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Perception of Pre- Service Biology Teachers on the Usability of AI-Enhanced Personalised Instruction in Learning Biology Concepts in Alvan Ikoku Federal University of Education Owerri, Imo State.

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Abstract

The integration of Artificial Intelligence (AI) into education has introduced innovative instructional approaches aimed at improving teaching and learning outcomes. One such approach is AI-enhanced personalized instruction, which adapts learning content, pace, and feedback to individual learners' needs. This study investigated the perception of pre-service Biology teachers on the usability of AI-enhanced personalized instruction in learning Biology concepts at Alvan Ikoku Federal University of Education (A.I.F.U.E), Owerri, Imo State. A descriptive survey research design was adopted. Four research questions and one hypothesis guided the study. The population of the study comprised 285 pre-service Biology teachers, while a sample of 70 students was selected using simple random sampling. Data were collected using a researcher-designed questionnaire titled Perception of Pre-service Biology Teachers on the Usability of AI-Enhanced Personalized Instruction Questionnaire (PPBTUAEPIQ). The instrument was validated by three experts in Biology education, educational technology, and measurement and evaluation. The reliability was established using Cronbach's Alpha. Data were analyzed using descriptive statistics of mean and standard deviation. Findings revealed that pre-service Biology teachers had positive perceptions of the ease of use (grand mean = 3.26), usefulness (grand mean = 3.40), accessibility (grand mean = 3.13), and instructional support (grand mean = 3.34) of AI-enhanced personalized instruction in learning Biology concepts. The study concluded that AI-enhanced personalized instruction is perceived as usable, beneficial, and supportive of Biology learning among pre-service teachers. Based on the findings, it was recommended that teacher education institutions should integrate AI-enhanced instructional tools into Biology teaching and provide adequate training and infrastructure to support their effective use

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Introduction

Advancements in technology remains an important driving force of the 21st Century for transformation in all facets of life globally. The field of education is also among the fields that are currently using AI through machine learning in developing and automating processes. Considerably, Artificial Intelligence (AI) has been able to influence educational practices globally, and efforts have continually been made to ensure that it is widely integrated into all instructional processes (Kim & Kim 2022).

Artificial Intelligence in particular has remained a capable tool for instructional delivery personally, in adaptive learning platforms, and data-driven instructional decision-making. According to Khan et al. cited in Opele, et al. (2024), Artificial Intelligence (AI) refers to a field of computer science that focuses on developing intelligent systems capable of simulating human-like cognitive abilities and performing tasks that typically require human intelligence. AI-enhanced personalized instruction represents a learner-centered instructional approach that uses AI algorithms to adapt content, learning pathways, pacing, and feedback to individual learners' needs. Intelligent systems provide the ability to adjust to the specific requirements of each learner, deliver tailored learning experiences, and provide immediate feedback (Aina et al., 2023). The greatest potential for the use of AI in teaching is seen as improving adaptivity and interactivity by providing learner-centered, personalized teaching strategies (Celik, 2023; Chui et al., 2024; UNESCO, 2024). However, these benefits can only be fully realized if pre-service teachers are adequately prepared to integrate AI into their future teaching (Anyanwale et al 2022, Anyanwale et al., 2022, 2024; UNESCO, 2024; Yao & Wang, 2024)

Teacher education in Nigeria entails critical training of would-be teachers to inculcate relevant skills for content knowledge development, instructional skills and values in their respective disciplines to be effectively prepared to model, train and guide learners to acquire knowledge and skills during their in-service career years (Akinyemi et al., 2022). Biology education presents unique instructional challenges due to its abstract concepts, complex terminologies, and dynamic processes. Traditional instructional methods often fail to accommodate learners' individual differences, resulting in poor conceptual understanding and reduced learner engagement (Okebukola, 2019). AI-enhanced personalized instruction provides opportunities for differentiated learning experiences that can improve comprehension, retention, and motivation among learners.

Pre-service Biology teachers are critical stakeholders in the adoption and sustainability of innovative instructional technologies. Their perception of the usability of AI-enhanced personalized instruction significantly influences their intention to use such technologies during training and in future classroom practice. Usability encompasses ease of use, perceived usefulness, accessibility, and the extent to which instructional tools support learning objectives (Davis, 1989). This study is anchored on the Technology Acceptance Model (TAM) proposed by Davis (1989). TAM explains users' acceptance and use of technology based on two core constructs: Perceived Usefulness and Perceived Ease of Use. AI-enhanced personalized instruction is viewed as a technological system whose adoption depends on pre-service Biology teachers' perception of its usability. Ease of use, usefulness, accessibility, engagement, and instructional support align with the core constructs of TAM. The application of TAM in this study provides a theoretical basis for understanding how usability perceptions influence pre-service Biology teachers' acceptance of AI-enhanced personalized instruction.

Ugwuoti, Ugochukwu, Ugoeze, and Ekwe (2023) discovered that while students found AI tools helpful in understanding complex biology concepts, there was variability in their perceptions and a preference for traditional teaching methods. They highlighted the importance of providing training and support to enhance students' experience with AI tools and the potential of these tools to enhance understanding of complex biology concepts. Understanding pre-service teachers' perceptions is therefore essential for effective integration of AI technologies into teacher education programmes.

Statement of the Problem

Despite the increasing availability of AI-driven instructional technologies, the teaching and learning of Biology in Nigerian teacher education institutions remain largely dependent on traditional instructional approaches. These approaches often overlook individual differences in learners' abilities, learning pace, and prior knowledge. Although AI-

enhanced personalized instruction has the potential to address these challenges, its adoption depends largely on users' perception of its usability. In Alvan Ikoku Federal University of Education, Owerri, there is limited empirical evidence on how pre-service Biology teachers perceive the usability of AI-enhanced personalized instruction in learning Biology concepts. Without such evidence, stakeholders may face challenges in implementing and sustaining AI-based instructional innovations. This study therefore seeks to fill this gap by examining pre-service Biology teachers' perception of the usability of AI-enhanced personalized instruction.

Purpose of the Study

The purpose of this study is to investigate the perception of pre-service Biology teachers on the usability of AI-enhanced personalized instruction in learning Biology concepts at Alvan Ikoku Federal University of Education, Owerri, Imo State.

Specifically, the study seeks to determine;

1. Pre-service Biology teachers' perception of the ease of use of AI-enhanced personalized instruction.
2. Pre-service Biology teachers' perception of the usefulness of AI-enhanced personalized instruction in learning Biology concepts.
3. Pre-service Biology teachers' perception of the accessibility of AI-enhanced personalized instruction.
4. Pre-service Biology teachers' perception of the level of instructional support provided by AI-enhanced personalized instruction.

Research Questions

1. What is the perception of pre-service Biology teachers on the ease of use of AI-enhanced personalized instruction in learning Biology concepts?
2. What is the perception of pre-service Biology teachers on the usefulness of AI-enhanced personalized instruction in learning Biology concepts?
3. What is the perception of pre-service Biology teachers on the accessibility of AI-enhanced personalized instruction?
4. What is the perception of pre-service Biology teachers on instructional support provided by AI-enhanced personalized instruction?

Research Hypothesis

There is no significant difference in the mean perception scores of male and female pre-service Biology teachers on the usability of AI-enhanced personalized instruction in learning Biology concepts.

Methodology

Area of the Study

The study was carried out at Alvan Ikoku Federal University of Education (A.I.F.U.E), Owerri, Imo State, Nigeria.

Population of the Study

The population size is 285 comprised all pre-service Biology teachers in the Department of Biology Education at A.I.F.U.E, Owerri.

Sample and Sampling Technique

A representative sample of 70 pre-service Biology teachers comprises of third and fourth year students was selected using simple sampling technique to ensure fairness and representativeness

Instrument for Data Collection

Data were collected using a researcher-designed questionnaire titled Perception of Pre-service Biology Teachers on the Usability of AI-Enhanced Personalized Instruction Questionnaire (PPBTUAEPIQ). The questionnaire was structured on a four-point Likert scale.

Validity of the Instrument

The instrument was validated by experts in Biology education, educational technology, and measurement and evaluation to ensure content and face validity.

Reliability of the Instrument

The reliability of the instrument was determined using Cronbach's Alpha method, and an acceptable reliability coefficient was obtained.

The reliability analysis results obtained using IBM SPSS Statistics 23 tool software employed the Cronbach Coefficient Alpha method as shown in Table 1. The Cronbach's Coefficient Alpha of all the question items is 0.756, which is greater than 0.7, indicating that the results are highly reliable.

Table 1: Reliability Statistics result of the questionnaire items

Reliability Statistics			
Cronbach's Alpha	Part 1	Value	0.572
		N of Items	10[a]
	Part 2	Value	0.750
		N of Items	10[b]
	Total N of Items		20
Correlation Between Forms			0.623
Spearman-Brown Coefficient	Equal Length		0.768
	Unequal Length		0.768
Guttmann Split-Half Coefficient			**0.756**

In the test to investigate the perception of pre-service Biology teachers on the usability of AI-enhanced personalized instruction in learning Biology concepts at Alvan Ikoku Federal University of Education, Owerri, Imo State, Table 1 shows that the coefficients of all dimensions of the students' perception are between 0.623 and 0.768; and all falls within 0.35 to 0.7 (and greater than 0.7). This is an indication that from an overall point of view, the use of the questionnaire was highly reliable.

Results

Data were analyzed using descriptive statistics such as mean and standard deviation. A criterion mean was used to determine respondents' perception levels.

Research Question 1: What is the perception of pre-service Biology teachers on the ease of use of AI-enhanced personalized instruction in learning Biology concepts?

Table 2: Mean perception of pre-service Biology teachers on the ease of use of AI-enhanced personalized instruction in learning Biology concepts

S/N	ITEM	SA (4)	A (3)	D (2)	SD (1)	$\bar{X}$	REMARK
1	I find the AI-enhanced personalized instruction easy to use when learning biology	41	28	0	1	3.56	Accept
2	The steps involved in using the AI learning platform is simple to follow	31	32	2	1	3.41	Accept
3	I can navigate through the AI based lessons without assistance	14	37	12	5	2.88	Accept
4	AI system is user friendly and well organized.	31	35	0	1	3.43	Accept
5	I rarely encounter technical difficulties when participating in AI-enhanced biology lessons	19	35	12	2	3.04	Accept

Key: Accept ($\bar{X} \geq 2.5$); Reject ($\bar{X} < 2.5$)

The results in Table 2 showed that all the items recorded mean scores above the criterion mean of 2.50, ranging from 2.88 to 3.56, with a grand mean of 3.26. This indicates that pre-service Biology teachers perceived AI-enhanced personalized instruction as easy to use. Specifically, respondents agreed that the AI platform was easy to use, simple to follow, user-friendly, and required minimal assistance for navigation.

Research Question 2: What is the perception of pre-service Biology teachers on the usefulness of AI-enhanced personalized instruction in learning Biology concepts?

Table .3: Mean perception of Biology teachers on the usefulness of AI-enhanced personalized instruction in learning Biology conceptspolicy recommendations

S/N	ITEM	SA (4)	A (3)	D (2)	SD (1)	$\bar{X}$	REMARK
1	AI-enhanced personalized instruction improves understanding of biology concepts.	30	35	1	0	3.44	Accept
2	I find the AI-feedback helpful in correcting my misconceptions in biology.	33	32	2	1	3.43	Accept
3	The personalized learning activities from the AI system support my academic goal.	29	36	0	1	3.41	Accept
4	AI-enhanced personalized instruction make learning biology faster and effective.	29	36	2	0	3.40	Accept
5	AI-enhanced personalized instruction increases my interest to study biology.	24	37	3	0	3.33	Accept

Key: Accept ($\bar{X} \geq 2.5$); Reject ($\bar{X} < 2.5$)

The results in Table 3 show that all the items had mean scores ranging from 3.33 to 3.44, with a grand mean of 3.40, which is above the criterion mean. This implies that pre-service Biology teachers perceived AI-enhanced personalized instruction as useful in improving understanding, correcting misconceptions, supporting academic goals, increasing learning speed, and enhancing interest in Biology.

Research Question 3: What is the perception of pre-service Biology teachers on the accessibility of AI-enhanced personalized instruction?

Table 4: Mean perception of pre-service Biology teachers on the accessibility of AI-enhanced personalized instruction

S/N	ITEM	SA (4)	A (3)	D (2)	SD (1)	$\bar{X}$	REMARK
1	I can easily access the AI learning platform for biology whenever I need it	29	34	3	2	3.29	Accept
2	The devices required to use AI-enhanced biology instruction are readily available to me.	14	36	15	0	2.98	Accept
3	Internet connectivity does not prevent me from using AI-based biology learning tools.	18	20	22	4	2.81	Accept
4	The AI learning platform is compatible with the devices I use for studying biology.	18	40	7	0	3.17	Accept
5	I can access AI-enhanced biology lessons both on campus and outside the campus environment	27	37	1	0	3.40	Accept

Key: Accept ($\bar{X} \geq 2.5$); Reject ($\bar{X} < 2.5$)

The results in Table 4 indicate that all the items had mean scores ranging from 2.81 to 3.40, with a grand mean of 3.13. This shows that respondents perceived AI-enhanced personalized instruction as accessible. However, internet connectivity had the lowest mean score (2.81), suggesting that access challenges such as unstable internet may still affect usability.

Research Question 4: What is the perception of pre-service Biology teachers on instructional support provided by AI-enhanced personalized instruction?

Table 5: Mean perception of pre-service Biology teachers on instructional support provided by AI-enhanced personalized instruction

S/N	ITEM	SA (4)	A (3)	D (2)	SD (1)	$\bar{X}$	REMARK
1	AI-enhanced instruction provides adequate explanations for difficult biology concepts.	25	40	0	0	3.38	Accept
2	The AI system guides me step-by-step while learning biology concepts.	32	34	1	0	3.46	Accept
3	AI-enhanced personalized instruction supports my independent learning in biology.	28	35	2	0	3.40	Accept
4	The AI system provides learning resources that complement my biology lectures.	20	39	8	0	3.18	Accept
5	AI-enhanced instruction helps me prepare better for biology tests and examinations.	23	39	4	0	3.29	Accept

Key: Accept ($\bar{X} \geq 2.5$); Reject ($\bar{X} < 2.5$)

The results in Table 5 revealed that all items recorded mean scores ranging from 3.18 to 3.46, with a grand mean of 3.34, indicating positive perceptions of instructional support. Respondents agreed that AI-enhanced personalized instruction provides adequate explanations, step-by-step guidance, supports independent learning, complements lectures, and helps prepare for examinations.

Hypothesis Ho1: There is no significant difference in the mean perception scores of male and female pre-service Biology teachers on the usability of AI-enhanced personalized instruction in learning Biology concepts

Table 6: Mean perception scores of male and female pre-service Biology teachers on the usability of AI-enhanced personalized instruction in learning Biology concepts.

	Independent Samples T-test								
								95% Confidence Interval of the Difference	
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	**10.303**	**.002**	.837	57	**.406**	1.70612	2.03728	-2.37346	5.78570
Equal variances not assumed			.542	9.921	**.600**	1.70612	3.15003	-5.32021	8.73246

From the result in Table 6 of the independent samples t-test was conducted to examine the difference in perception scores between male and female pre-service Biology teachers. Levene's test for equality of variances was significant ($F = 10.303$, $p = 0.002$), indicating that the assumption of equal variances (assumed means) was violated. Therefore, the results for equal variances not assumed (estimated means) were used. The analysis showed that there was no statistically significant difference in perception scores between male and female teachers, $t(9.921) = 0.542$, $p = .600$. Hence, gender does not significantly influence perception of AI-enhanced personalized instruction in learning Biology concepts. Therefore, the null hypothesis is accepted.

Discussion of Findings

The findings of the study revealed that pre-service Biology teachers perceived AI-enhanced personalized instruction as easy to use in learning Biology concepts. This was evident from the high mean ratings across all items, indicating that respondents found the AI-based instructional platform simple to navigate, easy to understand, and user-friendly. This finding agrees with the study of Kim and Kim (2022), who reported that students' willingness to adopt AI-supported instructional technologies depends largely on how easy they perceive the system to be. Their study showed that ease of navigation and user-friendliness significantly improve students' acceptance of AI learning tools. Similarly, Zhou, Xue, and Li (2022) found that ease of use positively influences learners' intention to adopt online educational technologies, especially in higher education settings. Also, Celik (2023) reported that AI-supported personalized learning environments improve learners' engagement when the platforms are easy to use and interactive. This finding suggests that ease of use is a strong determinant of usability perception among pre-service Biology teachers.

The findings also revealed that pre-service Biology teachers perceived AI-enhanced personalized instruction as useful in learning Biology concepts. Respondents agreed that AI-enhanced instruction improved their understanding of Biology concepts, helped correct misconceptions, supported academic goals, increased learning effectiveness, and enhanced their interest in Biology. This finding is consistent with Aina et al. (2023), who found that AI-driven personalized learning improves students' conceptual understanding by providing adaptive feedback and individualized content delivery. The finding also agrees with UNESCO (2024), which reported that AI-powered personalized instruction improves learning outcomes by tailoring learning experiences to students' needs and abilities. Furthermore, Ugwuoti, Ugochukwu, Ugoeze, and Ekwe (2023) found that students considered AI tools useful in understanding complex Biology concepts and enhancing academic performance. Similarly, Chui et al. (2024) noted that AI-enhanced instruction increases learners' motivation and academic productivity by making learning more personalized and effective.

The findings showed that pre-service Biology teachers perceived AI-enhanced personalized instruction as accessible. The respondents agreed that they could easily access the AI platform, use compatible devices, and engage with Biology lessons both within and outside the campus environment. However, internet connectivity posed a moderate challenge. This finding aligns with UNESCO (2024), which emphasized that accessibility remains a key factor in successful AI integration in education. Similarly, Anyanwale et al. (2022) found that accessibility to digital devices and internet connectivity significantly influences the adoption of AI-driven learning systems among teacher trainees. In the same vein, Yao and Wang (2024) reported that access to AI-supported educational platforms enhances learners' flexibility and

supports continuous learning beyond the classroom environment. This finding implies that accessibility is essential for maximizing the benefits of AI-enhanced personalized instruction.

The findings discovered that pre-service Biology teachers perceived AI-enhanced personalized instruction as providing adequate instructional support in learning Biology concepts. Respondents agreed that AI systems provide clear explanations for difficult Biology concepts, guide them step-by-step, support independent learning, complement classroom instruction, and help them prepare for examinations.

This finding agrees with Luckin et al. (2016), who reported that AI-driven instructional systems provide adaptive instructional support by responding to learners' needs and offering real-time feedback. Similarly, Opele et al. (2024) found that AI-enhanced instructional platforms improve students' independent learning by providing immediate explanations and corrective guidance. Chui et al. (2024) also reported that AI-based instructional tools enhance instructional support through intelligent tutoring, instant feedback, and personalized content recommendations. Furthermore, Anyanwale et al. (2024) found that AI-supported instruction promotes self-regulated learning and improves learners' confidence in handling difficult academic tasks. This suggests that AI-enhanced personalized instruction provides meaningful instructional support that strengthens Biology learning.

Overall, the findings indicate that pre-service Biology teachers in Alvan Ikoku Federal University of Education, Owerri, have a positive perception of AI-enhanced personalized instruction in terms of ease of use, usefulness, accessibility, and instructional support. This demonstrates the strong potential of AI-enhanced personalized instruction for improving Biology teacher education and enhancing learners' academic experiences.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Teacher education institutions should integrate AI-enhanced personalized instructional tools into Biology education programmes to improve learning outcomes.
2. Biology teacher educators should provide practical training for pre-service teachers on the effective use of AI-enhanced instructional platforms.
3. Educational administrators and policymakers should invest in digital infrastructure, especially reliable internet access, to improve accessibility of AI-based learning tools.
4. Pre-service teachers should be encouraged to utilize AI-enhanced learning tools regularly to improve independent learning and deepen conceptual understanding of Biology.

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