

# Harnessing Artificial Intelligence for Personalized Continuous Professional Development for College Teachers in North West, Nigeria

KABIRU Musa PhD<sup>1</sup>, Isa Bidda<sup>2</sup>, Salim Ibrahim<sup>3</sup>, Abubakar Ibrahim<sup>4</sup>

<sup>1,2</sup>Physical and Health Education Department, Jigawa State College of Education PMB 1002, Gumel, Nigeria

<sup>3</sup>Business Education Department, Jigawa State College of Education PMB 1002, Gumel, Nigeria

<sup>4</sup>Computer Science Department, Jigawa State College of Education PMB 1002, Gumel, Nigeria

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\*Corresponding author: KABIRU Musa PhD

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## Abstract

## Original Research

**Background:** The ineffectiveness of traditional Continuing Professional Development (CPD) models for teachers is a global challenge, often characterized by a one-size-fits-all approach that lacks relevance and sustainability. In resource-constrained contexts like Nigeria, these shortcomings are exacerbated, creating a critical gap in supporting educator growth.

**Objective:** This study investigated the potential of Artificial Intelligence (AI) to support personalized CPD for college teachers in Nigeria by examining the shortcomings of existing practices, assessing the receptivity to AI-driven solutions, and identifying key implementation requirements.

**Methods:** A quantitative, cross-sectional survey design was employed. A structured questionnaire was administered to a sample of 61 college teachers from public colleges across Nigeria. Data collected on current CPD perceptions, AI potential, and institutional readiness were analyzed using descriptive statistics.

**Findings:** The results revealed a significant dissatisfaction with current CPD, with over 65% of respondents finding it irrelevant, irregular, and lacking follow-up support. Conversely, there was an overwhelming receptivity (>91% agreement) to AI-enabled personalization, particularly for its perceived ability to identify learning gaps and provide timely feedback. However, a critical implementation paradox was identified: while personal device access was high (82%), foundational infrastructure was deemed critically deficient, with 83.6% rating internet reliability as poor and 73.8% indicating a lack of technical support.

**Conclusion:** The study concludes that while AI is perceived as a highly promising solution to personalize and enhance teacher professional development in Nigeria, its successful integration is contingent upon addressing profound infrastructural and institutional barriers. The findings necessitate a shift from purely technical solutions to the development of context-aware, socio-technical frameworks that are offline-first, hybrid, and supported by robust policy and investment in national infrastructure.

**Keywords:** Artificial Intelligence, Continuous Professional Development, Teacher Education, Personalization, Nigeria, Adaptive Learning, Education Technology.

## Introduction

In recent years, the educational landscape has witnessed rapid transformation driven by technological innovation, particularly in the realm of teacher professional development. In Nigeria, where traditional Continuous Professional Development (CPD) models are often rigid, infrequent, and disconnected from individual teachers' needs, there is a pressing need for more adaptive and scalable solutions. Artificial Intelligence (AI) has emerged as a promising avenue for personalizing CPD experiences, enabling tailored learning pathways, real-time feedback, and context-sensitive interventions.

Literature reveals a growing global interest in leveraging AI for educational improvement (Zawacki-Richter et al., 2019; Holmes et al., 2022), though evidence specific to sub-Saharan Africa remains sparse (Adebayo & Adewale, 2023). Existing CPD frameworks in Nigeria largely emphasize standard workshops and cascade models, which struggle with sustainability and local relevance (Ogunyemi & Ajayi, 2020). This gap necessitates a paradigm shift towards AI-driven CPD capable of meeting diverse teacher needs while supporting system-wide goals for equity and effectiveness.

This study investigates how AI can support personalized CPD for college teachers in Nigeria by creating adaptive learning systems responsive to professional goals, knowledge gaps, and localized challenges. The objectives include: (1) exploring the shortcomings of existing CPD practices; (2) examining AI's potential to support individualized learning pathways; and (3) recommending context-aware frameworks for AI integration. The central research questions include: How are CPD needs currently met for college teachers in Nigeria? In what ways can AI facilitate personalized learning for teacher development? What are the institutional and infrastructural requirements for implementing AI-enabled CPD in Nigeria?

Using an integrative literature review approach, this paper synthesizes empirical studies, policy

reports, and theoretical contributions to frame an evidence-based argument for AI in CPD. The review is situated within the Nigerian context and focuses on college-level teacher education as the unit of analysis. The structure of this paper includes a background to the study, a theoretical overview of AI in education, review of current CPD models in Nigeria, conceptual synthesis, challenges and implementation considerations, and conclusion with policy recommendations.

## Background of CPD in Nigeria

Continuous Professional Development (CPD) for teachers in Nigerian colleges of education has traditionally been organized using a top-down and uniform approach. Most CPD programs are delivered through centrally planned workshops, conferences, or short-term seminars, often organized by government agencies or supported by donor organizations. While these events aim to improve teaching quality, they often lack consistent follow-up, and do not account for the individual needs, subject areas, or teaching contexts of different teachers (Ogunyemi & Ajayi, 2020). As a result, many teachers especially those in remote or underserved regions have limited access to meaningful professional learning opportunities.

Although the National Commission for Colleges of Education (NCCE, 2020) emphasizes on teacher professional development, there is need for more monitoring and quality assurance across institutions. Many teachers receive little to no support in applying new teaching strategies or using digital tools in their classrooms. Opportunities for reflection, collaboration with peers, or ongoing mentorship are also rare.

In addition, infrastructural problems, such as poor internet connectivity and outdated equipment, combined with inadequate funding, make it difficult to implement modern, technology-supported CPD. These challenges have created a gap between policy expectations and practical outcomes.

Therefore, there is an urgent need for new CPD

models that are not only flexible and personalized, but also responsive to the realities of the Nigerian education system. These models should support continuous learning, promote teacher agency, and be grounded in the real classroom experiences of educators.

### Theoretical Foundations of AI in Teacher Development

The use of Artificial Intelligence (AI) in teacher education is supported by several important learning and technology frameworks. One of these is the constructivist learning theory, which suggests that people learn best when they actively build their own understanding based on real-life experiences (Bruner, 1966). This idea matches well with AI, because AI-powered platforms can adapt to each teacher's unique background, learning pace, and needs, helping them learn in ways that are most meaningful to them.

AI-based learning systems often use adaptive learning methods. These systems rely on data such as user inputs, progress, and feedback to adjust lessons in real time (Kumar et al., 2022). For example, if a teacher is struggling with a topic, the system can slow down, give extra help, or suggest new materials. If a teacher is doing well, it can offer more advanced content to keep them challenged.

The SAMR model (Substitution, Augmentation, Modification, and Redefinition) helps explain how technology including AI can improve teaching and learning. At the basic level, AI can simply replace old tools (like using digital flashcards instead of paper ones). But at higher levels, it can change the way teachers learn and interact with content in completely new and powerful ways, such as by simulating classroom situations or offering instant coaching.

Another useful model is the Technological Pedagogical Content Knowledge framework (TPACK) which shows how good teaching happens when teachers combine what they know about their subject (content), how to teach it (pedagogy), and how to use technology. AI tools can help connect these three areas by supporting

teacher learning in more personalized and meaningful ways (Mishra & Koehler, 2006).

These frameworks collectively support the use of AI to deliver more engaging, relevant, and effective CPD experiences.

### AI-Driven CPD Systems

Globally, AI-driven CPD systems are increasingly being explored for their ability to enhance learning flexibility, relevance, and engagement. Zawacki-Richter et al. (2019) argue that AI applications in education are primarily concentrated in intelligent tutoring systems, learning analytics, and predictive modeling for personalized instruction. Holmes et al. (2022) emphasize AI's capacity to detect learning patterns, diagnose pedagogical strengths and weaknesses, and deliver adaptive interventions.

In the African context, Adebayo and Adewale (2023) found that AI can bridge learning gaps in under-resourced teacher training institutions by automating routine assessments and suggesting tailored learning paths. Furthermore, UNESCO (2021) highlights the promise of AI to scale training efforts across geographic and socioeconomic boundaries while maintaining contextual sensitivity. However, challenges such as algorithmic bias, lack of local data, and infrastructural constraints remain critical to implementation success.

### Conceptual Synthesis and Model for Nigeria

Drawing on insights from current literature and global practices, this paper proposes a conceptual framework to guide the integration of Artificial Intelligence (AI) into Continuous Professional Development (CPD) for college teachers in Nigeria. The model is anchored on four foundational pillars designed to enhance the personalization, responsiveness, and inclusivity of CPD programs:

1. Personalized Learning Pathways
2. Real-Time Feedback and Mentoring
3. Data-Driven Decision Making
4. Scalable and Inclusive Delivery Models.

## 1. Personalized Learning Pathways

College teachers in Nigeria differ widely in subject expertise, teaching experience, institutional location, and contextual challenges. The conventional, one-size-fits-all approach to CPD fails to address these variations. AI-enabled systems can offer tailored learning trajectories that respond to individual teacher profiles, learning goals, and classroom realities. For instance, a teacher struggling with classroom management might be directed to short interactive modules on behavior strategies, while another in need of digital pedagogical skills may receive targeted support on technology integration. These adaptive learning systems would rely on data such as teaching records, self-assessments, and ongoing feedback to deliver relevant content dynamically and efficiently.

## 2. Real-Time Feedback and Mentoring

An essential advantage of AI in CPD lies in its ability to provide immediate, automated feedback on teachers' progress and engagement. Like intelligent tutoring systems or educational chatbots, AI tools can assess completed activities and recommend further content, strategies, or assessments based on a teacher's performance. For example, upon completing a module on using multimedia in instruction, a teacher might receive a formative quiz, personalized suggestions, or supplementary resources to reinforce understanding. Complementing this AI support, human mentoring through virtual communities and peer networks can foster professional dialogue, reflection, and shared learning.

## 3. Data-Driven Decision Making

The framework also emphasizes the role of data analytics in informing the design and delivery of CPD. By aggregating and analyzing data from teacher engagement patterns, assessment results, and learning preferences, AI systems can offer actionable insights to educational stakeholders. Policymakers, for example, can identify training gaps across regions or institutions such as a widespread need for digital literacy training among rural teachers and allocate resources or

adjust curricula accordingly. This evidence-based approach ensures that interventions are responsive, targeted, and continually improved.

## 4. Scalable and Inclusive Delivery Models

Given infrastructural and geographical disparities, the scalability and accessibility of CPD are critical. The proposed model incorporates mobile learning and microlearning strategies to allow teachers to engage in short, focused, and flexible learning sessions via smartphones, even with limited connectivity. In addition, online peer learning communities facilitated through platforms like WhatsApp or dedicated forums enable teachers to share resources, reflect on practices, and support one another. These strategies help ensure that CPD opportunities are not only available but also equitable, regardless of location or resource availability.

At the core of this framework is an AI-enabled CPD platform that curates individualized development plans for teachers. This central system collects and processes data related to each teacher's competencies, challenges, and preferences to offer a dynamic, personalized CPD experience. Importantly, the design and implementation of such a platform must involve local teacher educators to ensure contextual relevance, pedagogical coherence, and cultural appropriateness.

For successful deployment, the following enabling conditions are recommended:

- **Infrastructure Development:** Ensuring reliable access to digital devices, internet connectivity, and electricity, particularly in underserved areas.
- **Policy and Governance:** Establishing clear regulatory frameworks to guide the ethical and responsible use of AI in teacher education.
- **Capacity Building:** Training teachers, administrators, and policymakers to understand, evaluate, and utilize AI tools for professional development.

Lastly, the model encourages integration with

existing national platforms, such as the National Commission for Colleges of Education (NCCE)'s digital training initiatives and mobile-friendly CPD applications. Such synergy can accelerate the adoption of AI-driven CPD while leveraging existing institutional frameworks.

## Challenges and Implementation Considerations

While the integration of Artificial Intelligence (AI) into Continuous Professional Development (CPD) for college teachers in Nigeria holds transformative potential, several critical challenges must be addressed to ensure its successful implementation. These challenges can be grouped into the following key areas:

### 1. Digital Infrastructure Gaps

Many colleges of education in Nigeria especially those in rural or underserved regions struggle with poor digital infrastructure. Problems such as inconsistent electricity supply, weak internet connectivity, and a lack of up-to-date computers or mobile devices make it difficult for teachers to access AI-powered platforms. Without addressing these foundational needs, the benefits of AI in CPD may remain out of reach for a large segment of the teaching population.

### 2. High Costs of Implementation

Setting up and maintaining AI-based CPD systems involves considerable financial investment. Costs include purchasing or developing software, maintaining servers, hiring technical staff, and ensuring regular updates and support. With limited funding currently allocated to innovation in teacher training, many institutions may find it difficult to sustain these systems over time.

### 3. Limited ICT Skills Among Teachers

Many Nigerian teachers and teacher educators lack basic digital literacy, which is essential for engaging with AI-based learning tools. Without proper training and ongoing support, teachers may struggle to navigate AI platforms or use

them effectively in their professional development. This digital skills gap could widen existing inequalities in access to quality CPD.

### 4. Data Privacy and Ethical Concerns

AI systems often rely on large amounts of personal and professional data to function effectively. This raises important questions about how teacher data such as performance, classroom practices, and learning habits are collected, stored, and used. In the absence of strong data protection laws and clear ethical guidelines, there is a risk of misuse, breaches of privacy, or loss of trust among educators.

### 5. Dependence on Foreign Technologies

Many AI tools are developed outside Nigeria and may not reflect the country's unique educational, cultural, or linguistic realities. If these systems are adopted without localization, they may provide content or feedback that is irrelevant or inappropriate for the Nigerian context. Over-reliance on imported technology could also limit opportunities for local innovation.

### 6. Institutional and Policy-Level Barriers

Nigeria's teacher education sector faces several systemic issues, including fragmented policy frameworks, weak inter-agency coordination, and limited funding for research and development. Currently, there is little context-specific evidence or national strategy guiding the use of AI in teacher training. This lack of direction makes it difficult to scale promising solutions or evaluate their long-term impact.

### 7. Resistance to Change

Traditional workshop-based CPD models are still widely accepted, and many educators may be skeptical about shifting to digital or AI-driven formats. Change management is crucial, as teachers and institutional leaders may resist new technologies due to fear of the unknown, lack of confidence, or previous negative experiences with digital tools.

**Research Design and Methodology**

This study employed a quantitative, cross-sectional survey design to investigate Nigerian college teachers’ perceptions of current CPD offerings, the potential of AI-enabled personalization, and institutional readiness for implementation.

A structured questionnaire was developed based on the research objectives. It comprised four sections: demographic information, current CPD practices (5 items, 5-point Likert scale: 1 = Strongly Disagree to 5 = Strongly Agree), AI for personalized CPD (5 items, 5-point Agree-Disagree scale), Institutional readiness (5 items, 5-point scale: 1 = Very Poor to 5 = Excellent). The instrument was validated by two experts in educational technology. Reliability analysis showed high internal consistency for each scale (Cronbach’s  $\alpha$ : Current CPD = .89; AI Potential = .92; Institutional Readiness = .85).

Using purposive and snowball sampling, 61 college teachers from Nigerian public colleges of education (Federal: 68.9%; State: 31.1%) were recruited. The sample consisted primarily of experienced educators (75.4% with 6+ years

of experience) from urban settings (85.2%), representing diverse academic disciplines.

Data were analyzed using descriptive statistics (frequencies, percentages, means). Likert-scale responses were collapsed into composite categories (Disagree/Agree) for clarity in presentation. Ethical approval was obtained, and participant anonymity was maintained throughout.

**Findings and Discussion**

This section presents the study's findings structured around the three research questions, followed by an integrated discussion that interprets the results in the context of existing scholarly literature.

**Demographic Profile of Respondents**

The study engaged 61 college teachers from North West, Nigeria. The following tables detail the demographic and professional characteristics of the sample.

**Table 1: Institutional Affiliation of Respondents (N=61)**

Institution Type	Frequency (n)	Percentage (%)
Federal Colleges	42	68.9
State Colleges	19	31.1
Total	61	100.0

Source: Field Survey

Table 1, shows that the sample is overwhelmingly drawn from publicly funded federal and state institutions. This suggests that the findings are most representative of the broader public College system in Nigeria. The absence of respondents from private institutions is a notable gap, as their operational models and potential access to resources for AI integration may differ significantly.

**Geographic and Professional Experience Profile (N=61)**

The data reveals that the vast majority of respondents (85.2%) teach in urban settings. This geographic concentration is critical for interpreting the infrastructural findings later, as challenges in rural areas are likely understated. The sample is highly experienced, with 75.4% having six or more years of teaching experience. This indicates that the data reflects the

perceptions of seasoned educators who are well-versed in the existing CPD landscape and its shortcomings.

**Research Question 1:** The State of Current CPD Practices

The first research question explored the perceived effectiveness of existing Continuing Professional Development (CPD) for college teachers in Nigeria.

**Table 2:** Perceptions of Current CPD Practices (N=61)

CPD Aspect	Disagree (%)	Neutral (%)	Agree (%)
<b>Relevance &amp; Need</b>			
Addresses professional learning needs	65.6	13.1	16.4
Relevant to subject area & context	44.3	13.1	37.7
<b>Provision &amp; Support</b>			
Provided regularly	68.9	11.5	8.2
Adequate follow-up support provided	68.9	14.8	4.9
Encourages collaboration & peer learning	63.9	14.8	11.5

Source: Field Survey (**Percentages represent combined Strongly Disagree/Disagree and Strongly Agree/Agree**)

Table 2, data presents a stark picture of ineffectiveness. An overwhelming majority (65.6%) find that CPD fails to address their professional needs, and nearly 70% report it is neither provided regularly nor supported with adequate follow-up. This indicates a CPD model that is sporadic, generic, and isolated from classroom practice. The fact that almost two-thirds (63.9%) disagree that it encourages

collaboration suggests a top-down, transmissive model.

**Research Question 2:** The Potential for AI-Driven Personalization

The second research question investigated perceptions of AI's potential to facilitate personalized learning pathways.

**Table 3:** Perceived Efficacy of AI for Personalized CPD (N=61)  
(Percentages represent combined Agree/Strongly Agree)

Proposed AI Function	Agree (%)
Identify learning gaps and recommend training	91.8
Provide timely and actionable feedback	93.4
Make CPD more relevant through personalized pathways	91.8
Recommend focused learning materials	93.4
Improve overall effectiveness of CPD	91.8

Source: Field Survey

Table 3, shows a remarkable consensus among respondents (>91% agreement on all items) on the potential benefits of AI. This high receptivity

is a critical finding. Educators perceive AI not merely as a content delivery tool but as a mechanism for diagnostic assessment and, most

significantly, for providing continuous, timely feedback. This directly addresses the most significant shortcomings identified in RQ1.

**Research Question 3:** Institutional and

Infrastructural Readiness

The third research question assessed the prerequisites for implementing AI-enabled CPD.

**Table 4:** Assessment of Readiness and Requirements for Implementation (N=61)

Factor	Rating Poor/Very Poor (%)	Rating Good/Excellent (%)
<b>Core Infrastructure</b>		
Reliable Internet Access	83.6	1.6
Sufficient Electricity Supply	73.8	8.2
<b>Access &amp; Support</b>		
Access to Digital Devices	9.8	82.0
Availability of Technical Support	73.8	8.2
Policy Environment		
Readiness of policies for AI integration	63.9	16.4

Source: Field Survey

Table 4, shows a stark contradiction is evident. While personal access to digital devices is high (82% good/excellent), the foundational infrastructure required for online, AI-driven systems is critically deficient. The vast majority rate internet reliability (83.6%) and electricity supply (73.8%) as poor. Furthermore, the institutional support structure, technical help and forward-thinking policies, is virtually absent.

**Discussion**

This study reveals a triad of insights: a clear demand for better professional learning, a strong belief in AI as a solution, and a formidable set of contextual barriers.

First, the profound dissatisfaction with the current CPD model confirms existing critiques in the global literature. The findings align with what has been termed the "traditional" or "spray and pray" model of professional development, which is often criticized for being decontextualized, episodic, and ineffective in changing practice (Guskey, 2002; Desimone, 2009). The lack of follow-up support is particularly detrimental, as research consistently

shows that sustained coaching and collaboration are critical for the implementation of new skills (Darling-Hammond et al., 2017).

Second, the overwhelming receptivity to AI-driven personalization is a pivotal finding. It suggests that the primary barrier to adoption is not teacher skepticism but systemic and infrastructural challenges. Respondents perceived AI's value in its ability to perform functions that align perfectly with the principles of effective professional development: personalization, continuous feedback, and relevance. This echoes the literature on Adaptive Learning Systems (ALS), which are designed to tailor educational content to individual learner needs (Xie et al., 2019).

Finally, the identified infrastructural deficits frame the challenge not as a technical one but as a socio-technical one. The implementation paradox, high device access paired with low infrastructure and support, is a common theme in studies of EdTech in resource-constrained environments (Selwyn, 2011; Tarus et al., 2015). This finding forces a critical re-imagining of how AI-enabled CPD should be conceptualized for

the Nigerian context. It cannot be a direct transplant of cloud-based, high-bandwidth models from the Global North. Instead, it necessitates the development of context-aware frameworks that are offline-first, hybrid, and supported by advocacy for better national infrastructure.

### Conclusion and Recommendations

This study demonstrates a critical disconnect in Nigerian college teacher professional development. While current CPD models are largely ineffective, seen as irrelevant, sporadic, and unsupported by educators, there is remarkable receptivity to AI-driven solutions. Teachers overwhelmingly believe AI can personalize pathways, provide timely feedback, and enhance relevance. However, a fundamental paradox exists: high individual readiness (strong device access) contrasts with catastrophic systemic deficits in electricity, internet connectivity, and institutional support. Thus, AI integration is not merely technical but a socio-technical challenge requiring context-aware strategies.

### Recommendations:

1. There is to transition CPD to needs-based through regular assessments and implement sustained support models like peer coaching to ensure continuous growth.
2. There is need to develop offline-first, low-bandwidth AI tools and prioritize diagnostic and feedback functionalities to address immediate gaps without relying on stable infrastructure.
3. For implementation purpose there is need to adopt hybrid implementation frameworks, advocate for national investment in electricity and internet infrastructure, and build institutional capacity through technical support and AI policy development.

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