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Perceptions and Utilisation of Mobile Technologies among Pre-service Biology Teachers in the Digital Era in Nigeria

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Abstract
This study investigated perceptions and utilisation of mobile technologies among pre-service biology teachers in the digital era in Nigeria. Only a limited number of studies have examined how pre-service biology teachers in Nigeria perceive and utilise mobile technologies. This research gap impedes the development and implementation of evidence-based strategies to improve digital teaching practices in biology education. A descriptive cross-sectional survey was adopted for this study and simple random technique was used to select a sample of 800 pre-service biology teachers at Tai Solarin Federal University of Education, Ogun State, Nigeria. An adapted instrument by (Edeh *et al*., 2023) was used for this study. A reliability co-efficient of r = 0.941 was calculated for the instrument. Descriptive statistics (Mean, Frequency, Percentages and Standard Deviation) and Inferential Statistics (independent samples t-test and ANOVA) were used to analyze the data. Results showed mobile phones as the most prevalent device (97.9%), while laptops (8.6%), tablets (1.5%), and digital cameras (1.0%) were less common. Perception was high, with participants reporting confidence in presentations, accessing online resources, and collaborative learning. Utilisation was equally high, with frequent use for research, internet access, emailing, personalized learning, and seminars. Gender significantly influenced perception ($p<.05$), but not utilization ($p>.05$). It was recommended from the study that there should continuous professional development of pre-service biology teachers and that there should be integration of mobile technology into biology teacher education. The study therefore concluded with a call for equitable, innovative training to strengthen teachers' digital competence.

Keywords: Pre-service Biology Teachers, Mobile Technologies, Technology Perceptions, Technology Utilisation, Digital Era

1. Introduction

Progress in mobile technology has significantly influenced teaching and learning across various educational levels (Bai, 2019). The use of mobile technologies for learning has become standard practice in the education sector (Anohah *et al*., 2017) and now serves as a means to meet the demands of both industry and academia (Hussin, 2018). The ongoing development and careful use of mobile technologies have made connectivity, interactivity, and productivity integral components of education. The effective integration of technology in education has introduced innovative teaching methods, transforming teachers from sole knowledge providers into facilitators, mentors, and motivators. This transformation fosters a more participatory and engaging learning experience for students (Edeh *et al*., 2019).

Educational institutions are being forced to reevaluate and reorganize their pattern of lesson delivery due to the disruptive potential of these new technologies and the waves of innovation they have sparked. Stakeholders are quickly realizing the potential of mobile technology, and as a result, a variety of tools, including sensors, apps, and devices, are being developed with education in mind. Mobile devices and applications now act as pedagogical tools that facilitate human rights, creativity and access to legal education and training (Thakre & Thakre, 2015). The International Telecommunication Union (ITU) (2023) reported that there are more mobile technology subscribers than there are people on the planet. Mobile technology uptake has been extraordinary in all spheres of life especially among students. The way people communicate and do business has changed significantly in recent time due to the development of more advanced mobile technologies (Swamy, 2020).

Biology, as a scientific discipline and fundamental subject, plays a crucial role in many fields of study and significantly influences the technological advancement and development of a nation. Learning biology in senior secondary schools and higher education institutions provides students with essential principles, concepts, and theories that prepare them to face challenges both during and after their education. The importance of biology and biology education for sustainable national development is undeniable, as its applications are clearly evident in agriculture, pharmacy, medicine, biotechnology, and other related

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fields (Ahmad *et al*., 2018).

We are now in the mobile age where people make use of internet enabled mobile technologies to execute various activities at any point in time. The characteristics of mobile technologies, which includes wide usage areas, time and space independence and portability is remarkable. These features provided to the user, the idea of using mobile technologies in education and this influenced the formation of mobile learning (Agah & Husniye, 2018). The power of mobile technologies are being felt in different spheres of life such as education, health, aviation, defense, hospitality and tourism, politics, transportation and engineering amidst others (Onyema *et al*., 2023). The use of mobile techs have evolved from communication to education, gaming, voting, meeting, content creation, security, sporting, banking, research and entertainment etc. The ubiquity of mobile technology has changed the way humans interact, relate and respond to emergencies. Studies show that mobile technology offers countless opportunities for humanity especially the Generation Z who appears to have affinity for engagement and creativity (Edeh *et al*., 2020; Thiraput, 2013). One area that mobile technology has gained influence is in the education sector, it has become tool for technology education (Maria, 2015). This was noticeable during the Coronavirus pandemic crisis when most schools shutdown and had to depend on mobile devices and platforms for continued education (Edeh *et al*., 2022; Edeh *et al*., 2022b; Errabo & Ongoco, 2024). There is a need to integrate mobile technologies into the teaching and learning of biology, as they offer numerous benefits. The use of mobile technologies facilitates the rapid and efficient sharing of ideas with learners. However, it is essential for teachers to have a positive perception of technology adoption, as positive attitudes often encourage utilisation, while negative perceptions may hinder effective integration.

Based on the results of this study, empirical evidence will be obtained regarding pre-service biology teachers' perceptions of mobile technologies and the extent of their use in pre-service teacher education in biology. The findings will assist teacher trainers, institutions, and curriculum developers in enhancing the integration of mobile technologies in teacher training programs. Additionally, they will guide policymakers and school administrators in policy development and the provision of technology enriched infrastructure to support technology enhanced learning. Moreover, the study will inform the design of mobile science learning resources with a learner-centered approach by educational technology developers and contribute to existing research on mobile learning, serving as a reference for future studies in science and teacher education. Finally, the study will support the development of digitally competent biology teachers who can meet the demands of the twenty-first-century classroom. While integrating mobile technologies into biology education offers numerous advantages, several challenges may hinder their effective use. These challenges include resistance to change and issues related to the perception and utilisation of these technologies. Therefore, it is essential to explore perceptions and utilisation of mobile technologies among pre-service biology teachers in the digital era in Nigeria.

1.1 Statement of Problem

Mobile technologies have the potential to enhance biology teaching through interactive learning, virtual experiments, multimedia content, real-time access to scientific information, and learner centered pedagogical approaches. Despite these benefits, the integration and utilisation of mobile technologies remain inconsistent and below expectation. In addition, previous studies have examined technology integration in education generally, however, relatively few studies have specifically investigated pre-service biology teachers' perceptions and their utilisation of mobile technologies within the Nigerian educational context. This creates a knowledge gap that limits the application of evidence-based strategies for improving the digital teaching practices in biology education. Consequently, there is the need to investigate perceptions and utilisation of mobile technologies among pre-service biology teachers in the digital era in Nigeria. The findings of this study will provide sufficient evidence that can guide educational policy aimed at strengthening the integration of mobile technologies into biology teaching in Nigeria.

1.2 Aim and Objectives of the Study

This study aimed to investigate perceptions and utilisation of mobile technologies among pre-service biology teachers in the digital era in Nigeria. Specifically, the objectives of the study are to;

1. Identify the most prevalent mobile devices among pre-service biology teachers.
2. Assess the pre-service biology teachers' level of perception of the mobile technologies.
3. Examine pre-service biology teachers' level of utilisation of the mobile technologies.
4. Investigate the difference in the pre-service biology teachers' level of perception of mobile technologies based on gender.
5. Determine the difference in biology teachers' level of utilisation of mobile technologies based on gender

1.3 Research Questions

The following research questions guided this study:

1. What is the most prevalent mobile devices among pre-service biology teachers?
2. What is the pre-service biology teachers' level of perception of the mobile technologies?
3. What is the pre-service biology teachers' level of utilisation of the mobile technologies?

1.4 Research Hypotheses

The following research hypotheses was tested:

1. There is no significant difference in the pre-service biology teachers' level of perception of mobile technologies based on gender.
2. There is no significant difference in biology teachers' level of utilisation of mobile technologies based on gender.

2. Literature Review

This section reviews the literature relevant to this study, organized under the following subheadings:

2.1 Concepts of Mobile Technologies

2.1.1 Meaning and Types of Mobile Technologies

Mobile technology is the collection of tools, services, and gadgets that facilitate productivity, communication, and information access while on the go. In addition to the networks and infrastructure that enable its communication, it includes a broad variety of devices, including laptops, tablets, smartphones, and wearable technology. The use of mobile technology is spreading rapidly due to the high penetration of mobile gadgets in the world (Edeh *et al*., 2023). Because of the global shift toward mobility, focus is now being directed on mobile technology rather than stationary hardware (Sharma & Madhusudhan, 2017). The various types of mobile technologies are smart phones, tablets/ipads, personal digital assistants, laptop, notebook computers, digital books etc.

2.1.2 Digital Transformation in Biology Instruction

The integration of mobile technologies into biology education is redefining how complex scientific concepts are taught, learned, and experienced. Unlike static textbooks, mobile devices support dynamic representations of biological processes, allowing students to interact with 3D models of the human body, simulate genetic mutations, or visualize ecological systems in real time (Teplá *et al*., 2022). Research has shown that such immersive learning environments enhance conceptual understanding and retention, particularly in abstract areas like molecular biology and genetics (Adewumi, 2024; Adewumi *et al*., 2024). A key strength of mobile technologies lies in their portability, which extends biology learning beyond classrooms into authentic environments. During fieldwork, students can use mobile devices for species identification, geotagging ecological data, or capturing microscopic images through mobile-connected lenses, thereby merging inquiry-based learning with digital innovation (Adewumi *et al*., 2023). Studies also highlight that mobile learning fosters collaboration; biology students can instantly share experimental data, crowd source observations, and engage in virtual discussions that strengthen scientific reasoning (Maishanu *et al*., 2024). Nonetheless, challenges persist, including unequal access, infrastructural deficits, and limited teacher preparedness in leveraging advanced applications such as augmented reality (AR) and gamified biology apps (Ishengoma *et al*., 2024). Addressing these barriers through targeted training and supportive policies could enable mobile technologies to transform biology education into an interactive, student-centered, and future-ready discipline.

2.1.3 Past Studies on Perception and Utilisation of Mobile Technologies

Universities in Nigeria are increasingly exploring the role of mobile technologies in enhancing teaching and learning, particularly for pre-service biology teachers who are expected to model technology integration in their future classrooms. Edeh *et al*. (2023) reported that students perceive mobile technologies such as mobile phones and laptops as essential tools for academic and non-academic purposes, providing access to internet resources and supporting effective learning beyond classroom boundaries. Their study highlighted students' enthusiasm and satisfaction in using mobile devices as educational tools, while also pointing to the transformative prospects of mobile technologies in reshaping professional practices. Similarly, Oladosu *et al*. (2021) demonstrated that secondary school students find mobile ICT (MICT) both useful and easy to use for learning, regardless of gender. This finding aligned with research by Uwakwe (2021), which showed that pre-service biology teachers hold positive perceptions of digital technologies in terms of effectiveness, motivation, and ease of use. Importantly, gender differences in perceived usefulness and ease of use were statistically non-significant, underscoring broad inclusivity in technology adoption. At the tertiary level, lecturers also acknowledge the usefulness of mobile devices, although infrastructural challenges and communication barriers persist (Maishanu *et al*., 2024). Expanding this perspective, Adewunmi *et al*. (2023) observed that Nigerian teachers are willing to adopt mobile learning and rate themselves above average in technology adoption, but unsupportive curricula and infrastructural deficits hinder its effective utilisation.

2.2 Theoretical Framework

2.2.1 Technology Acceptance Model

The Technology Acceptance Model (TAM), developed by Davis in 1989 and later refined by Venkatesh and Davis (2000), is one of the most influential frameworks for explaining technology adoption due to its simplicity, adaptability, and theoretical rigor (Granić & Marangunić, 2019). TAM emphasizes two key constructs which are Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) which further shapes Attitude Toward Use (ATU) and Behavioral Intention (BI), ultimately predicting actual usage. In this study, PU reflects how pre-service biology teachers perceive mobile technologies as improving learning outcomes and teaching effectiveness. PEOU reveals whether mobile apps, platforms, or instructional tools are user-friendly and require minimal technical expertise. When technologies are perceived as useful and easy to use, TAM suggests users form positive attitudes that strengthen their intention to apply them in practice (Akhigbe *et al*.,

2021). For pre-service biology teachers, this translates into practical applications such as designing lesson plans with mobile apps, using interactive tools to demonstrate biological concepts, and engaging in online peer collaboration (Adeyele & Ogegbo, 2024). TAM is particularly relevant in the Nigerian context, where challenges such as digital literacy gaps, infrastructural limitations, and unequal device access persist (Adetona, 2025). These contextual realities influence not only whether mobile technologies are adopted but also why they are embraced or resisted. By uncovering these psychological and structural factors, TAM provides a robust theoretical lens for understanding technology acceptance. Ultimately, it guides strategies to support Nigerian pre-service biology teachers in overcoming barriers and maximising the transformative potential of mobile technologies in biology education (Olajide, 2024).

2.2.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

This study is grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT), originally introduced by Venkatesh *et al.* (2003) and later refined by Weerakkody *et al.* (2017). UTAUT has been extensively applied by researchers to understand how individuals accept and use information systems and technology. The theory integrates components from eight different models, including the Theory of Reasoned Action, Theory of Planned Behavior, Technology Acceptance Model, Model of Personal Computer Utilization, Diffusion of Innovation Theory, Social Cognitive Theory, and the Motivational Model. By combining these models, UTAUT offers a comprehensive framework for understanding technology adoption. It effectively explains a significant portion of the variance in users' behavioral intentions and actual technology use. The theory comprises four key constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. These factors are believed to shape users' intentions to adopt technology, which subsequently influences their actual usage. Facilitating conditions are thought to have a direct positive effect on technology use. In this research, UTAUT is applied to explore how pre-service biology teachers in Nigeria perceive and utilize mobile technologies in the digital age. The theory is well-suited to identify critical factors and conditions influencing these teachers' perceptions and use of mobile technology. Moreover, it provides a foundational model for addressing the research questions in this study.

3. Methodology

This present study adopted descriptive survey design and data was collected cross-sectionally. The participants were drawn from pre-service teachers at the College of Science and Information Technology, Tai Solarin University of Education, Ijagun, Ogun State, Nigeria. This college is made up of seven departments including biology, chemistry, computer and information science, heath education, human kinetics, mathematics and physics. Biology was purposively selected for the study and the department has four levels of pre-service biology teachers. The target population of the senior pre-service biology teachers in the department was 1,500. A simple random sampling technique was used to select 800 participants for the study. An adapted instrument by (Edeh *et al*., 2023) was used for this study. The instrument has three sections consisting of the demographic variables and the construct of the study. The demographic variables included gender, age and level of the participants. Sections 2 and 3 has items to elicit responses from the participants on their perception and utilisation of mobile technologies respectively. The sections has 15 and 17 items respectively anchored on four-point Likert scale of Strongly Agree-4, Agree-3, Disagree-2, Strongly Disagree-1. The instrument was validated by two experts in science education. All corrections and suggestions made was incorporated and used as final data gathering instrument for this study. The validated instrument was administered on 100 pre-service science teachers not part of the main study and a cronbach alpha co-efficient was calculated. A reliability co-efficient of r= 0.941 was calculated for the entire instrument. The reliability co-efficient was calculated for perception (r = 0.866) and utilisation (r = 0.914). Thus, the instrument is said to be valid and reliable for this study. The primary data generated from the participants was coded and organized on the IBM SPSS version 20 for analysis. Descriptive statistics (Mean, Frequency, Percentages and Standard Deviation) and Inferential Statistics (independent samples t-test and ANOVA) were used to analyze the data.

4. Results and Discussion of Findings

The demographic variables of the respondents showed that 185 participants (23.1%) were male, while 615 participants (76.9%) were female. This indicates that the number of female participants exceeded that of male participants in the study. The distribution of participants by age revealed that 366 (45.8%) were less than 16years, 403 (50.4%) were aged 16-20 years, and 31 (3.9%) were aged 21-25 years. This indicates that the largest group of participants fell within the age bracket of 16-20 years. The distribution of participants by level of study revealed that 221 (27.6%) of the respondents were first-year students, 265 (33.1%) were second-year students, 140 (17.5%) were third-year students, and 174 (21.8%) were fourth-year students. The majority of the participants were second-year students.

Research Question 1: What is the most prevalent mobile devices among pre-service biology teachers?

Table 1 shows the prevalence of mobile devices among pre-service biology teachers. The most commonly used mobile devices by pre-service biology teachers are Mobile Phones: (97.9%), followed by Laptop: 69(8.6%), Tablet: 12(1.5%) and Digital camera:

Table 1: Prevalence of Mobile Devices among Pre-service Biology Teachers

Mobile Devices	Yes (%)	No (%)
Laptop	69 (8.6)	731 (91.4)
Digital Camera	8 (1.0)	792 (99.0)
Mobile Phones	783 (97.9)	17 (2.1)
Tablet	12 (1.5)	788 (98.5)

Table 2: Descriptive Statistics of Pre-service Biology Teachers' Level of Perception of Mobile Technologies

Item	Statements	SA (%)	A (%)	D (%)	SD (%)	Mean	Std.
1	I feel comfortable using mobile technologies for class presentations and discussion	202(25.3)	521(65.1)	73(9.1)	4(0.5)	3.15	0.584
2	I find it easy using my mobile devices to access the internet and online educational materials	307(38.4)	466(58.3)	23(2.9)	4(0.5)	3.35	0.560
3	I can easily access science related updates and research using my mobile devices	323(40.4)	456(57.0)	16(2.0)	5(0.6)	3.37	0.558
4	Mobile devices are important tools for my education and daily activities	317(39.6)	451(56.4)	29(3.6)	3(0.4)	3.35	0.569
5	Mobile technologies enable me to acquire experiences outside the classroom	322(40.3)	462(57.8)	14(1.8)	2(0.3)	3.38	0.535
6	I find it easy recording lectures in class using my mobile devices	203(25.4)	414(51.7)	170(21.3)	13(1.6)	3.01	0.729
7	Mobile devices enables me to study easily with my colleagues	224(28.0)	495(61.9)	76(9.5)	5(0.6)	3.17	0.609
8	I find it easy downloading scientific games using my mobile devices	171(21.4)	462(57.8)	162(20.3)	5(0.6)	3.00	0.665
9	I use my mobile devices to join scientific groups on social networking sites like Facebook, Twitter, Yahoo Messenger etc	251(31.4)	485(60.6)	60(7.5)	4(0.5)	3.23	0.597
10	I use my mobile devices to download mobile dictionaries	246(30.8)	518(64.8)	34(4.3)	2(0.3)	3.26	0.541
11	I can solve scientific problems using mobile device	265(33.1)	490(61.3)	40(5.0)	5(0.6)	3.27	0.578
12	Whenever I use my mobile devices for learning, I take full control	222(27.8)	503(62.9)	65(8.1)	10(1.3)	3.17	0.616
13	The use of mobile devices for learning is expensive	164(20.5)	411(51.4)	215(26.9)	10(1.3)	2.91	0.719
14	The use of mobile devices to write examinations, continuous assessments and check results is very secure	213(26.6)	472(59.0)	102(12.8)	13(1.6)	3.11	0.669
15	The use of mobile devices for course registration is very reliable	254(31.8)	482(60.3)	64(8.0)	-	3.24	0.584

Table 3: Descriptive Statistics of Pre-service Biology Teachers' Level of Utilisation of Mobile Technologies

Item	Statements	SA (%)	A (%)	D (%)	SD (%)	Mean	Std.
1	Mobile technologies are useful tools for scientific research	284(35.5)	495(61.9)	16(2.0)	5(0.6)	3.32	0.544
2	I use my smartphone to access the internet	354(44.3)	432(54.0)	12(1.5)	2(0.3)	3.42	0.538
3	I use my mobile phone for emailing	344(43.0)	442(55.3)	11(1.4)	3(0.4)	3.41	0.540
4	Mobile device facilitate my access to scientific contents and materials online	291(36.4)	485(60.6)	24(3.0)	-	3.33	0.532
5	I use my mobile device for seminar presentations	165(20.6)	484(60.5)	142(17.8)	9(1.1)	3.01	0.655
6	I use my mobile device for mobile learning	272(34.0)	512(64.0)	15(1.9)	1(0.1)	3.32	0.512
7	I used my mobile device e.g Zoom, Google meet, Skype for virtual meeting and conferences	211(26.4)	470(58.8)	110(13.8)	9(1.1)	3.10	0.660
8	I used my mobile device such as IPad for professional development programmes	184(23.0)	487(60.9)	120(15.0)	9(1.1)	3.06	0.650
9	I use my mobile devices for accessing updates on scientific researches	251(31.4)	527(65.9)	19(2.4)	3(0.4)	3.28	0.523
10	I use my mobile device for real time communication	298(37.3)	483(60.4)	16(2.0)	3(0.4)	3.35	0.537
11	I use my mobile device to learn whatever I want anywhere and anytime	335(41.9)	449(56.1)	9(1.1)	7(0.9)	3.39	0.560
12	I use mobile device to prepare notes and assignments	296(37.0)	474(59.3)	29(3.6)	1(0.1)	3.33	0.549
13	I use my device for personalized learning and science related tasks	277(34.6)	502(62.7)	20(2.5)	1(0.1)	3.32	0.524
14	I use my mobile devices to get easy feedback from my lecturers	219(27.4)	493(61.6)	86(10.8)	2(0.3)	3.16	0.605
15	I use my mobile devices to improve my learning skills in science	273(34.1)	503(62.9)	21(2.6)	3(0.4)	3.31	0.537
16	The use of mobile devices for learning takes time	130(16.3)	327(40.9)	303(37.9)	40(5.0)	2.68	0.801
17	The use of mobile devices for scientific learning is fun filled	227(28.4)	523(65.4)	46(5.8)	4(0.5)	3.22	0.561

8(1.0%). Therefore, it can be observed that Mobile Phones are the most prevalent mobile devices among pre-service biology teachers. Given the growing role of digital technologies in education, this study examined the prevalence, perception, and utilisation of mobile technologies among pre-service biology teachers in Nigeria. Mobile phones were the most prevalent devices, followed distantly by laptops, tablets, and digital cameras. Their dominance reflects affordability, portability, and multifunctionality, making them the most accessible gateway to digital resources.

Research Question 2: What is the pre-service biology teachers' level of perception of the mobile technologies?

Table 2 revealed that majority of the pre-service biology teachers had high perception of mobile technologies as they feel comfortable using them for class presentations, discussion, accessing online materials, science related updates and other biology related academic contents. The mean ranges from 2.91 to 3.38 and this implies that the perception of pre-service biology teachers towards mobile technologies is high. This study revealed that pre-service biology teachers hold a high perception of mobile technologies, particularly in areas that support academic enrichment and collaborative learning. The highest-rated perception wars that mobile technologies enable them to acquire experiences outside the classroom, followed closely by the ability to access science-related updates and research with ease. They also reported finding it easy to access the internet and online educational materials and considered mobile devices important tools for both education and daily activities. Additionally, high ratings were recorded for solving scientific problems, downloading mobile dictionaries, and using mobile devices for reliable course registration.

Table 4: Independent samples t-test Analysis of Pre-service Biology Teachers Perception of Mobile Technologies based on Gender

	N	Mean	SD	df	T	P
Male	185	48.83	5.759	798	2.446	0.015
Female	615	47.70	5.433			

Table 5: Independent samples t-test Analysis of Pre-service Biology Teachers Utilisation of Mobile Technologies based on Gender

	N	Mean	SD	Df	T	P
Male	185	55.72	6.659	798	1.762	0.078
Female	615	54.80	6.111			

Research Question 3: What is the pre-service biology teachers' level of utilisation of the mobile technologies?

Table 3 revealed that most of the pre-service biology teachers had high level of utilisation of mobile technologies. Majority of the participants admitted using mobile technologies to conduct scientific research, access the internet for contents, materials, seminar presentation and host of other useful activities. The mean score ranges from 2.68 to 3.39 which showed high utilisation of mobile technologies among pre-service biology teachers.

Research Hypothesis 1: There is no significant difference in the pre-service biology teachers' level of perception of mobile technologies based on gender

Table 4 indicated the t-test value of the perception of mobile technologies based on gender of pre-service biology teachers. The average score of the male (48.83±5.759) is higher than of the female (47.70±5.433). Statistically, this disparity was significant. The conclusion is that gender was a decisive element in the level of perception of pre-service biology teachers on mobile technologies. Statistically, gender had evidentiary effect on the perception level of pre-service biology teachers on mobile technologies.

Research Hypothesis 2: There is no significant difference in biology teachers' level of utilisation of mobile technologies based on gender

Table 5 indicated the t-test value of the utilisation of mobile technologies based on gender of pre-service biology teachers. The average score of the male (55.72±6.659) is higher than of the female (54.80±6.111). Statistically, this disparity was not significant. The conclusion is that gender was not a decisive element in the level of utilisation of mobile technologies by pre-service biology teachers. Statistically, gender had no evidentiary effect on the utilisation of mobile technologies by pre-service biology teachers.

5. Discussion of Findings

The result of our findings that mobile phones are the most prevalent mobile devices among pre-service biology teachers aligns with global patterns reported by the International Telecommunication Union (2023), showing mobile subscriptions exceeding the world's population, and with findings by Iqbal *et al*. (2017) and Aina (2025), who noted mobile phones as the most used devices among university students. Sharma and Madhusudhan (2017), similarly observed that smartphones are more preferred because of their lower purchase and maintenance costs and this aligns with the findings of our study that mobile phones were the most prevalent mobile devices among pre-service biology teachers. Ahmad and Omaid (2020) also reported that smartphones are the most widely used educational tool in the classroom. Minimal tablet and digital camera use may be linked to higher costs and limited academic utility.

Our findings further reveals that that majority of the pre-service biology teachers had high perception of mobile technologies. This corroborate the findings of Uwakwe (2021), which showed that pre-service biology teachers hold positive perceptions of digital technologies, Falade *et al*. (2021) and Thakre and Thakre (2015), who emphasized the educational value of mobile devices and the item showing slightly lower scores on expense reflect cost as a persistent barrier aligns with Onyema *et al.* (2023), who identified affordability as a major challenge among students. Ahmad and Omaid (2020) further reported that university students uses phones mostly for note taking, recording and access to internet which denotes a higher perception of mobile technology usage among students. However, Masadeh (2021) reported that students also perceive significant drawbacks to smartphone use in learning, with the highest concern being high data consumption, feelings of isolation from instructors and increased multitasking which many reduce academic performance.

This study revealed that pre-service biology teachers reported high utilisation of mobile technologies, particularly for core academic and communication

purposes with top scores for internet access, emailing, and anytime-anywhere learning. These results align with Maria *et al*. (2015) and Masadeh (2021) which reported the high usage of mobile technologies as a result of flexibility and quick information retrieval for academic purposes. Also the findings of Edeh *et al*. (2023) on collaborative and self-paced learning corroborates our findings on high utilization of mobile technologies by pre-service biology teachers. Item on time consumption scored lowest, reflecting concerns about the effort required, similar to Onyema *et al*. (2023), who linked unstructured use to reduced efficiency.

The result of hypothesis one revealed a significant gender based difference in the perception of pre-service biology teachers on mobile technologies. This is similar to the findings of Oladapo *et al*. (2024) who reported a significant gender difference in the perception of teachers towards using mobile technologies in secondary schools in Oyo state, Nigeria. However, Gambari *et al*. (2024) reported that there is no significant difference between male and female perceptions towards mobile phone usage in public school in Abuja meaning that both gender perceived the usage of mobile technologies in the same way. Olalude (2025) also reported similar findings as they reported no significant difference in the perception of teachers towards mobile technologies. The finding that male pre-service biology teachers showed higher perception of mobile technologies is consistent with Aliyu and Abdullahi (2020) and Aina (2025) who reported significant gender gaps in mobile technology use favoring males. However, Udeani and Akhigbe (2020) and (Sakulphon *et al*., 2015) reported no gender difference, indicating that socio-cultural context, not inherent ability, largely explains variations.

The result of hypothesis two revealed no significant gender based difference in the utilization of mobile technologies by pre-service biology teachers. This aligns with Aliyu and Abdullahi (2020) who reported that male pre-service teachers used smartphones more for academic tasks, while females leaned towards reading and downloading e-books. Also, supporting our findings are evidences from Abdulazeez *et al*. (2024); Abdulrahman and Soetan, (2018) and Oyewole *et al*. (2022) which found no significant gender difference in mobile technology use. These suggest that gender differences may be context-dependent, influenced by socio-cultural norms, institutional exposure, and individual preferences rather than inherent disparities. Furthermore no significant gender differences in utilisation were found, indicating similar engagement across sexes despite perceptual variations. Our findings contrasts with Aliyu and Abdullahi (2020), who found gender-based differences.

6. Conclusion

The study revealed that mobile phones were the most prevalent device among pre-service biology teachers reflecting affordability and accessibility, while laptops, tablets and digital cameras were rarely used. Findings further showed that pre-service teachers held a high perception and utilisation of mobile technologies, particularly for academic enrichment, research and collaborative learning. Gender differences were significant in perception, with males showing higher scores, but not in utilisation, suggesting equal engagement in practice. The study further highlights the central role of mobile technologies in supporting teaching and learning, while also emphasizing cost as a barrier to broader adoption.

7. Recommendations

1. **Continuous Professional Development of Biology Teachers:** Continual professional development programs for teachers should be offered periodically, equipping biology teacher educators with up-to-date information and skills on the pedagogical use of mobile technologies, and providing biology teachers with practical skills. These programs should aim to integrate mobile applications, virtual laboratories, digital assessment tools, and platforms that support collaborative learning into biology instruction. Implementing agencies include the Federal Ministry of Education, State Ministries of Education, Teachers Registration Council of Nigeria (TRCN), National Teachers' Institute (NTI), universities, colleges of education, and professional associations.

2. **Integration of Mobile Technology into Biology Teacher Education:** Mobile technology skills must be explicitly integrated into the biology teacher education programs at teacher education institutions. Practical courses should equip pre-service biology teachers with insights into using mobile devices for lesson planning, classroom teaching, assessment, fieldwork, scientific inquiry, and collaborative learning. This approach will ensure that graduates possess the 21st-century digital pedagogical skills required for effective biology teaching. Implementing bodies include the National Universities Commission (NUC), the National Commission for Colleges of Education (NCCE), university senates, faculties of education, biology education departments, and curriculum developers.

3. **Institutional Support from School Administrators:** School administrators should create a conducive learning and teaching environment that promotes the effective use of mobile technologies in biology. This includes providing reliable internet access, technical support services, flexible institutional policies, incentives for technology integration, and regular monitoring of digital teaching practices. Implementing bodies include Vice Chancellors, Provosts, Deans of Faculties of Education, Heads of Departments, school principals, and the ICT directorates within institutions.

4. **Development of Digital Biology Resources:** The production of high quality, curriculum-aligned, and easily accessible digital biology learning resources

such as mobile apps, virtual laboratory simulations, multimedia instructional materials, e-books, interactive quizzes, and offline learning packages should be prioritized and made readily available for pre-service biology teachers. These resources should be culturally relevant to Nigeria and tailored to the local learning context. The implementing bodies include the Nigerian Educational Research and Development Council (NERDC), universities, colleges of education, educational technology experts, biology educators, publishers, and educational software developers.

5. **Policy Formulation and Funding:** Governments should design and implement policies that promote the integration of mobile technologies into teacher training programs. They must also ensure adequate funding for technological infrastructure, internet access, the development of digital resources, teacher training, and the ongoing maintenance of these facilities. Effective funding models are essential to support the successful integration of technology. Implementing bodies include the National Assembly, the Tertiary Education Trust Fund (TETFund), the National Universities Commission (NUC), the National Council for Curriculum and Examinations (NCCE), institutional governing councils, State Ministries of Education, and the Federal Ministry of Education.

6. **Collaboration and Partnerships with technology Companies:** Schools need to coordinate technology purchases with technology firms and telecommunications companies to increase access to affordable cell phones, distance learning software, internet access, cloud-based learning platforms, and technical support. Such collaboration can also help pre-service biology teachers build their capacity through workshops, internships, and innovation projects. Implementing bodies include universities and colleges of education, technology companies, telecommunications providers, non-governmental organizations (NGOs), development partners, and private-sector organizations.

7. **Awareness Promotion of Positive Biology Teachers Perceptions:** Regular awareness campaigns, seminars, conferences, and workshops should be organized to foster a positive attitude among pre-service biology teachers and teacher educators toward using mobile technologies as educational tools. Successful experiences, empirical evidence, and best practices should be shared to minimize resistance to technology adoption and to promote its effective use. Implementing entities include universities, colleges of education, biology education departments, professional associations, educational NGOs, and educational technology organizations.

8. **Access to Mobile Devices in Educational Institutions to Support Technology-Enhanced Instruction:** To enhance the mobility and utilization of mobile devices and the associated digital infrastructure, educational institutions should establish mobile learning laboratories, implement mobile device loan programs, offer subsidized acquisition schemes, develop mobile device infrastructure that provides Wi-Fi on campus, and create digital innovation centers. These initiatives will enable pre-service biology teachers to gain firsthand experience using technology-enhanced teaching methods and improve their digital competencies before their initial classroom teaching experience. Implementing agencies include the Federal and State Governments, TETFund, universities, colleges of education, institutional ICT units, donor agencies, corporate organizations, and alumni associations.

References

Abdulazeez, B.T.A., Bolaji, H.O., & Bello, A.Z. (2024). Pre-service biology teachers' pedagogical skills and usability of mobile technology for instructional delivery during teaching practice. *Journal of Environmental and Science Education, 4*(1), 12-19.

Abdulrahman, M.R., & Soetan, A.K. (2018). Lecturers' perceived ease of use of mobile devices for teaching undergraduates Kwara state, Nigeria. *International Journal for Innovative Technology Integration in Education, 2*(1), 1-14.

Adetona, B.O. (2025). The future of digital learning: Post-pandemic EdTech adoption in Nigeria and globally. *International Journal of Modern Science and Research Technology*, *3*(7), 211.

Adewumi, O., Asino, T., Kushimo, O., & Audu, C. (2024). Exploring the effectiveness of immersive mobile learning in enhancing stem subjects. *International Journal for Educational Media and Technology*, *18*(2).

Adewumi, O.E. (2024). *Immersive technologies: Exploring the effectiveness of immersive mobile learning in enhancing STEM subjects* (Doctoral dissertation, Oklahoma State University).

Adewumi, O.E., Asino, T.I., & Jha, K. (2023). Preparedness of pre-service and in-service teachers' towards the use of mobile devices in Nigeria. *International Journal of Education and Development using Information and Communication Technology*, *19*(1), 102-114.

Adeyele, V.O., & Ogegbo, A.A. (2024). "Investigating students' perspectives and attitudes towards mobile learning at a Nigerian university". In: *Proceedings of the International Conference on Education and New Developments (END 2024)* (pp. 90–98). IADIS Press. https://doi.org/10.36315/2024v2end090

Agah, TK., & Husniye, B. (2018). Investigation of postgraduate students' attitudes towards mobile learning and opinions in mobile learning. *International Technology and Education Journal, 2*(1), 21-32.

Ahmad, H. (2015). Gender differences in students' utilisation of electronic information resources in Ramat library, University of Maiduguri,

Nigeria. *Journal of Social Science and Community Resources Implementation, 2*(5), 6-26.

Ahmad, S. I., Abubakar, B. B., & Yau, S. (2018). Biology education a panacea for sustainable national development. *Frontiers in Environmental Microbiology, 4*(2), 71-74.

Ahmad, Z.W., & Omaid, M.E. (2020). The use of smartphones as an educational tool in the classroom: Lecturers' perceptions. *International Journal of Emerging Technologies in Learning (Online), 15*(16), 238.

Aina, J.K. (2025). Mobile phone usage in higher education among pre-service teachers in Nigeria: A qualitative study. *Advances in Mobile Learning Educational Research, 5*(1), 1331-1343.

Akhigbe, J.N., Ogbonnaya, U. N., & Owolabi, J.O. (2021). Nigerian pre-service teachers' perceptions of collaborative mobile learning with Google Classroom: A pedagogical alternative in the era of COVID-19 pandemic. *Nigerian Online Journal of Educational Sciences and Technology*, *3*(1), 55-65.

Aliyu, A.M., & Abdullahi, Y. (2020). Gender and academic utilisation of smartphone among pre-service teachers in Nigeria. *ATBU Journal of Science, Technology and Education*, *8*(4), 295-306.

Anohah, E., Oyelere, S. S., & Suhonen, J. (2017). Trends of mobile learning in computing education from 2006 to 2014. *International Journal of Mobile and Blended Learning*, *9*(1), 16-33.

Edeh, M. O., Udeze O. A., & Edeh, C. D. (2019). Potentials of mobile technologies in enhancing the effectiveness of inquiry-based learning approach. *International Journal of Education (IJE), 2*(1), 1-25.

Edeh M.O., Ugboaja, S.G., Ugwuja, N.E., Igwe, J.S., Daniel, I.E., & Richard-Nnabu, N.E. (2022b). Smartphone usage among computer science students in higher education during COVID-19 Lockdown. *Journal of Computer Science and its Application (Nigeria Computer Society), 29*(2), 20-26.

Edeh, M.O., Edeh, C.D., Ugboaja, S.G., Ezemoyih, C.M., Madubuezi, C.O., & Nneka, E.R. (2023). Utility and perception of mobile technology among law students in Enugu, Nigeria. *Babcock University Journal of Education (BUJED), 9*(3), 56-71.

Edeh, M.O., Nwafor, C.E., Nnaji, A.D., Fyneface, G.A., Obiekwe, C.P., & Omachi, D. (2020). The impact of inquiry-based teaching approach on computer science learning. *EBSU Science Journal*, *1*(1), 61–70.

Edeh, M.O., Ugorji, C.C., Nduanya, U.I., Onyewuchi, C., Ohwo, S.O., & Ikedilo, O.E. (2022). Prospects and limitations of machine learning in computer science education. *Benin Journal of Educational Studies, 27*(1), 48–62.

Errabo, D.D., & Ongoco, A.A. (2024). Effects of interactive-mobile learning modules in students' engagement and understanding in genetics. *Journal of Research in Innovative Teaching & Learning*, *17*(2), 327-351.

Falade, A.A., Aladesusi, G.A., & Ogunlade, O.O. (2021). Perceptions on the utilisation of mobile technologies for learning among postgraduate students. *Indonesian Research Journal in Education, 5*(1), 159-174.

Gambari, A.I., Mudi, M.S., Sobowale, F.M., & Thomas, G. (2024). Teachers' perception of integrating the use of mobile phones into teaching in public senior secondary schools in Federal Capital Territory, Abuja. *Bichi Journal of Technology Education*, *7*(2), 1-12.

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology*, *50*(5), 2572-2593.

Hussin, A. A. (2018). Education 4.0 made simple: Ideas for teaching. *International Journal of Education and Literacy Studies, 6*(3), 92.

Iqbal, S., Khan, M.N., & Malik, I.R. (2017). Mobile phone usage and students' perception towards M-learning: A cause of undergraduate students in Pakistan. *International Journal of E-learning and Distance Education*, *32*(1), 1-16.

Ishengoma, F., Ngeze, L., & Ndibalema, P. (2024). Augmented reality applications in STEM education: A review. *International Journal of Open Information Technologies*, *12*(11), 48-57.

International Telecommunication Union (ITU) (2023). *Broadband subscriptions continue to grow strongly*. Available online via: https://www.itu.int/itu-d/reports/statistics/2023/10/10/ff23-subscriptions/

Maishanu, S.Z., Abdulkadir, U., & Zanna, T. (2024). Lecturers' perception of mobile device use in teaching and learning at Shehu Shagari College of Education, Sokoto. *International Journal of Innovative Information Systems and Technology Research, 12*(4), 32-41.

Maria, J.F., Fernando, M., Carla, S.P., & Natercia, D. (2015). "The role of mobile technologies in the teaching/learning process improvement in Portugal". *Proceedings of ICERI2015 Conference 16th-18th November 2015, Seville, Spain*.

Masadeh, T.S.Y. (2021). Smartphone use in learning as perceived by university undergraduates: Benefits and barriers. *International Journal of Research-granthaalayah, 9*(3), 56-65.

Oladapo, G.W., Ogunlade, O.O., & Onasanya, S.A. (2024). Teachers' perception towards using mobile technologies in secondary schools in Oyo State. *Palgo Journal of Education Research*, *9*(1), 1-8.

Oladosu, K.K., Adedokun-Shittu, N.A., Ajani, A.H.,

Nuhu, K.M., Abdullateef, B.E., & Alasan, N.J. (2021). Perception and Utilisation of mobile Information and Communication Technology for learning in secondary schools in Ekiti State, Nigeria. *Journal of Capital Development in Behavioural Sciences*, *9*(1), 45-63.

Olajide, A.A. (2024). Acceptance, adoption, and use of mobile learning technologies among students in Nigerian universities. *International Journal of Mobile Learning and Organization*, *18*(1), 1–16.

Olalude O. (2025). Pre-service teachers' insights into the integration of mobile devices as instructional aids in higher institution. *Journal of Institutional Research, Big Data Analytics and Innovation*, *1*(3), 269-78.

Onyema, E.M., Khan, R., Eucheria, N.C., & Kumar, T. (2023). Impact of mobile technology and use of big data in physics education during coronavirus lockdown. *Big Data Mining and Analytic (IEEE)*, *6*(3), 381–389.

Oyewole, A.S., Toriola, A.K., Adebayo, A.A., Shabi, S.O., & Edith, I.O. (2022). The adoption of mobile technology for learning in public universities in Ogun State, Nigeria. Al-Hijr: *Journal of Adulearn World*, *1*(4), 229-245.

Sakulphon, M., Srisawasdi, N., & Wangsomnuk, P. (2015). "Examining relationship between biology attitudes and perceptions toward mobile augmented reality of photosynthesis and impact on gender difference". In: *International Conference on Computers in Education*.

Sharma, R., & Madhusudhan, M. (2017). Use of mobile devices by library and information science students in central universities of Uttar Pradesh. *DESIDOC Journal of Library & Information Technology*, *37*(4), 287-296.

Swamy, R.K. (2020). Mobiles have changed the way we communicate. *International Journal of English Research*, *6*(6), 40-43.

Teplá, M., Teplý, P., & Šmejkal, P. (2022). Influence of 3D models and animations on students in natural subjects. *International Journal of STEM Education*, *9*(1), 65.

Thakre, S.S., & Thakre, S.B. (2015). Perception of medical students for utility of mobile technology use in medical education. *International Journal of Medicine and Public Health*, *5*, 305-11.

Thiraput, P. (2013). Smartphones in the workplace: Changing organizational behavior, transforming the future. *Journal of Trans-disciplinary Writing and Research*, *3*(1), 1-10.

Udeani, U., & Akhigbe, J.N. (2020). In-service biology teachers' perceptions and pedagogical rating of two mobile learning applications recommended for learning biology in Nigerian secondary schools. *The African Journal of Information Systems*, *12*(1), 5.

Uwakwe, B.O. (2021). *Perception and acceptance of digital technology for instruction among university pre-service biology teachers in Niger State* (Doctoral dissertation).

Venkatesh, V., & Davis, F.D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204.

Venkatesh, V. Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425-478.

Weerakkody, V., Irani, Z., Kapoor, K., Sivarajah, U., & Dwivedi, Y. K. (2017). Open data and its usability: An empirical view from citizen's perspective. *Information Systems Frontiers*, *19*(2), 285-300.