AJSTME, Volume. 12, Issue 2. 332-342, March, 2026. https://www.ajstme.com.ng
ISSN: 2251-0141 (Print), 2971-6233 (Online)

Perspectives of the Nigerian University Undergraduates on Technology Adoption in Science, Technology, Engineering and Mathematics Education

Christian Sunday Ugwuanyi
Faculty of Education, University of the Free State, South Africa
ugwuanyics@ufs.ac.za

Abstract

This study examined Nigerian university students' perspectives on technology adoption in Science, Technology, Engineering, and Mathematics (STEM) education using the Unified Theory of Acceptance and Use of Technology (UTAUT) as its theoretical foundation. A cross-sectional survey design was employed, involving 90 undergraduate students purposively selected from STEM-related disciplines in Nigerian universities. Data were collected through an adapted and validated Technology Adoption for Teaching and Learning Questionnaire administered via Google Forms. The instrument demonstrated high internal consistency reliability across its dimensions. Descriptive and inferential statistical analyses were conducted using SPSS version 25. The findings revealed that students generally held positive perceptions regarding the adoption of technology in STEM education and reported favourable experiences with online teaching and learning. Students also rated the quality of technology-supported learning positively. While no statistically significant gender differences were observed in students' perceptions of technology adoption, significant differences emerged across age groups. Despite these positive perceptions, participants reported challenges related to limited experience with online assessment tools such as Google Forms, inadequate institutional internet data provision, insufficient technical support, and an unreliable power supply. The study concludes that technology has substantial potential to enhance STEM education in Nigerian universities when supported by appropriate infrastructure and institutional resources. It is therefore recommended that government agencies and university administrators invest in sustainable ICT infrastructure, internet accessibility, technical support services, and capacity-building initiatives to promote effective technology integration in STEM education.

Keywords: STEM, Perception, Technology, University

Introduction

Science, Technology, Engineering, and Mathematics (STEM) education has become increasingly important in the twenty-first century because of its contribution to technological innovation, economic competitiveness, and sustainable development. By fostering critical thinking, problem-solving, creativity, and analytical reasoning, STEM education equips learners with the competencies required to address contemporary societal and global challenges (Samuel & Salisu, 2025). In Nigeria, the advancement of STEM education has emerged as a strategic priority, particularly amid rapid technological transformation and the growing demands of a knowledge-based economy. Technological innovations and globalisation have significantly reshaped educational systems worldwide, compelling institutions to adopt more flexible and technology-driven approaches to teaching and learning (Chukwuemeka et al., 2025). Consequently, the transition from traditional instructional practices to digitally supported learning environments has become both necessary and inevitable. However, the process remains accompanied by numerous infrastructural and pedagogical challenges in Nigeria (Chukwuemeka et al., 2025).

The increasing prominence of Information and Communication Technology (ICT) has further intensified efforts to improve instructional practices across STEM disciplines, particularly in engineering and science-related fields (Oloyede et al., 2017). Recognising the transformative potential of technology in education, the Nigerian government has introduced several policy initiatives to promote technological integration in the educational sector. Notably, policy frameworks such as the National Science, Technology, and Innovation Roadmap (NSTIR) and the National Science, Technology, and Innovation Policy (NSTIP) emphasise the incorporation of emerging technologies into teaching and learning processes to strengthen national competitiveness and innovation capacity (Onanuga & Saka, 2025).

Despite these policy efforts, educational practices in many Nigerian institutions continue to reflect traditional instructional approaches that have changed only marginally over the past several decades. Concerns to enhance learning outcomes (Ndiku & Kaluyu, 2020). Traditional teacher-centred methods, which often position students as passive recipients of knowledge, have increasingly been criticised for their inability to develop the higher-order cognitive skills demanded by contemporary society. As a result, educational stakeholders are exploring ways of integrating advanced digital technologies, including Artificial Intelligence (AI), into higher education curricula to prepare learners for participation in an increasingly technology-driven world (Olatunde-Aiyedun, 2024). This evolving educational landscape has also necessitated reforms in STEM teacher preparation programmes to ensure that educators possess the competencies required to effectively utilise digital technologies in teaching and learning (Abah et al., 2024).

Recent technological developments have introduced a wide range of digital tools into educational practice, including learning management systems, virtual learning environments, augmented reality applications, smart boards, mobile technologies, and other interactive learning platforms (Sosa et al., 2018). These innovations have transformed educational delivery by extending learning beyond the traditional classroom and facilitating blended, online, and hybrid modes of instruction. Consequently, the role of teachers has evolved from that of primary knowledge transmitters to facilitators of learning who design and support engaging, learner-centred educational experiences (Oladele et al., 2021). Technology-enhanced learning environments have not only improved access to educational resources but have also expanded opportunities for collaboration, communication, and personalised learning. Furthermore, the Fourth Industrial Revolution (4IR) has accelerated the adoption of digital technologies in education, reinforcing the need for innovative instructional approaches that align with emerging societal and workforce demands (Oladele, 2024).

Within STEM education, technological innovations such as virtual laboratories have created new opportunities for experiential and inquiry-based learning. Virtual laboratories enable students to engage in simulations and practical activities that may otherwise be constrained by limited physical resources, thereby supporting deeper conceptual understanding and problem-solving skills (Ndunagu et al., 2023). Such developments underscore the potential of technology to transform STEM education and enhance learning effectiveness. Despite the growing integration of digital technologies in higher education, empirical evidence on university students' perceptions and acceptance of technology in STEM education remains limited in the Nigerian context. Understanding students' perspectives is particularly important because successful technology integration depends not only on institutional investments but also on users' willingness to adopt and utilise technological innovations. Guided by the Unified Theory of Acceptance and Use of Technology (UTAUT), this study therefore investigates Nigerian university students' perspectives on technology adoption in STEM education. It examines the factors that influence their acceptance and use of educational technologies.

Theoretical Framework

This study is grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Viswanath Venkatesh and colleagues in 2003. UTAUT is one of the most influential theoretical models for explaining individuals' acceptance and use of information technologies. The framework was designed to provide a comprehensive understanding of the factors that influence technology adoption and actual usage behaviour across different contexts. According to the model, technology acceptance is determined by four core constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy refers to the degree to which an individual believes that using a technology will improve task performance, while effort expectancy concerns the perceived ease of using the technology. Social influence reflects the extent to which significant others affect an individual's decision to adopt a technology does not. In contrast, facilitating conditions refer to the availability of organisational and technical resources that support the use of technology.

Within the UTAUT framework, performance expectancy, effort expectancy, and social influence directly influence behavioural intention to use a technology, while facilitating conditions directly affect actual technology use. The model further recognises that the effects of these determinants vary according to individual and contextual characteristics. Specifically, gender, age, experience, and voluntariness of use are proposed as moderating variables that shape the strength of the relationships among the core constructs and technology adoption behaviour. By integrating concepts from eight prominent technology acceptance theories, UTAUT provides a more comprehensive explanatory framework than many preceding models. Empirical validation of the theory demonstrated that it explains approximately 70% of the variance in behavioural intention and about 50% of the variance in actual technology use, indicating substantial predictive power (Venkatesh et al., 2003). Given its strong explanatory capacity, UTAUT provides an appropriate theoretical lens for examining university students' perspectives on technology adoption in STEM education.

The applicability of UTAUT has been extensively demonstrated across educational, organisational, and technological contexts. For instance, Koivumäki et al. (2007) employed the framework to investigate users' perceptions of mobile services in Finland and found that technological competence and familiarity significantly influenced adoption decisions. Similarly, Eckhardt et al. (2009) applied UTAUT in German organisations and reported that workplace social influences, particularly from supervisors and colleagues, played a significant role in shaping employees' intentions. These findings underscore the importance of both individual capabilities and social environments in influencing technology acceptance.

Further evidence of the model's utility was provided by Curtis et al. (2010), who examined social media adoption among nonprofit organisations in the United States. Their findings revealed that organisational structures and demographic characteristics significantly influenced technology adoption behaviours. Gender-related differences were also observed, with female participants reporting . In contrast,using technology. Likewise, Verhoeven et al. (2010) utilised UTAUT to investigate computer use among first-year university students in Belgium. They found that the framework effectively explained variations in ICT competencies and usage patterns across educational levels.

More recent studies have continued to affirm the robustness of the UTAUT model. Welch et al. (2020), for example, applied the framework to examine mobile learning adoption among museum professionals in England and confirmed its effectiveness in explaining the acceptance of mobile technologies for workplace learning. Furthermore, a comprehensive review by Michael D. Williams and colleagues (2015), synthesising findings from 174 UTAUT-based studies, concluded that the model remains one of the most reliable and widely applicable frameworks for understanding technology adoption across diverse settings. The review highlighted its consistent predictive validity and adaptability across educational, organisational, and technological environments.

The relevance of UTAUT to the present study lies in its ability to explain how university students perceive and adopt technological innovations in STEM education. Given that successful technology integration depends largely on users' perceptions of usefulness, ease of use, social support, and available resources, the framework provides a suitable basis for examining students' readiness, experiences, and attitudes toward technology-enhanced learning. Moreover, the inclusion of demographic moderators such as age and gender aligns closely with the objectives of this study, which seeks to determine whether students' perspectives on technology adoption differ across demographic groups. Consequently, UTAUT provides a robust theoretical foundation for understanding the factors shaping technology adoption among STEM students in Nigerian universities.

Review of Literature

The integration of Information and Communication Technology (ICT) into Science, Technology, Engineering, and Mathematics (STEM) education has become a strategic priority across many African countries. This emphasis stems from the recognition that digital competencies are essential for participation in the contemporary knowledge economy and for addressing the technological demands of the twenty-first century (Barakabitze et al., 2019). As educational systems increasingly seek to prepare learners for rapidly evolving technological environments, researchers have argued that improving STEM education requires not only the acquisition of ICT skills but also the adoption of learner-centred pedagogical approaches that promote active engagement, critical thinking, and problem-solving (Ndiku & Kaluyu, 2020). Consequently, innovation in STEM education has become central to educational reform efforts aimed at equipping students with competencies relevant to a digitally interconnected world (Abah et al., 2024).

The growing importance of ICT in STEM education is largely attributed to its capacity to enhance teaching effectiveness, improve learning outcomes, and prepare students for technology-oriented careers. Studies have shown that digital technologies foster innovation, strengthen technical competencies, and enhance students' ability to solve complex problems within STEM disciplines (Gbeleyi & Olusegun, 2023). Moreover, the increasing availability of internet connectivity and digital learning tools has transformed educational delivery by expanding access to information and creating opportunities for more interactive and flexible learning experiences. As a result, educational institutions are increasingly leveraging technology to promote meaningful learning and support the development of twenty-first-century skills.

Empirical evidence further demonstrates the positive contributions of specific digital platforms and emerging technologies to STEM education. For example, Google Classroom has been identified as an effective instructional platform that facilitates communication, resource sharing, and collaborative learning among university students (Oladele et al., 2021). Similarly, students have demonstrated a willingness to adopt innovative educational technologies, including immersive learning environments, Internet of Things (IoT) applications, and other digital tools associated with the Fourth Industrial Revolution (4IR) (Oladele, 2024). The integration of ICT into classroom instruction has also been found to increase student participation, improve access to learning resources, and promote active engagement with educational content (Barakabitze et al., 2019). More recently, the emergence of Artificial Intelligence (AI) has further expanded opportunities for innovation in education, creating new possibilities for personalised learning, intelligent tutoring systems, and data-driven instructional practices within STEM disciplines (Samuel & Salisu, 2025).

Within the Nigerian higher education context, the adoption of technology-enhanced learning has gained considerable momentum. Ndunagu et al. (2023) reported that several universities have implemented remote learning systems and Learning Management Systems (regardless of time or location. These digital learning environments have been shown to support learner engagement, facilitate instructional delivery, and generate valuable data for monitoring and improving learning outcomes. Likewise, the integration of ICT into teaching practices has been associated with improved digital literacy and enhanced learning experiences in STEM and STEAM education (Sidi et al., 2022). Recent scholarship has also emphasised the importance of incorporating AI-driven technologies into STEM education as a means of advancing scientific innovation and technological development in Nigeria (State et al., 2025).

Students' perceptions of technology adoption have generally been favourable across various educational contexts. Evidence from Sub-Saharan Africa indicates that students report positive experiences with online STEM learning environments and express willingness to engage with digital learning technologies (Oladele et al., 2023). Similar findings have been reported in other regions, where students demonstrated positive attitudes toward online learning and technology-mediated instruction (Forson & Vuopala, 2019; Kamaruzaman et al., 2021). However, positive attitudes alone may not guarantee effective learning outcomes. Ndlovu and Meyer (2019) argued that adequate preparation and support mechanisms are essential for meaningful participation in online learning environments. Similarly, Parkes et al. (2015) observed that while many students possess the basic technological competencies required for online learning, they often require additional support to develop higher-order cognitive and collaborative skills necessary for successful learning in digital environments.

Despite the documented benefits of technology integration, several challenges continue to impede the effective implementation of technology-enhanced STEM education. Research has shown that many STEM pre-service teachers possess limited competencies in emerging digital technologies, regardless of their educational backgrounds or admission pathways into teacher education programmes (Onanuga & Saka, 2025). Other barriers include inadequate technology-focused teacher training, insufficient technical support, weak collaborative learning structures, and unreliable internet connectivity, all of which constrain the successful adoption of digital technologies in African educational settings (Oladele et al., 2023). Furthermore, evidence suggests gender disparities in digital competence, with male pre-service teachers often reporting higher levels of technological proficiency than their female counterparts (Onanuga & Saka, 2025). However, findings regarding demographic influences on technology adoption remain inconsistent. For instance, Oladele et al. (2023) reported that variables such as age, discipline, and level of study did not significantly affect students' technology adoption during the COVID-19 pandemic, possibly due to the widespread availability of freely accessible online learning platforms.

The reviewed literature demonstrates that technology adoption has become a critical component of contemporary STEM education and that considerable research has examined its benefits, challenges, and determinants across diverse contexts. Nevertheless, empirical studies focusing specifically on Nigerian university students' perspectives toward technology adoption in STEM education remain limited. Most existing studies have focused on technology readiness, digital competence, or online learning experiences, with relatively little attention to students' overall perceptions and acceptance of technology in STEM disciplines. This gap in the literature underscores the need for further investigation. Accordingly, the present study seeks to examine university students' perspectives on technology adoption in STEM education and to determine whether these perspectives vary according to selected demographic characteristics.

Methods

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of the University of Nigeria. Before participation, informed consent was obtained electronically through the online survey platform. Participants were informed of the purpose of the study, assured of their voluntary participation, and advised of their right to withdraw at any stage without penalty. Furthermore, strict confidentiality and anonymity were maintained throughout the research process, and all responses were used solely for academic purposes.

Participants

The study involved 90 undergraduate students purposively selected from various universities across Nigeria. A purposive sampling technique was employed to ensure that only students enrolled in Science, Technology, Engineering, and Mathematics (STEM) disciplines participated in the study. This sampling approach was considered appropriate because the study specifically sought to examine STEM students' perspectives on technology adoption in higher education.

Instrumentation

Data were collected using an adapted version of the Technology Adoption for Teaching and Learning Questionnaire (TATLQ) developed by Oladele et al. (2023). The questionnaire consisted of two sections—section A elicited demographic information, including participants' gender, age, and academic department. Section B measured various dimensions of technology adoption in teaching and learning.

Section B comprised three clusters. Cluster A contained 14 items assessing students' readiness for technology adoption and reported an internal consistency reliability coefficient of α = .95. Cluster B consisted of 21 items measuring students' experiences with online teaching and learning and yielded a reliability coefficient of α = .95. Cluster C included 12 items that evaluated students' perceptions of the quality of online teaching and learning, with an internal consistency reliability coefficient of α = .99.

Although the instrument had previously been validated within the Nigerian educational context, it was revalidated and pilot-tested before the commencement of the present study to ensure its continued suitability. The pilot study produced reliability coefficients consistent with those reported by the original developers, confirming the instrument's validity and reliability for the current investigation.

Data Collection Procedure

Data collection was conducted through an online survey administered using Google Forms. The questionnaire was converted to an electronic format, and the survey link was distributed to participants via WhatsApp groups and other online communication platforms commonly used at their respective universities. The distribution process was facilitated by academic colleagues at various Nigerian universities who helped reach eligible STEM students. This approach enabled broad geographical coverage and enhanced accessibility for participants.

Data Analysis

The collected data were screened for completeness and accuracy before analysis. Responses with missing or incomplete information were carefully examined and appropriately addressed to ensure data quality. The cleaned dataset was subsequently analysed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise participants' demographic characteristics and responses to questionnaire items. Graphical representations, particularly bar charts, were employed to illustrate demographic distributions. To examine differences in students' perspectives on technology adoption across demographic groups, inferential statistical analyses were conducted. Independent-samples t-tests were used to determine gender-based differences, while one-way Analysis of Variance (ANOVA) was employed to assess differences across age groups. All statistical tests were performed at a 0.05 level of significance.

Results

Descriptive analysis of the demographic profiles of the students

Purposively selected STEM students from Nigerian Universities is presented below. It indicates that 40% of the respondents are male STEM students, while 60% are female STEM students. Besides, 22.2% of the respondents are below the age of 20 years, 63.3% are between 20 and 25 years, while 14.4% are above 25 years. Similarly, it shows that 8.9% of the respondents are from. In comparison, the Biology Department, 25.6% from the Chemistry Department, 2.2% from the Engineering Department, 13.3% from the Physics Department, 28.9% from Vocational and Technical Education, 17.8% from Mathematics Education, and 3.3% from other STEM Departments. Also, the Figure indicates that 95.6% of the respondents are from the Igbo tribe, 1.1% from the Hausa tribe, and 3.3% from the Yoruba tribe.

Table 1

Mean analysis of the STEM students on their readiness for online teaching and learning

Item Statement	Mean	Std. Deviation	Remark
1. Possession of personal computer	2.77	1.08	Agree
2. Having access to the internet supply	3.46	.58	Agree
3. Being able to an uninterrupted power supply	2.30	.81	Disagree
4. I can use online tools Google Collaborate, such as Google Collaborate	1.72	1.57	Disagree
5. Being able to participate in Zoom meetings	2.73	.78	Agree
6. Having a functional and accessible email address	3.56	.54	Agree
7. Being conversant in communication using email	2.89	.83	Agree
8. Being able to surf the internet for learning materials	3.18	.58	Agree
9. Possessing a variety of gadgets for adequate participation in online teaching and learning aside	2.48	.66	Disagree
10. Dedicating sufficient time to online teaching and learning participation	2.74	.73	Agree
11. Being prepared for the cost implications of data bundle for easy participation in online teaching and learning	2.57	.71	Agree
12. Being able to use chatbot and other facilities for different platforms	2.76	.71	Agree
13. Being able to use other learning platforms apart form from Zoom or Google meet.	2.67	.84	Agree
14. I perceive online learning as a good initiative	2.56	1.45	Agree
Overall Mean	**38.19**	**6.57**	**Agree**

Table 1 indicates that STEM students who participated in this study exhibited readiness to adopt technology in STEM education at Nigerian universities. However, it was found that STEM students are not ready in terms of access to an uninterrupted power supply, experience with Google collaboration tools, and having gadgets for effective participation in online teaching and learning other than computers. That notwithstanding, the overall mean score (M = 38.19, SD = 6.57) indicates that STEM students held positive perspectives on the adoption of technology in STEM education.

AJSTME, Volume. 12, Issue 2. 332-342, March, 2026. https://www.ajstme.com.ng
ISSN: 2251-0141 (Print), 2971-6233 (Online)

Table 2
Mean analysis of the STEM students on their experience with online teaching and learning

Item Statement	Mean	Std. Deviation	Remark
1. Being conversant in the use of WhatsApp	3.62	.51	Agree
2. Being skilled in the use of Google Forms for assessment purposes	2.43	1.49	Disagree
3. Being capable in the use of Google Docs for handing in assessments	2.83	.80	Agree
4. Provision of a data bundle for students to join online classes by school	2.13	.87	Disagree
5. Providing the data I use to join online classes	3.29	.74	Agree
6. Being able to use functions from different platforms during online class	2.66	.78	Agree
7. Being able to resolve internet issues while engaging in online classes	2.70	.73	Agree
8. Technical support is provided during online classes	2.47	.77	Disagree
9. During online classes, I have access to clear and legible presentations	2.69	.73	Agree
10. Having enough time to take note of important points during online classes	2.72	.72	Agree
11. During online classes, I have the opportunity to ask questions	2.89	.57	Agree
12. To aid my online learning process, I have access to lecture playbacks	2.85	.72	Agree
13. My learning process has been enhanced through the use of technology	2.73	.78	Agree
14. During online class, lecture information was effectively shared	3.03	.61	Agree
15. To get content to support learning, I was able to surf the internet	3.24	.56	Agree
16. Taking online assessments has been easy for me	3.00	.62	Agree
17. After the online assessment, I got feedback promptly	2.83	.64	Agree
18. I can access lecturer materials directly before and after classes	2.70	.70	Agree
19. Access to the lecturer's materials before the class was very easy for me	2.75	.64	Agree
20. During online learning, I enjoy educational and informative interactions and discussions with my fellow students	3.06	.61	Agree
21. My self-discipline to work independently improves during online teaching	3.06	.61	Agree
Overall Mean	**58.88**	**10.00**	**Agree**

Table 2 analysis shows that STEM students have an overall positive experiencethe overall positive experience of the STEM students with online teaching and learning was (*M* = 58.88, *SD* = 10.00). However, the results also showed that STEM students do not have a good experience using Google Forms for assessments, with the school providing the data they use to join classes and technical support during online classes.

Table 3
Mean analysis of the STEM students on their assessment of the quality of online teaching and learning

Item Statement	Mean	Std. Deviation	Remark
1. Maintaining timely lecture schedule	2.92	.75	Good
2. Enhancing access to online lecture slides	2.90	.83	Good
3. Making room for clear presentation of lecture materials	2.95	.79	Good
4. Improving learners' communication skills/ability	2.95	.83	Good
5. Ensuring adequate lesson contents coverage	2.99	.69	Good
6. Enabling adequate revision of lectures before the final examinations	2.92	.82	Good
7. Ensuring availability of online learning resources to support the class	2.93	.81	Good
8. Using suitable images and backgrounds to ensure engaging lecture presentations	2.92	.83	Good
9. Providing adequate feedbacks	2.95	.82	Good

10. Making sure that contents are communicated in simple and clear terms	3.03	.67	Good
11. Providing adequate support for achieving class tasks	3.02	.77	Good
12. Maintaining courteous classroom interaction	2.98	.77	Good
Overall Mean	**34.49**	**8.44**	Good

Table 3 indicates that the STEM students' assessment of the online teaching and learning is good with an overall mean of (*M* = 34.49, *SD* = 8.44).

Table 4

Mean analysis of the perspectives of STEM students on the adoption of technology based on gender and age

Gender	**n**	**Mean**	**Std. Deviation**	**df**	**t**	**p**
Male	36	135.44	18.17	88	1.388	.169
Female	54	128.96	23.76			
Age	**n**	**Mean**	**Std. Deviation**	**df**	**F**	**p**
Below 20 years	20	127.20	19.22			
20-25 years	57	136.12	18.28	2, 87	4.381	.015
Above 25 years	13	118.23	32.62			

Table 4 revealed that there is no significant difference in the mean scores with respect to the perspectives of male (*M* = 135.44, *SD* = 18.17) and female (*M* = 128.96, *SD* = 23.76) STEM students on the adoption of technology in universities, t (88) = 1.388, p = .169.

With respect to age, Table 4 revealed that there is a significant difference in the mean scores with respect to the perspective of STEM students of different age ranges, below 20 years ((*M* = 127.20, *SD* = 19.22), 20-25 years (*M* = 138.12, *SD* = 18.28) and above 25 years (*M* = 118.23, *SD* = 32.62) on the adoption of technology in universities, F (2, 87) = 4.381, p = .015. Thus, the null hypothesis was rejected ($p < .05$).

Table 5

Pairwise comparison test for the significant influence of age on perspectives of STEM students on technology adoption

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.
Below 20 years	20-25 years	-8.92	5.47	.269
	Above 25 years	8.97	7.49	.491
20-25 years	Below 20 years	8.92	5.47	.269
	Above 25 years	17.89*	6.46	.025
Above 25 years	Below 20 years	-8.97	7.49	.491
	20-25 years	-17.89*	6.46	.025

Table 5 revealed that the mean difference between STEM students who are within the age range of 20-25 years and above 25 years is the only pair that has significant p-value. This implies that the mean difference between STEM students aged 20-25 and those aged 25 and above contributed to the significant influence of age on STEM students' perspectives towards the adoption of technology in STEM education.

Discussion of Findings

This study was undertaken to address the limited empirical evidence regarding university students' perspectives on technology adoption in STEM education within the Nigerian context. The findings revealed that students generally hold positive perceptions toward the adoption of technology in STEM education. This positive disposition may be attributed to students' recognition of the educational benefits associated with technology-enhanced learning, including increased engagement, improved accessibility, personalized learning experiences, and enhanced preparation for participation in the digital economy. The positive perceptions reported by the participants further suggest that students view technology as an important tool for facilitating active learning, providing immediate feedback, and supporting the visualization of complex scientific and mathematical concepts through interactive and immersive learning environments.

The findings are consistent with previous studies that have emphasized the importance of integrating ICT into STEM education to improve learning outcomes and instructional effectiveness. For example, Ndiku and Kaluyu (2020) argued that learner-centred pedagogical approaches supported by digital technologies are essential for enhancing students' performance in STEM disciplines. Similarly, Abah et al. (2024) highlighted the need for continuous innovation in STEM education to respond to the demands of an increasingly interconnected and technology-driven society. The present findings also corroborate the work of Gbeleyi and Olusegun (2023), who reported that ICT contributes significantly to innovation, skills acquisition, and technical problem-solving among STEM learners. Likewise, the positive perceptions observed in this study align with evidence demonstrating the effectiveness of digital learning platforms such as Google Classroom in facilitating teaching and learning within higher education environments (Oladele et al., 2021).

Despite the generally favourable perceptions of technology adoption, the study identified several challenges that may hinder effective implementation. Specifically, students reported limited experience with the use of Google Forms for assessment purposes, inadequate institutional provision of internet data for online learning, and insufficient technical support during online classes. These findings suggest that although students are receptive to technology-enhanced learning, institutional and infrastructural limitations continue to constrain optimal utilization of digital tools in STEM education. Such challenges are consistent with previous studies that identified inadequate digital competencies, poor internet connectivity, insufficient technical expertise, and limited technology-focused training as major barriers to effective technology integration in African educational settings (Oladele et al., 2023; Onanuga & Saka, 2025). The findings therefore underscore the importance of strengthening institutional support systems and technological infrastructure to maximize the benefits of technology adoption in STEM education.

The study further revealed that students' perceptions of technology adoption did not differ significantly based on gender. This finding suggests that male and female students exhibit comparable levels of acceptance and readiness toward the use of technology in STEM learning. However, significant differences were observed across age groups, indicating that age may influence students' attitudes and experiences regarding technology adoption. The significant difference was particularly evident between students aged 20–25 years and those above 25 years. This outcome partially supports the propositions of the Unified Theory of Acceptance and Use of Technology (UTAUT), which identifies demographic characteristics such as age and gender as important moderating variables in technology adoption processes (Venkatesh et al., 2003). While the absence of gender differences contrasts with studies reporting gender disparities in digital competence (Onanuga & Saka, 2025), it aligns with findings suggesting that demographic influences on technology adoption may diminish in contexts where digital technologies have become widely accessible (Oladele et al., 2023). Overall, the findings provide empirical support for the UTAUT framework by demonstrating that users' perceptions of technology adoption are influenced by contextual and demographic factors. More importantly, the study contributes to the growing body of literature on technology-enhanced STEM education by providing evidence from Nigerian universities, where empirical investigations in this area remain relatively limited. The findings highlight both the opportunities and challenges associated with technology adoption and offer valuable insights for policymakers, educators, and institutional leaders seeking to strengthen STEM education through digital innovation.

Conclusion and Recommendations

The study concludes that university students generally possess positive perceptions toward the adoption of technology in STEM education. Participants acknowledged that technology enhances engagement, facilitates understanding of complex concepts, promotes self-directed learning, and supports collaboration among learners. Furthermore, students recognized the relevance of technological competencies for future employment and professional success in an increasingly digital world. These findings reinforce the critical role of technology as a catalyst for improving the quality and effectiveness of STEM education in higher education institutions.

Notwithstanding these positive perceptions, the study identified several barriers that may impede the successful implementation of technology-enhanced learning. These include inadequate ICT infrastructure, limited access to institutional internet support, insufficient technical assistance, and gaps in students' experience with certain digital learning tools. Addressing these challenges is essential for realizing the full potential of technology integration in STEM education.

Based on the findings, the study recommends that government agencies and university administrators prioritize investments in ICT infrastructure, including reliable internet connectivity, digital learning platforms, and technical support services. Universities should also provide regular training and capacity-building programmes aimed at improving students' and lecturers' competencies in the use of emerging educational technologies. Furthermore, STEM educators should be encouraged to integrate technology more effectively into instructional practices by adopting innovative pedagogical approaches that promote active learning, collaboration, and problem-solving. Such initiatives will contribute to the creation of inclusive, technology-rich learning environments capable of preparing students for the demands of the Fourth Industrial Revolution and the global knowledge economy.

References

Abah, J. A., Iji, C. O., & Chinaka, T. W. (2024). Preparing Pre-Service STEM Teachers in an Emerging Global Environment. *Discourse and Communication for Sustainable Education*, *15*(2), 62–78. https://doi.org/10.2478/dcse-2024-0016

Barakabitze, A. A., Lazaro, A. W., Ainea, N., Mkwizu, M. H., Maziku, H., Matofali, A. X., Iddi, A., & Sanga, C. (2019). *Transforming African Education Systems in Science , Technology , Engineering , and Mathematics (STEM) Using ICTs : Challenges and Opportunities*. *2019*. https://doi.org/10.1155/2019/6946809

Chukwuemeka, E. J., Dominic, S., Akanbi, K. R., & Aregbesola, B. G. (2025). Transforming from Traditional to Smart Education in Nigeria: Challenges and Opportunities for Learning. *Ilorin Journal of Education*, *46*(1), 48-62.

Curtis, L.; Edwards, C.; Fraser, K. L.; Gudelsky, S.; Holmquist, J.; Thornton, K.; & Sweetser, K. D. (2010). Adoption of social media for public relations by nonprofit organizations. *Public Relations Review*, ***36*** (1), *90*–92. *doi:10.1016/j.pubrev.2009.10.003. S2CID 154466947.*

Eckhardt, A.; Laumer, S.; & Weitzel, T. (2009). Who influences whom? Analyzing workplace referents' social influence on IT adoption and non-adoption. *Journal of Information Technology*, ***24*** (1), *11*–24*. doi:10.1057/jit.2008.31. S2CID 42420244.*

Gbeleyi, O. A., & Olusegun, O. P. (2023). *Teaching of STEM Subjects in Africa : Perspectives of Gender , Difficult Topics , School Ownership and Recommendation of CTCA*. *4*(1), 24–34.

Koivimäki, T.; Ristola, A.; & Kesti, M. (2007). The perceptions towards mobile services: An empirical analysis of the role of use facilitators. *Personal and Ubiquitous Computing*, ***12*** *(*1), *67–75. doi:10.1007/s00779-006-0128-x. S2CID 6089360.*

Menon, Devadas; Shilpa, K (November 2023). Chatting with ChatGPT: Analyzing the factors influencing users' intention to Use the Open AI's ChatGPT using the UTAUT model. *Heliyon*. ***9*** (11)e20962*. Bibcode:2023Heliy...920962M. doi:10.1016/j.heliyon.2023.e20962. ISSN 2405-8440. PMC 10623159. PMID 37928033.*

Ndiku, J. M., & Kaluyu, V. (2020). Learner perspective of pedagogy for improved performance in stem subjects: a literature review. *IOSR Journal of Research & Method in Education*, *10*(4), 15-27.

Ndunagu, J. N., Ukhurebor, K. E., & Adesina, A. (2023). Virtual Laboratories for STEM in Nigerian Higher Education: The National Open University of Nigeria Learners' Perspective. *CEUR Workshop Proceedings*, *3393*(Tell), 38–48.

Oloyede, A. A., Ajimotokan, H. A., & Faruk, N. (2017). Embracing the future of engineering education in Nigeria: teaching and learning challenges. *Nigerian Journal of*

Technology, *36*(4), 991-1001.

Oladele, J. I. (2024). *Technology Readiness and Implications for Higher Education in Universities in North-Central Nigeria*. *6*, 1–19. https://doi.org/10.38140/ijer-2024.vol6.39

Oladele, J. I., Ayanwale, M. A., & Ndlovu, M. (2023). *SCIENCE & TECHNOLOGY Technology Adoption for STEM Education in Higher Education : Students ' Experience from Selected Sub-Saharan African Countries*. *31*(1), 237–256.

Oladele, J. I., Koledafe, O. S., & Daramola, D. S. (2021). *Journal of Digital Learning and Education Prospects for Online Instructional Delivery Using Google Classrooms : Implications for Higher Education in Sub-Sahara Africa*. *01*(3), 92–108. https://doi.org/10.52562/jdle.v1i3.227

Olatunde-Aiyedun, T. G. (2024). Artificial intelligence (AI) in education: integration of AI into science education curriculum in Nigerian universities. *International Journal of Artificial Intelligence for Digital*, *1*(1).

Onanuga, P. A., & Saka, A. O. (2025). Emerging Digital Technologies: Building Competencies of STEM Pre-Service Teachers. *Journal of Teaching and Learning*, *19*(1), 155–169. https://doi.org/10.22329/jtl.v19i1.8810

Samuel, I. R., & Salisu, A. D. (2025). Shaping the Future of STEM Education in Nigeria through Artificial Intelligence. *Journal of African Innovation and Advanced Studies*.

Sidi, S. B., Gurjiya, A. U., & Umar, A. M. (2022). Challenges and Prospects of Teaching Science. *Technology*, *8*(1), 43–50. https://www.ajstme.com.ng

Sosa Neira, E., Salinas Ibáñez, J., & De Benito Crosetti, B. (2018). Factors that facilitate or limit the incorporation of emerging technologies in the classroom. International Online Journal of Education and Teaching (JET), 5(1), 38-59.

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. *doi:10.2307/30036540. JSTOR 30036540. S2CID 14435677.*

Venkatesh, V., Thong, J.Y.L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*. ***36*** (1), *157*–178. *doi:10.2307/41410412. ISSN 0276-7783. JSTOR 41410412.*

Verhoeven, J. C.; Heerwegh, D.; & De Wit, K. (2010). Information and communication technologies in the life of university freshmen: An analysis of change. *Computers & Education*, ***55*** (1), *53*–66. *doi:10.1016/j.compedu.2009.12.002.*

Welch, R., Alade, T., & Nichol, L. (2020). Using the unified theory of acceptance and use of technology (utaut) model to determine factors affecting mobile learning adoption in the workplace: a study of the science museum group. *International Journal on Computer Science and Information Systems*, ***15*** (1), *85*–98.