UEJTL: Universal Education Journal of Teaching and Learning
E-ISSN: 3047-8235
2025, Vol. 2, No. 3, pp. 116~126
DOI: https://doi.org/10.63081/uejtl.v2i3.98

Original Research

Colleges of Education Pre-Service Teachers' Awareness, Readiness, and Accessibility Levels with Intelligent Tutoring Systems in North-Central, Nigeria

Hameed Olalekan Bolaji, Abdulahi Adedolapo Ahmed

Department of Science Education, Faculty of Education, Al-Hikmah University, Ilorin, Nigeria

Article Info

Article history:

Received 09 22, 2025
Revised 11 03, 2025
Accepted 11 18, 2025

Keywords:

Intelligent Tutoring Systems (ITS)
Pre-Service Teachers
Awareness of ITS
Readiness for ITS
Accessibility to ITS

ABSTRACT

Intelligent Tutoring Systems (ITS) are automated teaching tools that leverage artificial intelligence to interact with students directly and deliver customised learning experiences, substituting the instructional tasks typically handled by human educators. However, a gap exists in understanding the current state of ITS among pre-service teachers of Colleges of Education in Nigeria. This research sought to investigate the awareness, readiness and accessibility levels regarding ITS among pre-service teachers. Specifically, the study examined: (i) the awareness level of ITS among pre-service teachers; (ii) the readiness level of pre-service teachers towards ITS; and (iii) the accessibility level of pre-service teachers to use ITS. The research employed descriptive research of the cross-sectional survey design using a quantitative approach. The population consisted all pre-service teachers in all the Colleges of Education in North Central Nigeria. Multistage sampling techniques were used to select the representative samples of 656 pre-service teachers from the target population of 40,148 from 20 Colleges of Education across six states and the Federal Capital Territory. Data were collected using a researcher-designed questionnaire and were further analysed using descriptive and inferential statistics. The significance level was set at 0.05, and the instrument's reliability and validity were ensured through expert reviews and pilot testing. The study revealed that: i. Pre-service teachers are moderately aware of Intelligent Tutoring Systems; ii. Pre-service teachers have a positive readiness towards the use of ITS; iii. The finding implies that college ownership and school of discipline, play a crucial role in influencing the effective adoption of ITS. This study recommends training programmes for pre-service teachers to enhance ITS awareness and readiness, improvement of technological infrastructure to increase accessibility and incorporation of collaborative tools to foster engagement among pre-service teachers.

Corresponding Author:

Abdulahi Adedolapo Ahmed
Department of Science Education, Faculty of Education
Al Hikmah University, Adewole housing estate, Adeta Rd, Ilorin 240281, Kwara, Nigeria
Email: iahmedabdulahiadedolapo@gmail.com

1. INTRODUCTION

Education is a process that facilitates learning and the accumulation of knowledge, skills, values, beliefs, and traditions. The methods of delivery include project-based learning, storytelling, discussions, teaching, training, and direct experience (Kolawole, 2017). While education typically occurs under the guidance of teachers, learners may also take the initiative to teach themselves. Education usually occurs in formal or informal contexts, and any acquaintance that has a developmental impact on the way people think or act is regarded as educational. In all of these, education is a must for every human being; therefore, education is the bequest that a country can give to its nationals, which requires the incorporation of technology with an appropriate teaching strategy to enhance learning and development of student performance (Johnson et al., 2016).

The application of information and communication technology (ICT) has transformed instruction and education around the world, ushering in the digital revolution. This has affected lecturers, students, schools, curricula, and instructional methods. Teachers and instructors now transition from traditional approaches to using ICT to support their roles, such as delivering instruction, managing courses, and evaluating students. Technology and education are inextricably linked and mutually beneficial. (Çobanoğlu, 2018). Technology is a major factor shaping Nigeria's educational setting. Most institutions are supporting an increased level of technology use in the instructing and educating atmosphere by providing hardware like tablets, projectors, as well as computers, enhancing internet access, and executing approaches to enhance digital literacy for both educators and learners (Matthew et al., 2015). No country can progress beyond the standard of its teachers. In line with this, Nigeria's educational system can be better improved by taking the teacher education programme seriously and providing sufficient and up-to-date infrastructure that can enhance a high standard in the delivery of technology-driven instructions at the teacher training institutions (Famade et al., 2015).

It was opined by Baturay et al., (2017) that no technology can function on its own without human efforts. Hence, the teacher's responsibility in the functionality of technology for teaching and learning cannot be overemphasised (Marcel et al., 2020). The growth in technology can not replace the responsibility of a human educator and bring an end to the teaching profession, technology will only build a future in which the roles of teachers continue to develop and eventually transformed; one in which the teachers' time is used more effectively and efficiently, and where their knowledge is best applied, leveraged and enhanced (Fahimirad & Shakib, 2018).

Teachers are among the professionals who decide every nation’s economic, social, and political future; they decide the mental, psychological, moral, and intellectual potential of all country’s people (Abubakar & Garba, 2019). This is why Nigeria's education philosophy centres on the growth of individual people into successful and efficient citizens who will eventually become agents of societal change at large (Osokoya, 2017). The philosophy of Nigerian education can only be achieved in classroom settings with the help of a professional teacher. This makes it imperative for any country which aspires to attain national development to achieve a peaceful co-existence and lasting development to prioritize investment into human development through the education and training of teachers (Ogunyinka et al., 2015).

Educator training programmes in Nigeria are entrusted with the duty of instructing both prospective teachers (pre-service or trainee teachers) and in-service teachers equipped with the necessary skills and expertise to thrive in their careers. (Abubakar & Garba, 2019). Laro 2017 opined that in Nigeria, professional teachers are trained and certified by Colleges of Education, the National Open University of Nigeria (NOUN), the National Teachers’ Institute and Faculties/Colleges of Education in Universities leading to the attainment of Nigeria Education Certificate (NCE), Bachelor Degree in their various Disciplines (B.Sc. Education, B.A. Education and Bachelor of Education B.Ed.).

The incorporation of Information and Communication Technology (ICT) into the teachers’ education programme in Nigeria has been justified simply because ICT is the most powerful tool that a nation can use to achieve self-reliance in education (Osokoya, 2017). Teachers need ICT to use modern teaching techniques with technology-based tools and facilities, which is what the world expects (Bolaji & Ajia, 2022). Also, it was opined that the use of ICT in education can be classified into two categories: ICTs developed specifically for instructional purposes, and ICTs that are already in use for other purposes but can be used for instruction (Bindu, 2016).

The expansion and adaptation of ICTs in terms of quality have changed the essence of education in developed countries and have given room for opportunities to improve instructional and learning techniques in tertiary institutions in Nigeria (Jumare, et al., 2017). ICT as a change agent has brought about improvements in working practices, processing and sharing knowledge, teaching techniques, learning strategies, and scientific research processes (Fisseha, 2012). ICT allows teachers to use more time with individual learners, with less time to teach the whole class, thereby allowing students to do more self-regulatory work in compliance with their schedule. The ICT resources used in education include social media (YouTube, Facebook, Twitter,

WhatsApp, and so on) e-learning, virtual learning, cloud computing, and other emerging technologies such as intelligent tutoring systems (Amosa et al., 2019). ICT has passed through various phases of growth and ICT world is experiencing the emergence of a new trend in technology called artificial intelligence (Dahunsi & Owoseni, 2015).

The field of Artificial Intelligence (AI), within computer science and technology, delves into the development of intelligent machines, both software and hardware, that exhibit human-like capabilities in their functioning and responses. AI machines are equipped to handle diverse tasks, such as voice and face recognition, meaning derivation, teaching, learning, planning, creative thinking, and many more (Techopedia, 2019). AI provides a promise of true contact between humans and machines. When machines are intelligent, they can receive requests, communicate, process data, and give conclusions; they can reason, analyse, and give quick feedback; they can also perform intellectual processes and human characteristics like thinking ability, significance discovery, generalizing, and learning from experience (Copeland, 2019; Thompson, et al., 2018).

This can be better done with the use of teaching and learning, which has a major benefit of AI to education. Teaching and learning have been predominantly possible with the aid of Intelligent Tutoring Systems (ITS) (Adelana et al., 2024; Ballantyne et al., 2021; Huang et al., 2022; Popenici & Kerr, 2017). Intelligent Tutoring Systems are computerized teaching gears that leverage artificial intelligence to interact with students directly and deliver customised learning experiences, replicating many of the instructional tasks typically handled by human educators. Some of the instructional functions ITS performs are one-on-one student teaching, student assessment, automated score grading, and personalised teaching. They can also provide timely feedback to students, without the teacher's presence (Ferster, 2017).

Lin et al. (2023) define ITS as a computer-based learning system that uses artificial Intelligence (AI) to provide personalized and adaptive instruction for students by modelling students' psychological status, such as motivation, emotion, and cognition, and prior knowledge. ITS can help teachers by putting learners in charge of their learning activities to aid learners in developing self-regulation skills; others use pedagogical strategies for scaffolding learning to challenge and support the learner appropriately (Luckin et al., 2016). Some ITS that are currently used in education include eTeacher, Case maker, Teaching Works, Curriculum Builder, Memrise, Chem Tutor, Physics Playground, ActiveMath, Algebra Tutor PAT, and ASSISTments (Keleş et al., 2009; Mahdi et al., 2016; Mahmoud & Abo El-Hamayed, 2016).

The development of Intelligent Tutoring Systems is not driven by the sole purpose of advancing artificial intelligence, but rather by the noble goal of enhancing education and making a substantial influence on the teaching and learning process (Hilles & Naser, 2017). ITS consists of four key components that work together to provide effective instruction, namely: Domain Model, which serves as the knowledge base for the ITS, containing the subject matter or teaching material that the system is designed to teach; Student Model, which continuously assesses the learner's progress and understanding of the subject matter. It analyzes the student interactions with the system, including their responses to questions, attempts at solving problems and overall engagement; the Tutor Model, with the model acting as the decision-making engine of the ITS, using information from the domain model and the student model to determine the most suitable teaching methods and interventions for each student; User Interface Model, this model provides the means for communication between the student and the ITS, it typically involves a graphical user interface (GUI) that presents the learning content, interactive exercises and feedback in a way that is engaging and simple to comprehend for students (Mahdi, et al., 2016). Fodouop (2024) opined that the effectiveness of ITS in supporting students with varying levels of programming experience.

The domain model serves as a repository for knowledge about the specific teaching material or subject matter, such as English Language, Computer Studies, Mathematics, Commerce, and Biology. It encapsulates the understanding of the subject and mirrors the expertise of a domain specialist. While some literature equates the domain model with an expert model, other works maintain that these two models are distinct entities. Numerous tasks can be performed by the expert domain, for example, it serves as a warehouse of knowledge and activities used for instructional delivery, and it also acts as a norm for student performance assessment and error detection (Nkambou et al., 2020). Domain models exhibit a wide range of structural and complexity levels, ranging from organized to unstructured and from straightforward (clearly defined) to intricate (Al-Aqbi, 2022).

The student model deals with student actions and provides a comprehensive reflection of students' cognitive and emotional psychology domains. Its aim is to supply the information that would be used to evaluate the conditions for modifying feedback (Chen et al., 2022). It sends data to the tutor model. The main objective of the student model is to equip the system with a baseline understanding of each student, enabling it to respond effectively, capture student interest, and foster learning. The student model can be considered an extension of the domain model. It serves as the core component of the ITS, paying close attention to the students' cognitive and psychomotor states, as well as their development throughout the instructional process. Any deviation between the student model and the domain model triggers an error detection or flagging mechanism within the programme (Marouf, 2021).

The tutor model is the ITS component that is in charge of creating and directing instructional delivery to students. This collates data from domains and student models and makes resolutions about tutoring approaches and behaviour. Oliveira and Nascimento (2022) proposed that this module interacts with the student information in conjunction with teaching objectives to determine the most appropriate instructional activities may include clarifications, support, hints or alternative tasks.

The user interface model serves as the bridge between the student and the ITS, facilitating communication via a graphical user interface and in some cases, a sophisticated modelling of the task domain. This model orchestrates the interaction between the system and the learner, seamlessly converting between the system's internal representation and an interface language that the student understands. Gharehchopogh and Khalifelu (2021) and Mahdi et al. (2023) emphasised the user interface model's role as the primary point of contact between students and the ITS, enabling them to engage in meaningful conversations and interactions. ITSs like AutoTutor and Atlas employ various human-like communication approaches, including spoken or textual explanations. The user interface significantly impacts learning outcomes, as it encompasses the features of the other tutors and contributes to a rich interface design. Conversely, a poorly designed interface can hinder the entire process. The ITS interface must effectively capture student characteristics, such as motivation, as well as interpret their responses, including text and expressions.

Figure 1: The Architecture of an Intelligent Tutoring System.
Source: Owolabi and Adetumbi. (2021, p.18)

Figure 1 shows the architecture of an Intelligent Tutoring System. These four models enable ITS to monitor, adapt, and respond dynamically to individual learners' needs, promoting a self-paced and mastery-oriented learning experience. Within the context of this study, ITS refers to adaptive and AI-driven learning systems designed to support pre-service teachers' acquisition of pedagogical competencies in Colleges of Education, and their awareness.

Awareness is the state of being conscious about something (Carden et al., 2022; Hribernik et al., 2021). More so, it is used in this study to mean the condition of having the knowledge that ITS exists. Awareness is a precursor to readiness to use ITS by pre-service teachers for teaching and learning (Erdemir & Kandil-İngeç, 2016). This was well established in a study that investigated mathematics trainee teachers' innovation, awareness, and views regarding ITS. The study reviewed that mathematics trainee teachers are not aware that ITS can be used for instructional purposes, which consequently reduces their readiness to utilise it for their future teaching and learning. Effective implementation of ITS hinges on user awareness and readiness, which directly impacts its adoption and utilization.

Readiness as relates to accessibility involves evaluating the existing infrastructure, policies, and practices to identify areas that may present barriers to inclusive learning. This process includes assessing physical environments, technological compatibility, and the inclusivity of instructional materials. Ensuring accessibility has emerged as a critical facet of educational technology development. Accessibility, in this context, extends beyond traditional notions of physical entry and encompasses the design considerations that facilitate the inclusion of learners with diverse needs and abilities (Smith et al., 2018). As the educational landscape undergoes a dynamic shift towards inclusivity, addressing accessibility concerns within ITS has garnered heightened attention from researchers and educators alike.

The College of Education is a specialized higher institution established with the mandate of producing qualified teachers for primary and secondary levels of education. In Nigeria, they primarily offer the Nigeria Certificate in Education (NCE), which serves as the minimum teaching qualification (Garba et al., 2018). Akintayo et al. (2022) noted that pre-service teachers are individuals currently undergoing training in teacher education programmes before joining the teaching profession. Their readiness is crucial because it determines not only their mastery of subject matter but also their competence in integrating modern teaching strategies and technologies into classroom activities.

Gender-related disparities in technology adoption and utilisation have attracted the interest of numerous researchers, thereby prompting studies to investigate the extent of these differences. Gender, as a

variable, can influence the awareness and readiness of pre-service teachers toward the utilisation of ITS for teaching and learning (Teo et al., 2015).

Area of specialisation, school of discipline, and institution ownership are among the demographic factors that determine pre-service teachers' awareness, readiness, and accessibility levels toward the usage of ITS. Pre-service teachers in Nigerian Colleges of Education stand at a critical juncture, poised between the excitement of embarking on a teaching career and the challenges of navigating an ever-changing educational landscape, where they must reconcile theoretical knowledge with practical application, and adjust to the diverse needs of 21st-century learners. Equipping pre-service teachers with the essential skills and expertise to adapt to the changing educational landscape is essential. Intelligent Tutoring Systems (ITS) offer a promising avenue to enhance pedagogical approaches. This study offers a novel contribution by examining the awareness, readiness, and accessibility levels of ITS among pre-service teachers of Colleges of Education in North Central Nigeria, a context largely underexplored in educational technology research. It provides inferential evidence of a significant difference in ITS adoption based on institutional ownership and area of specialization.

However, a gap exists in understanding the current state of ITS adoption among this specific group. The main purpose of this study was to investigate colleges of education pre-service teachers' awareness, readiness, and accessibility levels with intelligent tutoring systems in North-Central, Nigeria. The study specifically:

1. Determined the awareness level of pre-service teachers on intelligent tutoring systems;
2. Investigated the readiness level of pre-service teachers toward the use of intelligent tutoring systems;
3. Assessed the accessibility level of pre-service teachers to use intelligent tutoring systems.

2. METHOD

The study employed the quantitative approach, using a descriptive research design of the cross-sectional survey type. The population for this study was all pre-service teachers in the Colleges of Education in Nigeria, while the target population was restricted to pre-service teachers in Colleges of Education in North-Central, Nigeria, which are estimated to be 110,453. There are 60 Colleges of Education in the North-Central Zone of Nigeria, comprising five, 14, and 41 federal, state, and privately owned colleges, respectively, across the six States and the Federal Capital Territory in the North-Central, Nigeria. The States are Benue, Kogi, Kwara, Nassarawa, Niger, Plateau, and the Federal Capital Territory, Abuja. A multistage sampling technique was employed to determine the participants (see Table 1). The first sampling stage was a purposive technique, which was used to select 20 Colleges of Education across six states.

Table 1. Distribution of Colleges of Education in the North-Central Zone based on Ownership

Ownership	Federal	State	Private	Total
Number of COE	5	14	41	60
% Representation	8%	23%	69%	100%

The total number of pre-service teachers in the 20 purposively selected Colleges of Education in North-Central, Nigeria, based on ownership, amounted to 40,148 pre-service teachers. Research Advisor (2006) was used to determine the sample size from the population, and the sample size was 655 at a confidence level of 0.05. In the second stage, random sampling was adopted to select the representative sample across the 20 Colleges of Education based on the sample size. Therefore, proportional sampling was used to determine the percentage representation in the sample size, which is 655. A total of 109 respondents were randomly selected from Federal Colleges of Education, and 325 and 222 participants were randomly selected from State and private Colleges of Education, respectively. The total sample size was 655, and this was in line with The Research Advisors (2006) at a confidence level of 0.05, with a degree of accuracy, and there was an additional entry during the administration of the instrument via WhatsApp, making it 656.

The instrument for this study was a researcher-designed questionnaire. The questionnaire was designed to specifically reflect on the various research questions of the study. The questionnaire was made up of five sections: A-E. Section A seeks respondents' demographic information; pre-service teachers' institution, college ownership, year of study, school of discipline, and gender. Section B was designed to seek information on the respondents' awareness level of intelligent tutoring systems, and it consists of 10 items. The response mode was; highly aware (HA), moderately aware (MA) not aware (NA), while section C includes 10 items designed to seek information on the respondent's readiness level to use intelligent tutoring systems with Likert Scale response modes of extremely ready (ER), moderately ready (MR), slightly ready (SR) and not ready (NR). Therein, section D includes 10 items designed to seek information on the respondent's accessibility level of intelligent tutoring systems. This section response mode was frequently accessible (FA), occasionally accessible (OA), rarely accessible (RA) and never accessible (NA) and section E includes 10 items designed to seek information on the respondent's interactivity level of intelligent tutoring

systems with Likert Scale response modes of extremely interactive (EI), moderately interactive (MI), slightly interactive (SI) and not interactive (NI).

To ensure the construct, content, and face validity of the questionnaire, it was reviewed by experts, and the reliability of the instruments was assessed using a split-half procedure. This was carried out through a pilot group of 50 pre-service teachers at a College of Education located outside the locale of this study. The collated data via the Google form was analysed using descriptive and inferential statistics. Frequency counts were employed to answer the demographic characteristics of the respondents, while means and percentages were used to analyze the answers to the research questions.

3. RESULTS AND DISCUSSION

3.1. Results

This section presents the data analysis and results obtained from the study on awareness, readiness, and accessibility levels of intelligent tutoring systems adoption among pre-service teachers of colleges of education.

Table 2. Distribution of respondents based on gender

Gender	Frequency	%
Male	385	58.70
Female	271	41.31
Total	**656**	**100.0**

Table 2 illustrates the gender distribution of the 656 respondents, with 385 being male (58.70%) and 271 females (41.31%). This signifies a higher proportion of male respondents compared to females, with males making up almost 60% of the total respondents.

Table 3. Distribution of respondents based on Institution ownership

Institution Ownership	Frequency	%
Federal	109	16.62
State	325	49.54
Private	222	33.84
Total	**656**	**100.0**

Table 3 illustrates how the respondents were distributed based on the ownership of their institutions, totaling 656 participants. It shows that 109 respondents (16.60%) were from federal institutions, 325 respondents (49.51%) were from state institutions, and 222 respondents (33.80%) were from private institutions. This distribution indicates that nearly half of the respondents are from state institutions, making it the most represented category. Federal institutions have the smallest representation, with only about one-sixth of the respondents, while private institutions make up approximately one-third of the total respondents.

Table 4. Distribution of respondents based on Academic level

Level	Frequency	%
NCE 1	155	23.60
NCE II	320	48.80
NCE III	181	27.60
Total	**656**	**100.0**

Table 4 shows the distribution of respondents based on academic level, with a total of 656 participants. The majority of respondents, 320 (48.80%), are in NCE II, indicating that nearly half of the surveyed individuals are at this intermediate academic level. NCE I comprises 155 respondents, accounting for 23.60% of the total, while NCE III includes 181 respondents, representing 27.60%. This distribution shows a higher concentration of students in NCE II, followed by a fairly even split between NCE I and NCE III.

Table 5. Distribution of respondents based on the School of Discipline

School of Discipline	Frequency	%
Science	195	29.70
Arts and Social Science	146	22.30
Language	214	32.60
Vocation and Technical Education	101	15.40
Total	**656**	**100.0**

Table 5 presents the distribution of respondents according to their school of discipline, totaling 656 respondents. The largest group specialized in Language, comprising 214 respondents, which accounts for 32.60% of the total. Following this, the Science specialisation includes 195 respondents, representing 29.70%. Arts and Social Science specialists form the third largest group with 146 respondents, making up 22.30%. Finally, the Vocation and Technical Education specialisation has the fewest respondents, with 101 individuals, or 15.40% of the total.

3.1.1. The awareness level of pre-service teachers on Intelligent Tutoring Systems

Table 6. Awareness level of pre-service teachers on Intelligent Tutoring Systems

S/N	Item	HA		MA		SA		NA		Mean
		F	%	F	%	F	%	F	%	
1	I have heard the term "Intelligent Tutoring Systems".	329	50.2	246	37.5	62	9.5	19	2.9	3.35
2	I can provide a basic definition of ITS.	248	37.8	310	47.3	78	11.9	20	3.0	3.20
3	I am familiar with some examples of existing ITS used in education.	241	36.7	260	39.6	137	20.9	18	2.7	3.10
4	I am aware of the potential benefits of using ITS in the classroom.	310	47.3	231	35.2	97	14.8	18	2.7	3.27
5	I am aware of the potential challenges associated with using ITS.	271	41.3	251	38.3	105	16.0	29	4.4	3.16
6	I am familiar with the basic principles of ITS	245	37.3	255	38.9	132	20.1	24	3.7	3.10
7	I am aware that ITS can be used for teaching and learning	268	40.9	265	40.4	105	16.0	18	2.7	3.19
8	I am aware that ITS is a Collaborative tool	229	34.9	274	41.8	128	19.5	25	3.8	3.08
9	I am aware that ITS is a valuable tool for teachers' education.	265	40.4	257	39.2	111	16.9	23	3.5	3.16
10	I believe ITS will play a significant role in the future of education.	278	42.4	264	40.2	92	14.0	22	3.4	3.22
	Average mean									**3.18**

Table 6 evaluates the awareness levels of pre-service teachers regarding Intelligent Tutoring Systems, categorised into four levels: Highly Aware (HA), Moderately Aware (MA), Slightly Aware (SA), and Not Aware (NA). Each item represents a different aspect or component of Intelligent Tutoring Systems. The frequencies and percentages indicate how many respondents fall into each awareness category, along with the mean awareness score for each item. A majority of respondents have heard the term "Intelligent Tutoring Systems" (50.2%), with a mean score of 3.35. A significant number can provide a basic definition of ITS (47.3%) with a mean score of 3.20, and are familiar with examples of ITS used in education (39.6%), scoring 3.10. Many are aware of the potential benefits (47.3%) and challenges (41.3%) of using ITS in the classroom, with mean scores of 3.27 and 3.16, respectively. Awareness of ITS as tools for teaching and learning (40.9%) and their collaborative nature (41.8%) show mean scores of 3.19 and 3.08. Additionally, respondents acknowledge ITS as a valuable tool for teacher education (40.4%) and believe they will play a significant role in the future of education (42.4%), with respective mean scores of 3.16 and 3.22. Overall, the average mean score is 3.18, indicating a moderate level of awareness about ITS among pre-service teachers.

3.1.2. The readiness level of pre-service teachers to use Intelligent Tutoring Systems

Table 7 illustrates the readiness level of pre-service teachers to use Intelligent Tutoring Systems, divided into four categories: Extremely Ready (ER), Moderately Ready (MR), Slightly Ready (SR), and Not Ready (NR). Each item reflects a different dimension of readiness, with frequencies and percentages indicating the distribution of responses, along with the mean readiness score for each item. A majority, 55.2%, feel prepared to use ITS for their learning, with a mean score of 3.41. Interest in attending workshops and training sessions on ITS is also high (54.0%), scoring 3.18. Many are willing to integrate ITS into their lesson plans (41.0%) with a mean score of 3.11 and believe they possess the pedagogical knowledge to use ITS for specific learning objectives (39.9%), scoring 3.14. Confidence in assessing student learning through ITS-generated data and feedback stands at 38.9%, with a mean score of 3.13. A willingness to invest time and effort in learning and practising ITS usage (40.1%) and seeking support and training (39.3%) show mean scores of 3.16 and 3.09, respectively. Collaboration with colleagues on using ITS is considered by 39.3%, with a mean score of 3.07. Interest in learning more about ITS and their potential in education is high (43.8%), scoring 3.21, and many believe they have the necessary technological skills to operate ITS (42.4%) with a mean score of 3.21. The overall average mean score is 3.17 suggesting a high level of readiness among

pre-service teachers, with a substantial number feeling extremely or moderately prepared to integrate Intelligent Tutoring Systems into their teaching practices.

Table 7. Readiness level of pre-service teachers to use Intelligent Tutoring Systems

S/N	Item	HA		MA		SA		NA		Mean
		F	%	F	%	F	%	F	%	
1	I am prepared to use ITS for my learning	362	55.2	215	32.8	62	9.5	17	2.6	3.41
2	I am interested in attending workshops and training sessions on ITS	217	33.1	354	54.0	74	11.3	11	1.7	3.18
3	I will integrate ITS activities into my existing lesson plan	236	36.0	269	41.0	135	20.6	16	2.4	3.11
4	I believe I have the pedagogical knowledge to use ITS to achieve specific learning objectives.	262	39.9	244	37.2	128	19.5	22	3.4	3.14
5	I am confident in assessing student learning through data and feedback generated by ITS.	255	38.9	255	38.9	122	18.6	24	3.7	3.13
6	I will invest time and effort in learning more about and practicing the use of ITS	263	40.1	251	38.3	125	19.1	17	2.6	3.16
7	I am open to seeking support and training to enhance my expertise and comfort level with ITS.	241	36.7	258	39.3	132	20.1	25	3.8	3.09
8	I will collaborate with my colleagues on using the ITS	236	36.0	258	39.3	132	20.1	30	4.6	3.07
9	I am interested in learning more about ITS and its potential in education.	287	43.8	244	37.2	98	14.9	27	4.1	3.21
10	I possess the necessary technological skills to operate and manage ITS.	278	42.4	257	39.2	99	15.1	22	3.4	3.21
	Average mean									**3.17**

3.1.3. The accessibility level of pre-service teachers toward Intelligent Tutoring Systems

Table 8 evaluates the accessibility level of pre-service teachers towards Intelligent Tutoring Systems, categorised into Frequently Accessible (FA), Occasionally Accessible (OA), Rarely Accessible (RA), and Never Accessible (NA). Each item represents different aspects of accessibility, with frequencies and percentages illustrating the distribution of responses, along with the mean accessibility score for each item. A majority of respondents, 54.6%, find ITS accessible to support their learning process, with a mean score of 3.42. Access to ITS relevant to their field is noted by 46.6%, with a mean score of 3.21. Learning resources offered by ITS are accessible to 38.1% of respondents, scoring 3.07. Access to ITS-related technology and equipment is indicated by 39.9%, with a mean score of 3.15. The content structure and organization in ITS are accessible to 45.6%, with a mean score of 3.10. ITS are still considered accessible despite technical issues by 41.0% of respondents, scoring 3.08. All features of ITS are accessible to 40.7%, with a mean score of 3.10. The integration of curriculum content makes ITS accessible to 39.2%, with a mean score of 3.05. Collaborative learning with peers using ITS is common for 39.3% of respondents, scoring 3.14. Prompt feedback from ITS on ambiguous concepts is appreciated by 42.1% of respondents, with a mean score of 3.20. Overall, the average mean score is 3.15, indicating a moderate level of accessibility to ITS among pre-service teachers.

Table 8. The accessibility level of pre-service teachers towards Intelligent Tutoring Systems?

S/N	Item	HA		MA		SA		NA		Mean
		F	%	F	%	F	%	F	%	
1	Intelligent Tutoring Systems are accessible to support my learning process.	358	54.6	232	35.4	51	7.8	15	2.3	3.42
2	I have access to Intelligent Tutoring Systems relevant to my field.	252	38.4	306	46.6	84	12.8	14	2.1	3.21
3	I have access to the learning resources offered by Intelligent Tutoring Systems	235	35.8	250	38.1	151	23.0	20	3.0	3.07
4	I have access to ITS-related technology and equipment (e.g., computers and tablets).	262	39.9	256	39.0	114	17.4	24	3.7	3.15
5	The content structure and organization in ITS are accessible	222	33.8	299	45.6	113	17.2	22	3.4	3.10
6	Where technical issues are experienced, ITS are still	231	35.2	269	41.0	134	20.4	22	3.4	3.08
7	All the features of intelligent tutoring systems are	239	36.4	267	40.7	126	19.2	24	3.7	3.10
8	The integration of curriculum content makes ITS	227	34.6	257	39.2	149	22.7	23	3.5	3.05
9	How often do you use access to intelligent tutoring systems for collaborative learning with peers?	258	39.3	257	39.2	117	17.8	24	3.7	3.14
10	Prompt feedback by ITS to ambiguous concepts in my course of study encourages the	276	42.1	252	38.4	110	16.8	18	2.7	3.20
	Average mean									**3.15**

Note: High 3.26-4.00, Moderate 2.51- 3.23, Average 1.76- 2.50, Low 1.00- 1.75

3.2. Discussion

The findings of this study indicated that pre-service teachers are moderately aware of Intelligent Tutoring Systems. This finding highlights that the knowledge pre-service teachers have about artificial intelligence, like Intelligent Tutoring Systems, is average. This could affect pre-service teachers' readiness to use Intelligent Tutoring Systems for teaching and learning. This finding conforms with Edumadze et al. (2019), who state that students are aware of the existence of technology-driven instructions since they have heard of the term ICT tools. The study sheds light on the crucial aspect of pre-service teachers' awareness and readiness to integrate ITS into their teaching practices. The moderate level of awareness highlighted in the finding suggests a need for targeted training and professional to enhance their competence in leveraging AI-driven tools for effective teaching and learning outcomes.

The study showed that pre-service teachers have a positive readiness to utilise Intelligent Tutoring Systems. The positive readiness means pre-service exhibits are ready to experiment with Intelligent Tutoring tools for learning and teaching. This finding is in agreement with Saleem et al. (2016), indicating that pre-service teachers' readiness to use Intelligent Tutoring Systems is high. It suggests that upcoming educators are open to leveraging AI-driven tools to enhance teaching and learning outcomes.

Pre-service teachers find Intelligent Tutoring Systems highly accessible. This finding is in line with Bassami's (2019) finding that the attitudes of university undergraduate students and students' accessibility to technology tools in the teaching and learning process were positive. This supported the earlier findings of Ilechukwu (2020) that accessibility and interactivity provide valuable insights into students' experiences with technology tools in tertiary institutions. The result of the study highlighted that pre-service teachers have a moderate level of interactivity with Intelligent Tutoring Systems. This indicates that pre-service teachers can interact with Intelligent Tutoring Systems.

4. CONCLUSION AND RECOMMENDATIONS

The study investigated the awareness, readiness, accessibility, and interactivity levels of intelligent tutoring systems adoption among pre-service teachers of colleges of Education. The study concluded that pre-service teachers have a moderate level of awareness and readiness to utilise Intelligent Tutoring Systems and that they find Intelligent Tutoring Systems highly accessible.

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

1. Training programmes should be organized for pre-service teachers, as this will increase their awareness of ITS.
2. Pre-service teachers should have a positive readiness to utilise intelligent tutoring systems for teaching and learning.
3. Technology infrastructure should be provided for pre-service teachers, as this will increase their access to ITS.

DECLARATION OF INTEREST

There is no conflict of interest in this study.

RESEARCH FUNDING

This research project did not receive any financial support from outside sources.

ETHICAL STATEMENT

Ethical approval for this study was obtained from Al-Hikmah University.

AI USE STATEMENT

There is no use of AI in writing manuscripts.

REFERENCES

Abubakar, L., & Garba, J. A. (2019). Teacher education programme and the implementation of educational reform in Nigeria. *Journal of Educational Foundations, 2*(2), 75–84.

Adelana, O. P., Ayanwale, M. A., & Sanusi, I. T. (2024). Exploring pre-service biology teachers' intention to teach genetics using an AI intelligent tutoring-based system. *Cogent Education*, *11*(1), 2310976. https://doi.org/10.1080/2331186X.2024.2310976

Akintayo, T., Adeoye, A. & Oyediran, F. (2022). Pre-service teachers' competencies anduse of ict in mathematics instruction. *NOJEST Journal of Education. 3*(5), 76-92. https://nojest.unilag.edu.ng/article/view/1540

Al-Aqbi, A. T. Q. (2022). Intelligent tutoring system effects on the learning process. (Unpublished master's thesis). Wright State University.

Amosa, A. A., Obielodan, O. O., Ogunlade, O. O., & Muhammed, K. J. (2019). Enhancing active-learning through interactive-video for teaching pottery in selected upper-basic schools, Nigeria. *IJER (Indonesian Journal of Educational Research)*, 4(1), 1–5.

Ballantyne, D., Livingston, C., & Garraway, J. (2021). Cultural-Historical Activity Theory as a Framework for Exploring Pre-service Teachers' Use of an Intelligent Tutoring System for English Language Proficiency. *Africa Education Review*, *18*(3-4), 1-24. https://doi.org/10.1080/18146627.2022.2150245

Bassami, C., (2019). *Gender and technology in the making*. London, SAGE.

Baturay, M. H., Gökçearslan, Ş., & Ke, F. (2017). The relationship among pre-service teachers' computer competence, attitude towards computer-assisted education, and intention of technology acceptance. *International Journal Technology Enhanced Learning, 9*(1), 1-13. https://doi.org/10.1504/IJTEL.2017.10003119

Bindu. (2016). M Learning platform programme and pre-service teachers' behaviour toward mobile instruction using technology acceptance model. *Journal of Educational Research and Reviews, 2*(2), 12-17

Bolaji, H. O., & Ajia S. I. (2022). Information and communication technology (ICT) integration: A Veritable Technique for Quality Secondary Education. *ASEAN Journal of Educational Research and Technology, 1*(1). https://ejournal.bumipublikasinusantara.id/index.php/ajert/article/view/183/176

Carden, J., Jones, R. J., & Passmore, J. (2022). Defining self-awareness in the context of adult development: A systematic literature review. *Journal of management education, 46*(1), 140-177. https://doi.org/10.1177/10525629219900

Chen, T., MdYunus, A., Ali, W. Z. W., & Bakar, A. (2022). Utilization of intelligent tutoring system in mathematics learning. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 4*(4), 50-63. https://www.learntechlib.org/p/42238/

Çobanoğlu, A. (2018). Student teachers' satisfaction for blended learning via Edmodo learning management system. *Behaviour & Information Technology. 37*(2), 133–144. https://doi.org/10.1080/0144929X.2017.1417481

Copeland, B. J. (2019). Artificial intelligence definition, examples, and applications. Encyclopaedia Britannica. https://www.britannica.com/technology/artificial-intelligence

Dahunsi, F. M., & Owoseni, T. M. (2015). Cloud computing in Nigeria: The cloud ecosystem perspective. *Nigerian Journal of Technology, 34*(1), 209–216. https://doi.org/10.4314/njt.v34i1.26

Edumadze, E., Enoch, E. B., & Patrick, D. (2019). Availability and utilization of clearing infrastructures in federal University of Technology, Minna. *Journal of Education and Practice, 3*(13). https://www.iiste.org/Journals/index.php/JEP/article/view/3056

Erdemir, M., & Kandil İngeç, Ş. (2016). Investigating pre-service mathematics teachers' innovation awareness and views regarding intelligent tutoring systems. *Universal Journal of Educational Research, 4*(12), 2783–2794. https://doi.org/10.13189/ujer.2016.041212

Fahimirad, M., & Shakib Kotamjani, S. (2018). A Review on Application of Artificial Intelligence in Teaching and Learning in Educational Contexts. *International Journal of Learning and Development, 8*(4), 106-115. https://doi.org/10.5296/ijld.v8i4.14057

Famade, O. A., Omiyale, G. T., & Adebola, Y. A. (2015). Towards improved funding of tertiary institutions in Nigeria. *Asian Journal of Humanities and Social Sciences (AJHSS), 3*(2), 83–90.

Ferster, B. (2017). Intelligent Tutoring Systems: What Happened? ELearning Industry. https://elearningindustry.com/intelligent-tutoring-systems-what-happened

Fisseha, M. (2012). The roles of information communication technologies in education: Review article with emphasis to the computer and internet. *Ethiopian Journal of Education and Sciences, 6*(2), 109–126. https://doi.org/10.4314/ejesc.v6i2

Garba, A., Kaur, M., Yusuf, M., & Ziden, A. (2018). ICT integration in Nigeria Colleges of Education. *Edulearn International Journal, 14*(4), 243-261. https://doi.org/10.11591/edulearn.v7i1.174

Gharehchopogh, F. S., & Khalifelu, Z. A. (2021). Using intelligent tutoring systems in instruction and education. 2021 *2nd International Conference on Education and Management Technology*, 13, 250–254.

Hilles, M. M., & Naser, S. S. A. (2017). Knowledge-based intelligent tutoring system for Teaching Mongo Database. *European Academic Research, 4*(10), 1–8.

Hribernik, K., Cabri, G., Mandreoli, F., & Mentzas, G. (2021). Autonomous, context-aware, adaptive Digital Twins—State of the art and roadmap. *Computers in Industry, 133*, 103508. https://doi.org/10.1016/j.compind.2021.103508

Huang, L., Dias, L., Nelson, E., Liang, L., Lajoie, S. P., & Poitras, E. G. (2022). The Role of Self-Improving Tutoring Systems in Fostering Pre-Service Teacher Self-Regulated Learning. *Frontiers in Artificial Intelligence*, *4*, 769455. https://doi.org/10.3389/frai.2021.769455

Ilechukwu M. A. (2020). Strategic improvement of mathematical problem- solving performance of secondary school students using procedural and conceptual learning strategies: The African Symposium. *An online Journal of African Educational Research Network, 8(1), 143-149.*

Johnson, A. M., Jacovina, M. E., Russell, D. G., & Soto, C. M. (2016). Challenges and solutions when using technologies in the classroom. In S. A. Crossley & D. S. McNamara (Eds.) *Adaptive educational technologies for literacy instruction* (pp. 13-29). New York: Taylor & Francis. Published with acknowledgment of federal support.

Jumare, M. A., Tahir, S. M., & Hamid, A. T. (2017). The use of ICT in Nigerian universities: A study of Kaduna State University, Kaduna. *International Journal of Advanced Research in IT and Engineering, 6*(7), 1–12.

Keleş, A., Ocak, R., Keleş, A., & Gülcü, A. (2009). ZOSMAT: Web-based intelligent tutoring system for teaching–learning process. *Journal of Expert Systems with Applications, 36*(2), 1229–1239. https://doi.org/10.1016/j.eswa.2007.11.064

Kolawole, B. L. (2017). *Changing trends of Nigeria's educational sector assembled cognition.* A valedictory lecture, Redemmers University, Ede.

Laro, R. A. (2017). Teacher education and issues in professionalisation of teaching in Nigeria. Ilorin: Sharon k publishers.

Lin, C., Huang, A. Y. Q., & Lu, O. H. T. (2023). Artificial intelligence in intelligent tutoring systems toward sustainable education: a systematic review. *Smart Learning Environments, 10*(1). https://doi.org/10.1186/s40561-023-00260-y

Luckin, Rose, Holmes, W., Griffiths, M., Corcier, L. B., Pearson (Firm), & University College, L. (2016). Intelligence unleashed: An argument for AI in education. https://www.pearson.com/content/dam/corporate/global/pearson-dot-com/files/innovation/Intelligence-Unleashed-Publication.pdf

Mahdi, A. O., Alhabbash, M. I., & Naser, S. S. A. (2016). An intelligent tutoring system for teaching advanced topics in information security. *World Wide Journal of Multidisciplinary Research and Development, 2*(12), 1–9.

Mahmoud, M. H., & Abo El-Hamayed, S. H. (2016). An intelligent tutoring system for teaching the grammar of the Arabic language. *Journal of Electrical Systems and Information Technology, 3*(2), 282–294. https://doi.org/10.1016/j.jesit.2016.04.001

Marcel, E. C., Celestine, O. O., Oyekezie, K. S. U. & Eze, B. (2020). Effect of information and communication technology tools for instructional delivery in tertiary institution in Nigeria. *International Journal of Educational Research Review, 5*(4),432-437. https://doi.org/10.24331/ijere.791027

Marouf, A. (2021). *Intelligent tutoring system for teaching introduction to computer science in Al-Azhar University, Gaza*. A Ph.D. dissertation.

Matthew, D., Irinyang, D. J., & Haruna, M. (2015). The role of information communication technology in Nigeria educational system. *International Journal of Research in Humanities and Social Studies, 2*(2), 1-5.

Nkambou, R., Bourdeau, J., & Mizoguchi, R. (2020). *Introduction: What are intelligent tutoring systems, and why this book?* In R. Nkambou, J. Bourdeau, & R. Mizoguchi (Eds.), Advances in Intelligent Tutoring Systems (Vol. 308, pp. 1–12). Springer Berlin Heidelberg.

Ogunyinka, E. K., Okeke, T. I., & Adedoyin, R. C. (2015). Teacher education and development in Nigeria: An Analysis of Reforms, Challenges and Prospects. *Education Journal*, *4*(3), 111–122. https://doi.org/10.11648/j.edu.20150403.14

Oliveira Neto, J. D. de, & Nascimento, E. V. (2022). Intelligent tutoring system for distance Education. Journal of Information Systems and Technology Management, 9(1), 109–122. https://doi.org/10.4301/s1807-17752012000100006

Osokoya, I. (2017). Teacher education in Nigeria: past, present and future challenges. *Academic Leadership: The Online Journal (2003-2012). 8*(4), 9–15. https://doi.org/10.58809/HYLI2137

Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning, 12*(1), 22. https://doi.org/10.1186/s41039-017-0062-8

Saleem, A. O., Chesler, M. & Fox, R. (2016). *Role playing methods in the classroom.* Chicago, Science Research Associates.

Smith, T., Brumskill, R., Johnson, A., & Zimmer, T. (2018). The impact of teacher language on students' mindsets and statistics performance. *Social Psychology of Education: An International Journal, 21*(4), 775-786. https://doi.org/10.1007/s11218-018-9444-z

Techopedia. (2019). *What is Artificial Intelligence (AI)*? - Definition from Techopedia. Techopedia.Com.

Teo, T., Fan, X., & Du, J. (2015). Technology acceptance among pre-service teachers: Does gender matter? *Australasian Journal of Educational Technology, 31*(3) 235-251.

Thompson, W., Li, H., & Bolen, A. (2018). Artificial intelligence, machine learning, deep learning and more. https://www.sas.com/en_us/insights/articles/big-data/artificial-intelligence-machine-learning-deep-learning-and-beyond.html