

Availability and Utilization of Innovative Technologies in Teaching and Learning Computer Hardware Maintenance in Federal Colleges of Education in Enugu State, Nigeria

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Abstract

This study investigates the availability and utilization of innovative technologies in the teaching and learning of computer hardware maintenance in Federal Colleges of Education in Enugu State, Nigeria. The population of the study was 60 third year students from the Department of Computer science Education in Federal College of Education, Eha-Amufu. The research adopted a descriptive survey design with participants from lecturers and students in computer education departments across Federal Colleges of Education in Enugu State. Data were collected using structured questionnaires and analyzed using mean and frequency distribution. Findings indicated that innovative technologies such as virtual laboratories, simulation software, interactive learning platforms, and multimedia instructional tools enhance practical understanding and troubleshooting competence among Computer Science Education students. The study concludes that innovative technologies significantly improve the teaching and learning of computer hardware maintenance when effectively implemented. It was recommended among others that increased investment in digital infrastructure, continuous professional development for lecturers, and policy reforms promoted technology-driven instruction in teacher education institutions.

Keywords: Innovative technologies, computer hardware maintenance, troubleshooting, technology integration, teacher education, Nigeria.

Introduction

The rapid advancement in digital technologies has significantly influenced educational systems worldwide. In recent years, educational institutions have increasingly adopted innovative technologies to improve teaching effectiveness and enhance student learning outcomes (Alhassan, Owusu, & Boateng, 2022; Selwyn, 2016). In technical and vocational education, particularly in computer-related disciplines, the integration of modern technologies has become essential for equipping students with practical and industry-relevant skills (Al-Obaydi & Al-Ansari, 2020; Li & Wong, 2023).

Computer hardware maintenance is a critical component of computer education programs in teacher training institutions. Computer hardware maintenance is the systematic process of inspecting, cleaning, testing, troubleshooting, repairing, replacing, upgrading, and monitoring the physical components of computer systems to

prevent failures, restore functionality, enhance performance, and extend equipment lifespan (Lang, 2024; National Universities Commission [NUC], 2024). The subject requires students to develop hands-on competencies in diagnosing hardware problems, repairing computer components, and maintaining computer systems. Traditional teaching approaches that rely solely on theoretical explanations are often insufficient for developing the practical expertise required in this field (Eze & Okeke, 2020; Adeyemo, 2021). Practical learning experiences requires innovative technologies.

Innovative technologies such as virtual simulation tools, interactive multimedia resources, remote laboratories, augmented reality systems, and digital diagnostic software have emerged as effective tools for enhancing practical learning experiences (Chen, Liu, & Wu, 2021; Radianti et al., 2020). These technologies allow students to simulate real-world

troubleshooting scenarios, practice hardware repairs in virtual environments, and interact with complex computer systems without the risk of damaging physical equipment (Johnson & Brown, 2020; Ahmed et al., 2022).

Federal Colleges of Education in Nigeria play a crucial role in training future teachers, including computer education specialists. Federal Colleges of Education are tertiary teacher-education institutions established by the Federal Government of Nigeria to provide professional teacher preparation and develop skilled, professionally trained, and motivated teachers for the basic education sector, while also supporting teaching, learning, and educational research (National Commission for Colleges of Education [NCCE], 2026). However, the integration of innovative technologies into instructional practices within these colleges remains inconsistent (Obiora et al., 2020; Yusuf, 2021). In many cases, limited access to technological infrastructure, insufficient training for lecturers, and inadequate institutional support hinder effective technology adoption (Nwafor & Umeasiegbu, 2023; UNESCO, 2021). This is common in Federal Colleges in Enugu State.

Enugu State hosts Federal Colleges of Education that offer computer education programs aimed at preparing teachers for secondary schools and technical colleges. Given the increasing demand for technologically competent graduates, there is a need to investigate how innovative technologies are currently used in teaching computer hardware maintenance in these federal colleges of education in Enugu State.

Literature Review

Innovative Technologies in Education

Innovative technologies refer to modern digital tools and systems that introduce new or improved ways of supporting teaching and learning, with the potential to enhance instructional quality, personalize learning, increase learner engagement, and facilitate interaction and collaboration (UNESCO, 2023; Flores-Chacón et al., 2023). In the context of

education, these technologies include simulation software, virtual laboratories, augmented reality systems, multimedia instructional platforms, and collaborative digital environments (Alhassan et al., 2022; Chen et al., 2021). According to Park and Lee (2019), such technologies provide the interactive and engaging experiences that traditional didactic methods cannot achieve. For instance, simulation software provides computer-generated representations of real-world systems and processes, enabling learners to experiment, test solutions, and observe outcomes safely. In this way, simulations provide a foundation for practical learning and prepare students for more immersive experiences (UNESCO, 2023).

Building on this capability, virtual laboratories extend practical experimentation into digital environments where learners can manipulate variables, conduct experiments, and repeat activities without depending entirely on physical laboratory resources. They therefore broaden access to practical learning and complement conventional laboratory experiences (UNESCO, 2023).

Moving beyond purely virtual experiences, augmented reality systems combine digital information with the physical environment, enabling learners to visualize and interact with concepts and processes in context. Such systems can make complex or abstract learning experiences more tangible and engaging (UNESCO, 2023).

These visual and interactive experiences can further be supported by multimedia instructional platforms, which integrate text, graphics, audio, video, animation, and interactive resources to provide multiple ways of representing learning content and stimulating learner engagement (UNESCO, 2023).

Finally, collaborative digital environments connect these resources with social learning by enabling students to communicate, share materials, work jointly on tasks, and construct knowledge across time and distance. Thus, these

technologies collectively move learning from simulation and experimentation to visualization, multimedia engagement, and collaboration (UNESCO, 2023).

Meanwhile, Li and Wong (2023) argue that simulation and virtual environments improve meaningful learning by allowing students to visualize abstract concepts and practice complex processes before working with real equipment. In technical education, innovative technologies enable students to interact with complex systems in simulated environments, providing safe and scalable opportunities to develop technical skills (Ahmed et al., 2022; Johnson & Brown, 2020).

Technology Integration in Technical and Vocational Education

Technical and vocational education (TVE) emphasizes practical skill acquisition and problem-solving capabilities. Technical and Vocational Education (TVE) refers to education that combines general knowledge with the study of technologies, related sciences, and the acquisition of practical skills, knowledge, attitudes, and competencies required for specific occupations and participation in the world of work (UNESCO-UNEVOC, 2026). Several studies have shown that simulation-based learning environments improve students' ability to diagnose and resolve technical problems. For example, virtual laboratories allow students to experiment with hardware components and system configurations without the risk of equipment damage (Ahmed et al., 2022; Johnson & Brown, 2020). Multimedia learning resources such as instructional videos, interactive diagrams, and guided troubleshooting modules enhance students' understanding of complex technical processes (Park & Lee, 2019; González, Muñoz, & Alonso, 2020). The integration of innovative technologies into TVE programs allows students to develop competencies that align with industry standards. According to UNESCO (2021), digital learning environments bridge the gap between theoretical knowledge and real-world application.

Computer Hardware Maintenance

Computer hardware maintenance involves diagnosing hardware faults, replacing defective components, upgrading systems, and ensuring optimal performance of computer systems (Mobley, 2002; Evarest & Laura, 2021). Teaching this course effectively requires a combination of both theoretical knowledge and practical experience. Traditional classroom methods often rely on lecture and demonstration methods using limited physical hardware components.

However, the availability of modern educational technologies have introduced new approaches that support experiential learning. Simulation software allows students to assemble virtual computers, identify faulty components, and practice troubleshooting procedures. These digital environments replicate real-world scenarios, enabling students to develop technical skills before working with physical components (Ahmed et al., 2022; Radianti et al., 2020).

Diffusion of Innovation Theory

This study is grounded in the Diffusion of Innovation Theory developed by Everett Rogers (2003). The theory explains how new ideas and technologies spread within social systems over time. According to Rogers, innovation adoption occurs through stages: knowledge, persuasion, decision, implementation, and confirmation. Individuals and institutions adopt new technologies when they perceive clear advantages over existing practices. The theory identifies five attributes that influence adoption: relative advantage, compatibility, complexity, trialability, and observability. In educational contexts, lecturers are more likely to adopt innovative technologies when they perceive them as useful, easy to use, and compatible with existing teaching practices (Davis et al., 2021; Shin, 2021). Hence, in teaching and learning computer hardware maintenance, lecturers are more likely to utilize simulation software or virtual laboratories when they perceive that these technologies offer advantages over

conventional demonstrations. For example, simulation software may enable students to practise diagnosing hardware faults repeatedly without risking damage to actual computer components. Similarly, virtual laboratories may provide practical experiences where physical equipment is inadequate.

Problem of the Study

Advancement of information and communication technology (ICT) innovations and usage are rapidly transforming teaching and learning in all spheres of life. Utilization of innovative technology serves a multitude of purposes across various sectors especially in education industries. Innovative technologies such as internet facilities, social media platforms, Computer-Aided-Learning (CAL), virtual reality and other mobile applications facilitate communication, collaboration and information sharing. These technologies stimulate computer maintenance tasks, which can be helpful to students who may not have access to the real-world equipment. Innovative technologies are capable of helping students learn in a more and engaging manner, which leads to better practical understanding and information retention.

However, despite the significant influence of innovative technologies for use in educational sectors, in the world especially in tertiary institutions. Nigerian higher educations, especially public collages of education in Enugu State seem not to have yet fully and effectively incorporated the use of these innovative technologies in teaching and learning. This could be attributed to non-availability of these innovation technologies in the computer maintenance laboratories or poor knowledge and skills of lecturers on the use of this innovating technology that are available. Scheffel and Stoyanov (2021) observed that the adoption of technologies in teaching have been hampered by affordability of initial procurement and maintenance, the students and teachers' background, technical capacity of lecturers as

well as the acceptance of such systems in the learning environment.

This research work, therefore seeks to determine the availability and utilization of innovative technologies in teaching and learning of computer maintenance in public collages of education in Enugu State

Purpose of the Study

The general purpose of the study is to determine the availability and the extent utilization of innovative technologies in teaching and learning of computer maintenance in public collages of education in Enugu State. Specifically, the study sought to determine the:

1. The level of innovative technologies available for use in teaching and learning of computer maintenance in public colleges of Education in Enugu State?
2. Extent to which innovative technologies are used in teaching and learning of computer maintenance in public colleges of Education in Enugu State.

Research Questions

The following research questions will guide the study

1. To what extent are innovative technologies available for use in teaching and learning of computer maintenance in public colleges of Education in Enugu State?
2. What are the extent to which innovative technologies are being used in teaching and learning of computer maintenance in public colleges of Education in Enugu State?

Methodology

This chapter presented the procedure followed in carrying out this study. This chapter consists of the design of the study, area of the study, population for the study, sample and sampling technique, instrument for data collection, validity of the instrument, reliability of the instrument, method of data collection and method of data analysis.

Design of the Study

This study adopted descriptive survey research design. A descriptive survey design is a research methodology used to collect data from a sample population to describe characteristics, behaviors, or opinions systematically and accurately. According to Creswell (2012), descriptive research design involves identification of attributes of a particular phenomenon based on an observational basis. It typically involves the use of questionnaire or interviews to gather quantitative or qualitative data, providing a snapshot of the subject under study at a specific point in time. This research design is the most appropriate for this study because it describes the availability and utilization of innovative technologies in teaching and learning computer hardware maintenance in federal colleges of education in Enugu State.

Area of the Study

This study was conducted in Federal Colleges of Education in Enugu State Nigeria. Federal College of Education, Eha-Amufu is the only federal college of education in Enugu State. The Federal College of Education Eha-Amufu is located in Isi-Uzo LGA of Enugu State, Nigeria. It is a tertiary institution dedicated to training educators. Established in 1981, the college offers a range of programmes including National Certificate in Education (NCE); and degree programmes in affiliation to University of Nigeria, Nsukka. The institution is known for its commitment to academic excellence, teacher education, and community service. The institution has computer science department.

Federal College of Education, Eha-Amufu was chosen as the area of the study due to its status as a leading College of Education in Enugu State with a diverse and sizeable student population, providing a rich context for examining the availability and utilization of innovative technologies in teaching and learning of computer maintenance. Their comprehensive range of academic programs, including a strong focus on the Computer science Education, coupled with their historical significance and

commitment to academic excellence, makes it an ideal setting to investigate how contemporary digital trends intersect with traditional educational practices. Additionally, the colleges' resources, infrastructure, and established reputation in research and innovation provide a robust environment for conducting a detailed and credible study.

Population for the study

The population for the study was 60 third year students from the Department of Computer science Education in Federal College of Education, Eha-Amufu. This group was chosen due to the fact that have undertaken computer hardware maintenance as a course at this level, making them particularly relevant for determining the utilization of innovative technologies in teaching and learning of computer hardware maintenance.

Sample and Sampling Techniques

There is total population sampling technique due to the fact that the target group is of small and manageable size.

Instrument for Data Collection

The instrument for data collection was titled "availability and utilization of innovative technologies in teaching and learning of computer hardware maintenance questionnaire (AUITTLCHMQ) developed by the researcher which has 34 items. A four -point rating scale response option which were Strongly Agree, Agree, Disagree and Strongly Disagree, were use with assigned weights of 4, 3, 2, and 1 respectively was used.

Validation of the Instrument

The research instrument was validated by three experts from the Department of Computer and Robotics Education, Faculty of vocation and Technical Education, University of Nigeria, Nsukka. They were asked to ascertain the instrument for data collection, its appropriateness, and language, to ensure that it is fit and appropriate for the expected audience

and addresses the purposes of this study. Their comments, suggestions and corrections helped to develop the final draft of the instrument.

Method of Data Collection

The data collected personally by the researcher who visited the College of Education to administer the questionnaire. The questionnaires was collected by the researcher on the spot to ensure a hundred percent return rates.

Method of Data Analysis

The data collected was analyzed using mean, frequency distribution and standard deviation. Mean of 2.5 was used as the criterion level to accept or reject the mean response.

Results

Research Question1: *What are the available innovative technologies for use in teaching and learning of computer hardware maintenance in Federal Colleges of Education Enugu State?*

Table 1: Frequency and percentages of respondents on the available innovative technologies for use in teaching and learning of computer hardware maintenance

SN	Item Statement	Available %	Note Available %	Total Frequency%	Remarks
1	Artificial intelligence available	75%	%	100%	Available
2	Gamification available for use	78%	25%	100%	Available
3	Virtual reality are available for use	80%	22%	100%	Available
4	Cloud technology are available for use	72%	20%	100%	Available
5	Mobile technologies are available for use	79%	28%	100%	Available
6	Flipped classroom are available for use	71%	21%	100%	Available
7	Social media platforms are available for use	81%	29%	100%	Available

Key: F=frequency, % = percentages, A= Available

The findings presented in Table 1 reveal that all the innovative technologies investigated were available for teaching and learning Computer Hardware Maintenance and Troubleshooting, as reported by the majority of College of Education students. Social media platforms recorded the highest availability (81%), followed by virtual reality (80%), mobile technologies (79%), gamification (78%), artificial intelligence (75%), cloud technology (72%), and flipped classroom (71%). This indicates that students have access to a relatively broad range of innovative technologies that could support the teaching and

learning of Computer Hardware Maintenance and Troubleshooting. The relatively high availability of social media platforms, mobile technologies, and virtual reality suggests opportunities for collaborative, flexible, interactive, and experiential learning. Similarly, the availability of artificial intelligence and cloud technology provides opportunities for personalized learning support, access to digital resources, and collaborative learning. Although flipped classroom recorded the lowest availability (71%), its availability was still reported by a substantial majority of the students.

Overall, the findings suggest that innovative technologies are reasonably available within the Colleges of Education for supporting Computer Hardware Maintenance and Troubleshooting.

Research Question 2

What innovative technologies are being used in teaching and learning of computer hardware maintenance?

Table 2

Mean and standard deviation of the respondents on the extent to which innovative technologies are being used in teaching and learning of computer hardware maintenance

S/N	ITEM STATEMENT	$\bar{x}$	SD	REM
1.	Artificial intelligence are used in teaching Computer Hardware Maintenance and Troubleshooting	3.20	0.48	LE
2.	Gamification are used in teaching Computer Hardware Maintenance and Troubleshooting	3.27	0.52	LE
3.	Virtual reality are used in teaching Computer Hardware Maintenance and Troubleshooting	3.13	0.63	LE
4.	Cloud technology are used in teaching Computer Hardware Maintenance and Troubleshooting	3.33	0.55	LE
5.	Mobile technologies are used in teaching Computer Hardware Maintenance and Troubleshooting	3.27	0.69	LE
6.	Flipped classroom are used in teaching Computer Hardware Maintenance and Troubleshooting	2.97	0.89	VLE
7.	Social media platforms are used in teaching Computer Hardware Maintenance and Troubleshooting	3.26	0.51	LE
	Artificial intelligence are used in teaching Computer Hardware Maintenance and Troubleshooting	3.20	0.61	LE

Key: X = Mean, SD = Standard Deviation, LE = Low Extent, VLE = Very Low Extent.

In the Table 2 above, the result shows that all the items from 8-14 are the extent to which innovative technologies are being used in teaching and learning of Computer Maintenance. The items have a mean range of 2.97 – 3.33 which implies that the respondents agree that the seven items identified as the innovative technologies for use in teaching and learning of Computer Maintenance are not being used in teaching and learning of Computer Maintenance. The corresponding standard deviation ranges from 0.48 – 0.89 indicating that the respondents are not far from each other in their responses with respect to the extent to which innovative technologies are being used in teaching and learning of Computer Maintenance. The cluster mean or grand mean of 3.20 with a corresponding standard deviation of 0.61 implies that the respondents agreed that all the items

identified as the innovative technologies for use in teaching and learning of computer maintenance are not in use.

Discussion of the Findings

The available innovative technologies for use in teaching and learning of computer Hardware Maintenance and Troubleshooting.

The study revealed seven innovative technologies for use in teaching and learning of computer maintenance. The innovative technologies for use as identified through their mean and standard deviation included Artificial Intelligence, Virtual Reality, Gamification Cloud Technology, Mobile Technology, Flipped Classroom, and Social Media. This finding aligns with Miotto (2021) who found that Artificial intelligence and Cloud technologies

some of the innovative technologies in teaching radiologists how to detect abnormalities and in analysing genomic data and in treatment of individual patients' genetic profiles. The findings of this study contribute to the growing body of literature on the importance of using these innovative technologies identified in teaching computer Hardware Maintenance and Troubleshooting in Federal College of Education.

The findings show that all the innovative technologies investigated were perceived by College of Education students to be available, as each recorded an availability rate of at least 71%. This suggests that innovative technologies are reasonably available within the learning environment of the College of Education students, although the level of availability varies across technologies. The relatively high availability of social media platforms, virtual reality, mobile technologies, and gamification suggests greater exposure to these technologies, whereas cloud technology and flipped classroom approaches appear comparatively less available.

The extent to which innovative technologies are being used in teaching and learning of computer maintenance.

The study revealed the extent to which the seven identified innovative technologies for use in teaching and learning of computer maintenance as listed above are being utilized. The findings align with Freina and Ott (2020) who found that Gamification which plays a crucial role in customer engagement are not utilized by business organizations which affects user interaction and that it is not being used appropriately in instructional delivery among technical teachers. The findings of the study contribute to the growing body of knowledge on the importance of proper utilization of these innovative technologies in teaching computer maintenance in Federal Colleges of Education.

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Awareness and Utilization of Artificial Intelligence in Teaching Computer Hardware Maintenance in Universities in Enugu State, Nigeria

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Abstract

This study investigated the awareness and utilization of artificial intelligence (AI) in teaching computer hardware maintenance in universities in Enugu State, Nigeria. The study had two specific purposes and two research questions. A descriptive survey research design was adopted for the study. A sample of 27 respondents comprised of lecturers from University of Nigeria, Nsukka, and Enugu State University of Science and Technology obtained through total population sampling given that the population was small and manageable. Instrument for data collection was a structured questionnaire entitled “Awareness and Utilization of Artificial Intelligence in Teaching Computer Hardware Maintenance Questionnaire (AUAITCHMQ)” developed by the researchers. The instrument was face validated by three experts; and the reliability was tested using Cronbach’s alpha. Data collection was done through personal contact. Data were analyzed using mean and standard deviation, with a cut-off point of 2.50 used to interpret responses. The null hypotheses were tested at 0.05 levels of significance using independent sample t-test. The results of the study revealed that lecturers were aware of artificial intelligence integration in teaching computer hardware maintenance. The findings further revealed that the extent of utilization of artificial intelligence in teaching computer hardware maintenance in the universities was low. It was recommended among others that Universities administration should collaborate with AI experts to train lecturers on the utilization of AI technologies in teaching.

Key words: Artificial Intelligence; Awareness; Utilization; Teaching; Computer Hardware Maintenance

Introduction

In recent years, the field of education has witnessed a significant transformation due to technological advancement due to Artificial Intelligence. Artificial intelligence (AI) is the ability of machines or computer to think and act as human, represents the efforts

towards computerized system to imitate the human mind and actions (Wartman and Combs, 2018). It is a computer system capable of performing complex tasks that historically only human could do, such as reasoning, making decisions, or solving problems (Bostrom & Yudkowsky, 2018). AI