

# Science Educators' Awareness And Utilization Of Emerging Technologies For Teaching Senior Secondary School Students In Ilorin Metropolis

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## Abstract

**Background of Study:** This study investigates the awareness and utilisation of emerging technologies among senior secondary school Science educators in Ilorin Metropolis, Kwara State, Nigeria. As educational landscapes evolve, technologies like Virtual Reality, Augmented Reality, Blockchain, 3D Printing, and Artificial Intelligence (AI) are increasingly seen as transformative tools in teaching. However, there is limited research on how well Science educators in Nigeria are aware of and integrating these technologies into their teaching practices.

**Aims and Scope of Paper:** The aim of this study is to assess the level of awareness and extent of utilisation of emerging technologies among Science educators in Ilorin Metropolis. The paper seeks to identify gaps in awareness and utilisation, as well as the factors influencing the integration of these technologies in science education. It focuses on the use of innovative digital tools in secondary schools, providing insights into the challenges faced by educators in effectively employing these technologies.

**Methods:** The research employed a descriptive cross-sectional survey design, involving 176 Science educators selected through a multi-stage sampling technique from 85 secondary schools. Data were collected via a structured questionnaire focusing on educators' awareness and usage of emerging technologies. The instrument was validated by experts in science education and tested for reliability (coefficient = 0.72). Statistical analysis was performed using SPSS, applying descriptive and inferential statistics (t-test) at a 0.05 significance level.

**Results:** The findings revealed that most educators had limited awareness and usage of emerging technologies, with usage low across most tools except for AI, which was used mainly for assessments. A significant gap was identified between awareness and actual use, attributed to challenges such as poor infrastructure, inadequate training, and lack of clear implementation strategies.

**Conclusion:** The study highlights the need for targeted professional development, enhanced infrastructure, and mentorship programs to support the effective integration of emerging technologies into Science teaching, ensuring that educators can fully leverage these tools to improve educational outcomes.

## A. Introduction

Today's world is dominated by ever-increasing discoveries, inventions, and breakthroughs, which are huge in science and technology. It is a world of incredible scientific and technological advancements, supersonic jets, the Internet, emails, robotics, and biotechnologies.

It is very different from the world of the past, which was marked by taboos, witchcraft, dogma, and the subordination of people to the natural world. Thus, technological growth has transformed seemingly inescapable mysteries into plentiful ease and pleasure, and science has assisted us in solving many human riddles (Nwankwo, 2024). Sharing scientific knowledge and methods with those who are not often regarded as members of the scientific community is the focus of the area of science education (Rumjaun & Narod, 2025). Teaching pedagogy and science content are included in the topic of science education. Biology, chemistry, physics, and integrated science education are the traditional subjects covered in Nigerian standards. The goal of science education is to develop students who can appreciate the richness and excitement of learning about and comprehending the natural world, make personal decisions using appropriate scientific processes and principles, participate intelligently in public discourse and debate regarding scientific issues, and use their knowledge, comprehension, and skills to increase their economic productivity (Luehmann et al., 2024; Osborne, 2023). After taking science coursework, the scientific content outlines the knowledge, skills, and abilities a scientifically literate individual should possess. Students will learn science by actively participating in relevant and engaging investigations in schools that use the scientific curriculum.

A strong foundation in science education reflects the belief that, given the chance, all pupils can grasp science. More thought is given to what students should know and be able to perform and how they will accomplish those goals in science education (Akobe et al., 2025). Students will have varying levels of understanding as they respond to questions about the natural world. Students will reach the results at different speeds; some will do it sooner than others. All individuals should, however, have the chance to gain knowledge related to scientific concepts and science education through various experiences spread over several years. All of these are taught in formal science classes. According to Olayinka et al. (2024), Nigerian high school science teachers have access to a wide range of state-of-the-art technology to support their instruction. A technical innovation, application, or breakthrough that is still in its infancy but has the potential to impact society significantly and is expected to be extensively adopted in the near to medium term is referred to as emerging technology (De Alwis et al., 2021). According to Kroon et al. (2021), emerging technologies include innovative new applications for pre-existing technology and those that are new and whose use is growing. Since these technologies present businesses with both opportunities and risks, they must be regularly observed and evaluated. Emerging technologies are constantly changing. Examples include wearable devices with sensors and head-mounted displays, virtual and augmented reality (VR/AR), artificial intelligence (AI), and the Internet of Things made possible by the quick 5G mobile standard.

Along with other unexplored developing technologies, these breakthroughs promote the creation of new digital ecosystems powered by the data produced by the massive online interactions between people and their gadgets (Riina et al., 2020). More dependable and efficient learning environments have been produced due to the incorporation and use of well-known technologies like cloud computing, augmented reality, virtual reality, artificial intelligence, and the Internet of Things in educational systems. Universities worldwide are progressively integrating these new technologies into their official and informal teaching and learning processes, frequently with the help and support of students who are already accustomed to using them. Emerging technologies offer a more individualised, flexible, and varied approach to addressing individual learning needs and pedagogical methodologies, giving students more freedom and choice than traditional teaching approaches, which are teacher-centric and uniform (Hawthorn, 2018). Innovations, methods, and discoveries used in various educational contexts and objectives are known as emerging technologies. As a result, using new technologies to improve instruction necessitates institutional resources for funding, evaluating, and rewarding innovative teaching strategies. Though many colleges struggle to comprehend and adopt new advancements, the development of educational technologies has been accelerating for more than a decade.

Almufarreh and Arshad (2023) outline significant new educational technologies that lecturers and administrators must know to ensure that university students receive a top-notch education. The first new technology is virtual reality. With interactive computer-generated experiences and an artificial digital area, virtual reality (VR) technology creates a simulated environment.

A realistic environment that reflects the real world and a dream world that allows experiences beyond the limitations of everyday physical reality can be created using it. The development of virtual reality began in the 1960s (Sun et al., 2019). VR technology in education provides a new approach to learning that typically enhances the conventional approach. This innovative strategy increases students' interest in learning new techniques that use sensory information. More accurate depictions of operations or activities can be achieved through virtual reality (Smutny, 2022). One of the main benefits of using virtual reality (VR) in the classroom is its ability to help students understand and investigate complex or abstract ideas in a secure setting (Bourhim & Cherkaoui, 2020; Morélot et al., 2021). Students can explore places that might otherwise be unavailable through computer-generated simulations. Through interactive interaction, virtual reality (VR) immerses users in computer-generated environments to increase simulation realism and improve the overall effectiveness and impact of educational experiences. Augmented Reality (AR) is yet another important technical breakthrough. AR creates an integrated perspective by superimposing digital visuals on top of real-world surroundings. As more smartphones and other AR-capable gadgets become available, their significance is anticipated to increase. Charles McLellan asserts several significant differences between augmented reality (AR) and virtual reality (VR). Even while VR can create an infinite number of virtual worlds, it only offers people experiences that are limited by space.

One usually needs access to a powerful computer to efficiently use a state-of-the-art immersive VR system (Lozano, 2018). AR requires a certain amount of outdoor mobility. AR can improve conventional learning and comprehension by providing three-dimensional representations of items. For example, medical students can visualise a 3D model of a heart (Tzima et al., 2019). AR aims to improve comprehension by showing objects that are difficult to recreate in real life. However, the goal goes beyond just making learning more interesting and pleasurable. Numerous augmented reality (AR)-focused studies in the field of education have yielded consistent findings: The method, effectiveness, and motivation of learning could all be improved by AR applications (Osadchyi et al., 2021). The third new technical advancement is artificial intelligence. Researchers have been trying to improve computers' capacity for autonomous learning since the 1950s, when they first needed application manipulation to operate. This development signifies a radical shift in computer science, business, and society. In a way, computers can perform new tasks independently (Doshi-Velez & Kim, 2017). In order to adapt and recognise their cues, artificial intelligence (AI) will communicate with apps using its language, emotions, and actions. Due to the ubiquity and interconnectedness of several intelligent terminals, people will continue to be members of the digitally virtualised network while living in real physical space. Science fiction has long foreseen the drastic and maybe catastrophic changes that will arise from the widespread use of artificial intelligence. Despite these forecasts, artificial intelligence has progressively permeated many aspects of our daily lives.

Secondary school teachers' awareness of technology-enhanced instruction has steadily increased, primarily due to government-led capacity-building programs, focused professional development initiatives, and cooperative efforts with educational partners. Teachers must be aware of technology to incorporate it into the classroom successfully. The successful adoption of digital teaching tools is based on awareness, according to research by Okoro and Adebayo (2019). Teachers are more likely to include technology in their lesson plans when they know its accessibility, capabilities, and educational advantages. This awareness includes software tools, such as educational applications, virtual labs, and online learning platforms, and hardware equipment, such as projectors, interactive whiteboards, and tablets. According to Usman and

Lawal (2021), educators who participate in ongoing training initiatives have greater knowledge and a greater desire to integrate technology into their teaching strategies. However, access to technology resources is still tricky, especially in secondary schools that are underfunded and located in rural areas, even though awareness has increased. Using digital tools strategically to improve and facilitate learning is part of using new technologies in science teaching. This involves using digital simulations, virtual labs, and e-learning platforms that enable students to investigate biological processes in an engaging and participatory way (Ogunleye, 2020). This use is significant because it can provide students a more thorough grasp of biological ideas, encourage active learning, and accommodate different learning preferences (Omolafe et al., 2022).

Adopting these technologies is crucial for Nigeria to prepare students for future scientific pursuits and bring Science education courses into line with international norms (Oyovwi, 2022). The educational sector is one particularly noticeable area where ICT is causing significant changes (Oyelekan & Olorundare, 2021). Redefining conventional educational paradigms to incorporate digital tools that improve learning outcomes is necessary when integrating developing technologies into science teaching techniques. Students find learning more engaging and accessible with this method (Ogbonnaya & Okeke, 2022). The potential for this integration to enhance academic achievement, develop critical thinking skills, and promote student collaboration in learning makes it clear how important it is (Ogunleye, 2020). In order to overcome obstacles like scarce laboratory resources and improve the general standard of scientific instruction in Nigeria, Science education teachers must embrace new technology (Omolafe et al., 2022). Given the critical role Science education plays in nation-building, ICT must be incorporated into secondary school Science education instruction (Oyovwi, 2022). Incorporating technology is one of the most important tactics for enhancing teaching and learning outcomes in science education. It enables individualised instruction, boosts student engagement, and makes interactive learning easier. New technologies in the Science education subject, like learning management systems (LMS), virtual labs, and 3D simulations, allow students to see and investigate intricate biological ideas like microscopic organisms and cellular architecture. These instruments overcome the limits of conventional classroom approaches, increasing learning's interactivity and engagement. Students can manipulate 3D models and do virtual experiments with the help of cutting-edge technology like augmented reality (AR) and computer-based simulations, which improves their comprehension of abstract ideas. When taken as a whole, these developments have drastically changed Science education teaching, making it more efficient, approachable, and focused on the needs of the students.

By bridging the gap between theoretical ideas and real-world application, these electronic tools could improve Science education teaching for secondary school students by increasing accessibility, inclusivity, and interactivity. Numerous studies have examined the use of technology in Science education instruction, focusing on how it improves student engagement and academic achievement. According to a study, for example, pupils' conceptual grasp of Science education is enhanced when interactive multimedia tools are used (Kassa et al., 2024). Nevertheless, these studies tend to concentrate on the broad implications of technology adoption on education, with little attention paid to the particular aspects of Science educators' awareness and utilisation of developing technologies. Few studies have thoroughly investigated how these characteristics impact the actual usage of emerging technologies in Science education, despite some highlighting the difficulties in adopting new technologies, such as a lack of technical assistance and instructor opposition. This disparity calls for a more thorough examination of the factors influencing the successful application of cutting-edge technologies in Science education. By investigating the awareness, accessibility, sufficiency, and use of emerging technologies for Science education instruction in Ilorin Metropolis, the current study seeks to close this knowledge gap. This study adopts a more focused approach by examining the degree to which science educators are aware of developing technologies and proficient in their usage. In contrast, earlier research has frequently concentrated on widespread technological use. The study will thoroughly grasp the present situation of growing technology use in Science education by

addressing these factors. This will provide insightful information about areas that might need assistance, instruction, and policy changes to encourage the efficient use of these resources in Science education classes. Gaps in the current understanding of integrating technology into Science education instruction will be filled by this research, which will ultimately lead to better teaching strategies and student learning outcomes. Based on the literature studied, the researcher examined the awareness and use of emerging technology for teaching among science educators in secondary schools in Ilorin Metropolis, Kwara State.

The primary purpose of this study was to investigate science educators' awareness of and utilisation of emerging technologies for teaching senior secondary school students in Ilorin metropolis. Specifically, the study aims to;

1. Determined the awareness level of secondary school Science Educators towards the use of emerging technology for teaching Science students in Ilorin Metropolis, Kwara State;
2. Determined the utilisation level of emerging technology for teaching Science students in Ilorin Metropolis, Kwara State;
3. Examined the significant differences between secondary school Science Educators' awareness and utilisation level of emerging technology for teaching Science students in Ilorin Metropolis, Kwara State.

Research Questions: What is the awareness level of secondary school Science Educators regarding using emerging technology to teach Science students in Ilorin Metropolis, Kwara State? What is the utilisation level of emerging technology for teaching Science students in Ilorin Metropolis, Kwara State?

Research Hypotheses: H<sub>0</sub>: There is no significant difference between secondary school Science Educators' awareness and utilisation level of emerging technology for teaching Science students in Ilorin Metropolis, Kwara State.

## **B. Research Methods**

This study employed a descriptive survey of a cross-sectional type. The study collected data that was used to answer the research questions. The responses from the respondents to the questionnaire on awareness, accessibility, adequacy, and utilisation of emerging technology were used to determine the awareness, accessibility, adequacy, and utilisation of emerging technologies for teaching Science students in Ilorin Metropolis. This study aimed to identify 176 senior secondary school Science Educators in Ilorin Metropolis, Kwara State. A multistage sampling procedure was used, with 85 senior secondary schools selected using purposive sampling and 17 from each of the five local governments. The target population was grade 7-15 Science Educators from Asa, Ilorin East, Ilorin South, Ilorin West, and Moro Local Governments. Random sampling was used to select 41 teachers from Asa, 36 from Ilorin East, 25 from Ilorin South, 45 from Ilorin West, and 29 from Moro Local Government, resulting in 176 respondents. Ilorin West had the highest number of teachers due to its population. This study aimed to assess the awareness, accessibility, adequacy, and utilisation of emerging technology among secondary school Science Educators in Ilorin Metropolis, Kwara State. A researcher-designed questionnaire consisted of two sections: Section A, which collected demographic information about respondents, and Section B, which categorised the awareness level, accessibility rate, adequacy level, and utilisation level of emerging technology for teaching Science students in senior secondary schools. The instrument was subjected to a pilot study of 40 secondary school Science Educators outside the study's location. The overall reliability score was 0.72, and the Cronbach's Alpha Coefficient was used to determine its reliability at a 0.05 significance level. The researcher obtained permission from the Head of the Department of Science Education at Al-Hikmah University, Ilorin, and prepared a Google Forms survey on the awareness, accessibility, adequacy, and utilisation levels of emerging technology among secondary school Science Educators in Ilorin Metropolis, Kwara State. The study addressed ethical issues by allowing voluntary participation and adhering to strict guidelines to protect respondents' privacy, confidentiality, dignity, rights, and anonymity. Data was analysed using descriptive and inferential statistics, research questions were answered using mean, frequency counts, and standard deviation, and hypotheses were tested using a t-test at a 0.05 level. The Statistical Product and Service Solution (SPSS) version 25.0 was used for data analysis.

### C. Results and Discussion

#### Research Questions One: What is the awareness level of secondary school science educators towards using emerging technology to teach science students in Ilorin Metropolis, Kwara State?

Table 1. Awareness Level of Secondary School Science Educators towards the Use of Emerging Technology for Teaching Science

S/N	ITEMS	HA (%)	MA (%)	SA (%)	NA (%)	Mean	SD
1	Concept of emerging technology.	18 (10.2%)	39 (22.2%)	52 (29.5%)	67 (38.1%)	2.04	1.00
2	Existence of emerging technology specifically designed for senior secondary school Science education teaching.	16 (9.1%)	68 (38.6%)	46 (26.1%)	46 (26.1)	2.30	0.96
3	Benefits of using emerging technology in enhancing Science student learning outcomes.	14 (8.0%)	50 (28.4%)	68 (38.6%)	44 (25.0%)	2.19	0.90
4	Types of emerging technology available for various science education subjects in senior secondary education.	11 (6.3%)	19 (10.8%)	55 (31.3%)	91 (51.7%)	1.71	0.89
5	Integration of emerging technology into the senior secondary school Science education curriculum.	24 (13.6%)	33 (18.8%)	52 (29.5%)	67 (38.1%)	2.07	1.06
6	Potential challenges and solutions associated with using emerging technology in Science education teaching.	17 (9.7%)	17 (9.7%)	54 (30.7%)	88 (50.0%)	1.78	0.97

The study reveals a low level of awareness among secondary school Science Educators in Ilorin Metropolis regarding emerging technologies in education. The mean score for the first item, which evaluated teachers' understanding of emerging technology, was 2.04. However, 38.1% of respondents indicated a complete lack of awareness, while only 10.2% claimed a high level of familiarity. The mean score for the second item, which focused on knowledge of specific emerging technologies relevant to senior secondary Science education instruction, showed a modest increase in awareness. However, 26.1% still reported no awareness and 9.1% identified as highly aware. The mean score for the third item, which asked about the benefits of using emerging technologies to improve students' learning outcomes, was 2.19. Over a third of teachers reported moderate to low awareness levels. The mean score for the fourth item, which explored the understanding of various emerging technologies used across disciplines, dropped significantly to 1.71, with more than half of the respondents admitting no awareness. The mean score for the fifth item, which assessed the extent to which teachers were aware of integrating emerging technologies into the Science education curriculum, recorded a mean score of 2.07, with only 29.5% of teachers expressing some awareness. A substantial 38.1% indicated no awareness, reinforcing the trend of low engagement with curriculum-based technological integration. The results highlight a significant gap in awareness among Science Educators regarding the role and relevance of emerging technologies in classroom instruction. Targeted interventions, such as professional development workshops, awareness seminars, and curriculum-focused training, are needed to enhance teachers' understanding and effective use of educational technologies in Science education instruction.

**Research Question Two: What is the Utilisation Level of Emerging Technology for Teaching Science Students in Ilorin Metropolis, Kwara State?**

Table 2. Utilisation Level of Emerging Technology for Teaching Science Students

S/N	ITEMS	HU (%)	MU (%)	SU (%)	NU (%)	Mean	SD
1	Utilisation of Virtual Reality for teaching Science Education	0	5 (2.8%)	49 (27.8%)	122 (69.3%)	1.33	0.53
2	Usability of Augmented Reality for enhancing classroom management and Science student engagement	6 (3.4%)	9 (5.1%)	61 (34.7%)	100 (56.8)	1.55	0.74
3	Utilisation of Artificial Intelligence for creating and administering real-time multiple-choice quizzes for Science students	92 (52.3%)	46 (26.1%)	20 (11.4%)	18 (10.2%)	3.20	1.00
4	Utilisation of the Online Simulations platform for offering interactive lessons and assessments that help students master Science education concepts with engaging, game-like elements	12 (6.8%)	9 (5.1%)	53 (30.1%)	102 (58.0%)	1.60	0.87
5	Utilisation of Blockchain Technology for allowing teachers to help students solve math problems, with the game adapting to their skill levels and providing instant feedback	16 (9.1%)	12 (6.8%)	54 (30.7%)	94 (53.4%)	1.71	0.94
6	Utilisation of 3D Printing as an interactive quiz that allows Science Educators to create custom quizzes or use pre-made kits to assess students ' knowledge of Science education.	12 (6.8%)	12 (6.8%)	47 (26.7%)	105 (59.7%)	1.60	0.88
7	Utilisation of Internet of Things for providing animated educational videos and interactive quizzes across a wide range of subjects, including Science Education	26 (14.8%)	28 (25.9%)	49 (27.8%)	73 (41.5%)	2.03	1.08

The analysis of secondary school Science Educators in Ilorin Metropolis reveals a low level of technology utilisation, with only a few notable exceptions. Most of the mean scores fall below the benchmark average of 2.50, indicating limited use of these innovations in day-to-day instructional practices. Virtual Reality (VR) was the least reported technology, with a mean score of 1.33, indicating a near-total lack of VR application in Science education instruction. Augmented Reality (AR) received a mean utilisation score of 1.55, with over half of the respondents not using it and only 8.5% indicating active use. Artificial Intelligence (AI) stood out with a significantly higher mean score of 3.20, making it the most utilised emerging technology among the options provided. Over half of the teachers (52.3%) reported a high level of use, particularly for real-time assessments like multiple-choice quizzes. Online simulations recorded a mean score of 1.60, with a majority of teachers (58.0%) not using them. Blockchain Technology showed low use levels, with more than half of the respondents not using it. 3D Printing was minimally utilised, with a mean score of 1.60 and 59.7% of teachers indicating no usage. The Internet of Things (IoT) recorded a comparatively higher mean of 2.03, though still below the average threshold. The findings reveal that while Artificial Intelligence has gained considerable traction among Science Educators, most other emerging technologies are rarely used or absent from current teaching practices in Ilorin Metropolis. The underutilisation of these technologies could stem from several factors, including limited access to resources, inadequate professional development, poor infrastructure, or a lack of clarity on how to adapt these tools to specific classroom needs. Bridging these gaps is essential for modernising Science education and maximising the benefits of digital innovations in the teaching and learning process.

**H0: There is no significant difference between secondary school Science Educators' awareness and utilisation level of emerging technology for teaching Science students in Ilorin Metropolis, Kwara State.**

Table 3. T-test of significant differences between secondary school Science Educators' awareness and utilisation level of emerging technology

Variables	Mean	St.D	St.Err.	Df.	t (Cal.)	Sig. (2-tailed)	Decision
Awareness	12.13	2.34	0.18	175	-3.69	0.00	Rejected
Utilization	13.06	2.22	0.17				

Table 3 presents the results of a t-test to determine whether a significant difference exists between the awareness and utilisation levels of emerging technologies among secondary school Science Educators in Ilorin Metropolis, Kwara State. The computed t-value of -3.69 at 175 degrees of freedom, with a p-value of 0.00, falls below the standard significance threshold of 0.05. This confirms a statistically significant difference between the mean scores for awareness (M = 12.13, SD = 2.34) and utilisation (M = 13.06, SD = 2.22). Consequently, the null hypothesis is rejected. This outcome suggests that although teachers may possess a certain level of awareness regarding emerging technologies, this awareness does not fully translate into active use in their instructional practices. The result highlights a potential disconnect, possibly due to systemic, infrastructural, or professional challenges, that limits the effective integration of such technologies in the classroom.

The outcomes of this study provide valuable insights into the present status of awareness and application of emerging technologies among secondary school Science educators in Ilorin Metropolis, Kwara State. The data point to three notable challenges: a generally low level of awareness concerning these technologies, limited use of digital innovations except Artificial Intelligence, and a significant disconnect between technological awareness and classroom implementation. The observed low awareness among Science Educators is consistent with previous findings by Okoro and Adebayo (2019), who argued that awareness is a crucial precursor to successful technology integration in educational contexts. In this study, the mean scores for all awareness-related items were below the neutral benchmark of 2.50 on the Likert scale. This suggests that many teachers lack familiarity with emerging technologies' foundational principles and pedagogical applications. Usman and Lawal (2021) noted that inadequate exposure and insufficient professional development contribute significantly to low awareness levels, especially in environments with limited educational resources. Although there have been significant global strides in educational technology, this study revealed that many innovative tools—including Virtual Reality (VR), Augmented Reality (AR), Blockchain, and 3D Printing—remain extremely limited among the Science Educators sampled. This finding aligns with the report by Almufarreh and Arshad (2023), who identified infrastructural and institutional barriers as persistent obstacles to adopting cutting-edge technologies in schools. Virtual Reality, widely recognised for its potential to simulate complex scientific processes in immersive environments (Smutny, 2022; Bourhim & Cherkaoui, 2020), was largely absent from the teaching practices observed, with more than two-thirds of respondents indicating no experience with VR applications. This suggests that a potentially transformative tool for science education is significantly underutilised. Likewise, the use of Augmented Reality (AR) among respondents was minimal, echoing the insights of Tzima et al. (2019), who emphasised AR's potential to facilitate understanding through interactive three-dimensional content. However, this potential appears unrealised in the Ilorin context—likely due to technical limitations, financial constraints, and infrastructural inadequacies. Similarly, the rare use of Blockchain and 3D Printing, despite their growing significance in educational innovation (Osadchyi et al., 2021), highlights a broader systemic challenge in translating technological advancements into everyday teaching practice. Interestingly, Artificial Intelligence (AI) stood out as the most commonly utilised technology among the teachers, particularly for functions such as assessments and adaptive testing. This finding aligns with Doshi-Velez and Kim (2017), who discussed AI's expanding role in educational environments, particularly in automating processes and providing personalised feedback. The relatively high adoption of AI could be attributed to its integration into accessible tools like learning management systems and quiz platforms, making it more feasible for teachers to implement without extensive technical training. A statistically significant disparity between teachers' awareness and their actual use of these technologies ( $t = -3.69, p < 0.05$ ) further underscores a key finding: familiarity with technology does not necessarily result in practical application. This reflects Ogunleye's (2020) argument that structural barriers—such as inadequate access, lack of training, and insufficient institutional backing—can prevent teachers from using digital tools effectively, even when they are aware of them. In a related vein, Omolafe et al. (2022) argued that the mere presence of educational technologies in schools is not enough; meaningful

implementation requires pedagogical support and ongoing professional learning. The present study's findings resonate with these perspectives and reinforce the urgency of initiatives to develop technological awareness and instructional competence. From a broader educational standpoint, the results highlight the critical importance of incorporating emerging technologies into Science education instruction to improve learning outcomes and align with global educational developments. As Oyovwi (2022) suggested, leveraging these technologies can significantly enhance student engagement, deepen understanding of scientific concepts, and elevate teaching quality. However, the findings suggest that this opportunity has not been fully realised in Ilorin Metropolis. Oyelekan and Olorundare (2021) stressed that the transformative impact of Information and Communication Technology (ICT) on science education must not bypass Nigeria's secondary school system, lest it fall behind in global trends. Overall, this study confirms earlier research and deepens understanding by identifying specific gaps between awareness and usage of emerging technologies among Science Educators in Ilorin Metropolis. Unlike broader studies that assess general patterns of technology adoption, this research offers a more refined view of how knowledge of educational tools often fails to translate into active use. It underscores the pressing need for targeted professional development, awareness programs, and supportive policies to bridge this divide. Ultimately, this study contributes to the growing discourse on the role of emerging technologies in science education reform and offers practical guidance for stakeholders seeking to elevate the quality of Science education in Nigerian secondary schools.

#### **D. Conclusion**

The study provides crucial insights into the awareness and utilisation of emerging technologies among secondary school Science Educators in Ilorin Metropolis. The results indicate that teachers generally possess a limited awareness of modern educational technologies. Many are unfamiliar with essential concepts, specific tools, and how such technologies can be effectively integrated into Science education instruction. This limited knowledge is evidenced by the consistently low mean scores across awareness indicators, which suggests a significant informational gap that could impede effective adoption and classroom integration of these innovations. Furthermore, the study demonstrates that the practical use of most emerging technologies in Science education classrooms remains limited. Tools such as Virtual Reality, Augmented Reality, Blockchain, and 3D Printing are rarely employed, likely due to constraints such as lack of infrastructure, training, or institutional support. However, Artificial Intelligence appears to be an exception, showing relatively higher usage. Teachers were found to use AI more frequently, especially in areas like student assessment and adaptive feedback. This increased use may be attributed to the availability of AI-powered tools within commonly used educational platforms, making them more accessible and manageable for teachers. Finally, the study reveals a significant gap between awareness and practical utilisation. The statistical analysis confirms that having some knowledge about these technologies does not necessarily result in their use in classroom settings. This disconnect points to deeper systemic issues, including inadequate access to technological resources, limited opportunities for professional development, and insufficient guidance on how to apply these tools pedagogically. In conclusion, without intentional and sustained efforts to enhance awareness and practical competence, the educational benefits of emerging technologies in the teaching of Science education may continue to be underutilised in the studied context.

#### **E. Recommendations**

To improve the integration of emerging technologies into Science education, it is recommended that regular training workshops be organised to enhance Science educators' awareness and practical knowledge of these tools. In addition, sufficient infrastructure and access to modern digital tools must be provided to support the effective use of these technologies in teaching. Furthermore, clear implementation guidelines should be developed, along with mentorship programs, to ensure that teachers are equipped with the necessary skills and support to effectively apply emerging technologies in the classroom. These initiatives will foster a more effective and sustainable integration of innovative tools, ultimately improving the quality of Science education.

#### **F. Author Contribution Statement**

This research is the result of a collaborative effort between the authors, each contributing to distinct aspects of the study. Abdulmuhsin IBRAHIM was responsible for formulating the research background and identifying the key challenges related to the awareness and utilization of emerging technologies among Science educators in Ilorin Metropolis. Adedolapo Abdulahi AHMED contributed to the design of the research methodology and data collection process, ensuring a robust approach for analyzing educators' awareness and usage of these technologies. Adijat Omoladun OLAREWAJU played a critical role in

analyzing the data, focusing on the factors that influence the integration of emerging technologies in teaching practices. Halimat Jummai KPEROGI was involved in interpreting the results and providing insights into the implications of the findings for educational practices in the region. All authors contributed to the writing, editing, and finalization of the manuscript, ensuring a comprehensive and balanced approach to the study. Each author's expertise played a vital role in this research, resulting in the insightful and practical findings presented in this paper.

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