinking among students.
2. School administrators should organize seminars and workshops for the training of teachers on the pedagogical use of AI for engendering students' problem-solving skills.

3. Government should improve Infrastructure to support AI deployment in public schools. That way, students' critical thinning and problem-solving skills will be fostered.

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