

Navigating the Digital Era: Nigerian Higher Education Student's Experiences with Technology Integration Through the TPACK Lens

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Abstract

This study examines the incorporation of technology in Nigerian higher education, focusing on the viewpoint of students and utilizing the Technological Pedagogical Content Knowledge (TPACK) framework. In the middle of the worldwide digital revolution, it is essential to comprehend students' encounters with technology in education in order to cultivate productive learning environments. This study utilizes qualitative methodologies, collecting data through interviews and surveys conducted with students from multiple colleges throughout Nigeria. The key findings indicate that students acknowledge the potential advantages of technology-enhanced learning. However, the integration of technology faces obstacles such as insufficient infrastructure, poor digital literacy, and inconsistent access, which hinder its effectiveness. Moreover, the study emphasizes the necessity of enhancing faculty development in TPACK to overcome disparities between technology, pedagogy, and content. The observations made emphasize the significance of a supporting environment that encompasses strong infrastructure, specialized training for educators, and legislation that advocate for fair and equal access to technology. These findings add to the discussion on educational technology in developing environments and offer practical suggestions for stakeholders who want to improve the quality of higher education by strategically integrating technology.

Keywords: Higher Education, Student Experiences, Technology Integration, TPACK

Introduction

The incorporation of technology in education has revolutionized teaching and learning methodologies on a global scale. The transition has been motivated by the capacity of technology to improve educational results, expand accessibility, and equip students for a digital future.

Technology integration in education varies widely on a global scale, with differences being impacted by factors such as economic development, infrastructure, and governmental regulations. Wealthy nations frequently take the lead in implementing sophisticated educational technology, such as digital classrooms, online learning platforms, and tools powered by artificial intelligence (AI). The COVID-19 epidemic expedited the integration of technology in education, emphasizing the necessity for robust and adaptable learning environments. According to, the pandemic has caused a significant and unprecedented change

towards online learning, highlighting the crucial role of digital preparedness in education institutions [1].

Some researchers have expressed their opinion on the efficacy of digital technology, stating that it can enhance customized learning by enabling the customization of education to meet the specific needs of individual students. For example, Pane et al. (2015) discovered that the utilization of technology to assist personalized learning approaches has demonstrated encouraging benefits in enhancing student achievements. Online libraries and digital resources provide learners a wide range of educational materials that go beyond the limitations of traditional textbooks. Utilizing interactive tools like gamification and virtual reality (VR) can enhance student engagement and motivation. According to, virtual reality (VR) training greatly improves students' learning experiences by offering immersive and engaging environments [2]. Despite the numerous benefits, there are still individuals

who believe that a digital gap exists. The persistent disparities in technology access pose a substantial obstacle, especially in economically disadvantaged nations. According to, the digital gap poses a significant obstacle to achieving fair and equal education, as numerous students do not have access to the required technology tools [3]. Efficient incorporation of technology necessitates thorough instruction for educators, a component that is frequently deficient. contends that the proficiency of teachers in utilizing technology is crucial for its effective incorporation in the classroom [4]. Many regions still have challenges in providing reliable internet connectivity and technology infrastructure, which are essential requirements.

Blended Learning, which combines online and face-to-face training, is a well-established and growing trend. It is gaining popularity due to its ability to provide flexibility and enhance the learning experience. According to Garrison and, blended learning has the capacity to revolutionize educational processes by combining the advantages of both online and traditional techniques [5]. The widespread adoption of smartphones has enabled the feasibility of mobile learning, particularly in areas where traditional educational resources are scarce. According to Traxler (2007), mobile learning is transforming the education field by offering widespread access to learning resources. These technologies are utilized to create adaptive learning systems that can offer customized educational experiences for pupils. state that AI-powered educational systems have the ability to customize learning experiences according to the specific needs and progress of each learner [6].

The incorporation of technology in education in Nigeria has been progressing. The Nigerian government has acknowledged the significance of technology in education and has implemented several initiatives to incorporate it into the educational system. The objective of policies like the National Policy on Information and Communication Technology (ICT) in Education is to encourage the integration of technology in educational institutions. The Nigerian education system aims to undergo a transformation through the strategic utilization of technology, as emphasized by the Federal Ministry of Education (2019) in their ICT policy. The current status of technology adoption across different levels of education is still in progress. Technology adoption in primary and secondary education is increasing, facilitated by efforts such as the provision of tablets and laptops to pupils. Nevertheless, the persisting obstacles include insufficient infrastructure and a shortage of teacher training. According to, the use of ICT in Nigerian secondary schools is growing, but its effectiveness is hindered by a lack of infrastructure and training [7]. Universities and colleges in the Higher Education sector are progressively embracing online learning platforms and digital resources. The utilization of Learning Management Systems (LMS) has become increasingly prevalent, especially in light of the COVID-19 pandemic. Oye et al. (2012) discovered that e-learning platforms at Nigerian tertiary institutions had enhanced educational accessibility, despite the presence of persistent obstacles.

Undoubtedly, E-learning platforms have significantly enhanced the accessibility of education, especially for students residing in distant locations, by expanding their access to it. Additionally, the incorporation of technology in education is aiding students in acquiring essential digital skills that are crucial for the con-

temporary job market. Despite the existence of these facts, it remains true that numerous schools and colleges continue to lack the essential infrastructure, including dependable internet and sufficient computer laboratories. Financial limitations hinder educational institutions from investing in and maintaining sophisticated technologies. Additionally, there is a substantial demand for professional development programs to provide teachers with the necessary skills to effectively incorporate technology into their teaching. According to Yusuf and Balogun (2011), the achievement of incorporating ICT into Nigerian education relies heavily on the preparedness and proficiency of teachers.

The Nigerian government has initiated various initiatives with the objective of augmenting ICT in education, including the Universal Service Provision Fund (USPF) which seeks to furnish ICT infrastructure in rural regions. The USPF (2020) states that the strategic management plan seeks to narrow the digital gap by enhancing ICT infrastructure in underserved areas. The collaborations of the government, corporate sector, and non-governmental groups are also contributing to the reduction of the technological gap in education. Akomolafe and Adesua (2016) argue that public-private partnerships play a vital role in supplying the essential resources and support for ICT efforts in education.

The incorporation of technology in education provides substantial advantages and prospects on a global scale, including in Nigeria. Despite significant obstacles, such as inadequate infrastructure and insufficient teacher training, continuous initiatives by governments and stakeholders are facilitating the adoption of technology in education in a more inclusive and efficient manner. In order to effectively harness the potential of technology in education, Nigeria must prioritize ongoing investment in infrastructure, training, and new solutions.

The TPACK framework, devised by Mishra and Koehler, is a comprehensive method for incorporating technology into education by amalgamating three fundamental types of knowledge: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). This framework emphasizes the intricate interaction between various areas of knowledge that are essential for effective education using technology. Technological Knowledge (TK) encompasses the comprehension of utilizing digital tools and technologies. Pedagogical Knowledge (PK) encompasses the strategies and techniques employed in the process of instruction and acquisition of knowledge. Content Knowledge (CK) refers to the complete understanding and expertise in the specific subject matter that is being taught. The TPACK paradigm highlights that simply having these forms of knowledge separately is inadequate; successful integration of instructional technology necessitates educators comprehending the intersections and interactions among TK, PK, and CK [8]. The TPACK framework assists educators in creating and executing learning experiences that are technologically proficient, pedagogically impactful, and aligned with the topic being taught by emphasizing the connections between these areas of knowledge. This comprehensive method guarantees that technology is utilized not alone for its intrinsic value, but in manners that amplify the effectiveness of teaching and learning procedures [9].

Integrating technology in higher education is crucial for improving learning outcomes. It enables customized learning ex-

periences, encourages active participation, and accommodates different learning preferences. Pane et al. (2015) discovered that technology-supported personalized learning had a substantial positive impact on student performance, indicating that technology has the ability to meet the unique learning requirements and speed of individuals. Research has demonstrated that the acquisition of knowledge and skills related to the integration of technology is crucial in adequately equipping students to meet the challenges of the modern digital era. Today, having digital literacy is an essential ability in an occupation. By incorporating technology into higher education, students not only become consumers of information but also develop proficiency in using digital tools and platforms. The preparedness is crucial for their forthcoming professional achievement [6]. Technology integration can mitigate educational disparities by granting access to superior educational resources and learning experiences, irrespective of geographical constraints. According to, online learning platforms, digital libraries, and virtual classrooms have the potential to connect and provide educational opportunities to disadvantaged communities [3]. The TPACK framework is very applicable for assessing technology integration due to its inclusive methodology that takes into account the intricate interaction between technology, pedagogy, and content knowledge. This guarantees that technology is assessed within the broader framework of its influence on instructional techniques and comprehension of subject matter [8]. The TPACK framework is an invaluable tool for directing professional development for educators. Institutions can provide focused training programs that boost teachers' capacity to effectively incorporate technology by identifying the precise knowledge areas where teachers want support. This comprehensive strategy guarantees that teachers possess not only technical proficiency, but also the necessary instructional techniques to utilize these technologies proficiently within their particular subject domains [9].

The TPACK framework enables educational institutions to gain a deeper understanding of how to effectively integrate technology in a manner that aligns with pedagogical principles and is relevant to the topic being taught. This alignment facilitates the identification of suitable technologies that improve the quality of learning and teaching, rather than just adopting technology without purpose [9]. The TPACK framework offers a strong theoretical basis for studying technology integration, aiding in the identification of optimal methods and areas that need enhancement. Policymakers might utilize findings from TPACK-based research to build well-informed policies that encourage the proficient utilization of technology in education [8].

Statement of the Problem

As Nigeria adapts to the digital age, higher education institutions are confronted with the crucial task of successfully incorporating technology into their teaching and learning methods. Despite the adoption of various initiatives and investments to improve technological infrastructure and digital literacy, the application of technology in Nigerian higher education remains inconsistent and often subpar. This inconsistency presents various challenges, such as restricted access and inequality, inadequate teacher readiness, underutilization of technological resources, pedagogical difficulties, and effects on student learning and engagement. This study seeks to investigate the issues mentioned by examining how Nigerian higher education students incorpo-

rate technology into their learning using the Technological Pedagogical Content Knowledge (TPACK) framework. The research aims to analyze the intersections of technological, pedagogical, and content knowledge in this specific environment. Its goal is to find obstacles, optimal methods, and potential for improved technology integration that can boost educational outcomes and minimize disparities.

Purpose of the Study

In order to learn about the perspectives of Nigerian college students on the use of technology and In order to evaluate how well the TPACK framework was implemented in these situations.

Research Questions

- 1). What are the perspectives of Nigerian students regarding the incorporation of technology in their education?
- 2) What is the perception of students regarding the efficacy of technology integration within the TPACK framework?

Literature Review

Technology Integration in Education: A Global Perspective

Technology integration in education has become a fundamental aspect of contemporary teaching and learning methods on a global scale. Technology is revolutionizing education in both developed and developing areas, by improving educational environments, enriching learning opportunities, and tackling diverse educational obstacles. This transition involves the utilization of digital tools, online resources, and novel teaching methods with the goal of improving the learning experience. This subsection delves into the worldwide viewpoint on the integration of technology in education, analyzing its advantages, difficulties, and the various strategies adopted by different nations.

Technology in education has various functions, including increasing student involvement and granting access to a vast amount of knowledge and resources. Classrooms worldwide have widely adopted digital resources such as interactive whiteboards, educational software, and online learning platforms. These technologies facilitate a range of educational activities, such as individualized learning, group projects, and ongoing assessments.

According to a report published by the United Nations Educational, Scientific and Cultural Organization (UNESCO), technology has the capacity to close educational disparities and provide equal educational opportunities for all, promoting inclusivity and fairness in education [3]. In distant and underprivileged places, mobile learning solutions and online courses offer access to high-quality education that would otherwise be inaccessible.

Benefits of Technology Integration

Personalized learning is a significant benefit of technology in education. Adaptive learning technologies provide the ability to customize instructional content in order to cater to the specific needs of each learner, enabling individualized instruction. A study conducted by the Bill & Melinda Gates Foundation discovered that the implementation of individualized learning methods, with the assistance of technology, resulted in enhanced academic achievements among students [10]. Adaptive learning systems utilize data analytics to customize educational content according to the specific needs, pace, and learning preferences of individual students. Adopting a customized strategy can result

in improved learning results and increased student involvement. Platforms such as Khan Academy and Coursera utilize algorithms to suggest customized learning routes according to students' advancement and achievements (Zhu et al., 2020).

Moreover, technology promotes collaboration and communication between students and professors. Online forums, social media, and collaborative software facilitate students' collaboration on projects, idea sharing, and real-time feedback. This cooperative setting equips pupils for the interconnected global society outside of the classroom. Technology enables educators by equipping them with cutting-edge tools and resources to enhance their instructional methods. Professional development programs that specifically target digital literacy and pedagogical abilities are designed to enable educators to seamlessly incorporate technology into their classrooms. Proficiency in technology enables instructors to effectively establish interactive and collaborative learning environments, as stated by the [11].

The advancement of technology has greatly enhanced the accessibility of education, especially in geographically isolated and underserved regions. The advent of online courses, virtual classrooms, and e-learning platforms has eliminated the limitations imposed by distance, enabling students to obtain high-quality education regardless of their location. The Global Education Monitoring Report (2019) by UNESCO highlights the vital role that technology may play in promoting educational fairness by reaching out to marginalized and disadvantaged communities.

Challenges and Considerations of Technology Integration in Education

Although there are many advantages, the integration of technology in education also poses several difficulties. An important concern is the digital gap, which refers to discrepancies in technology availability and internet connectivity that might worsen educational inequality. According to a research conducted by the International Telecommunication Union (ITU), around 50% of the global population continues to lack internet connectivity, which hampers the potential advantages of digital education [12]. Unequal distribution of digital gadgets and high-speed internet is particularly evident in low-income and rural regions. This discrepancy can worsen pre-existing educational disparities, since children lacking access to technology are at a disadvantage in comparison to their peers [13].

Furthermore, successful incorporation of technology necessitates significant allocation of resources towards infrastructure, teacher training, and continuous technical assistance. Teachers must possess the requisite competencies to proficiently integrate digital resources into their instructional methods. Sufficient infrastructure and money are essential for the successful integration of technology. Numerous educational institutions, particularly in emerging nations, suffer from a deficiency of essential facilities, such as dependable energy, internet access, and contemporary gadgets. Obtaining finance for technological initiatives might be difficult due to the need for significant initial investment and continuous maintenance expenses (Trucano, 2015).

The successful incorporation of technology relies on the proficiency and self-assurance of instructors in using digital technologies. Inadequate training and support for teachers can im-

pede the effective integration of technology in the classroom. Continuous professional development and technical assistance are crucial to ensure that teachers can proficiently incorporate technology and stay updated with advancing educational technologies [14].

Ensuring privacy and safeguarding data security are equally important considerations. The growing utilization of online platforms and digital tools prompts concerns regarding the safeguarding of student data and the ethical implementation of technology in education.

Global Initiatives and Approaches to Technology Integration

Global initiatives have prompted countries to develop diverse techniques for incorporating technology into their educational systems, taking into account their specific settings and priorities.

The objective of the OLPC program is to offer cost-effective computers to children in impoverished nations with the purpose of augmenting their scholastic prospects. Since it was established in 2005, OLPC has disseminated millions of computers globally, advancing digital literacy and enabling access to educational material [15].

Mobile Learning Week, organized by UNESCO, is a yearly gathering of global stakeholders to engage in discussions and advocate for cutting-edge mobile learning solutions. The event showcases exemplary instances of success and promotes cooperation in order to exploit the potential of mobile technology for the advancement of education [3].

The objective of India's Digital India initiative is to convert the nation into a society that is empowered by digital technology and a knowledge-based economy. The effort comprises various education-focused programs, including the National Digital Literacy Mission and the eBasta project, which offers digital textbooks to pupils [16].

European Schoolnet is a consortium consisting of 34 Ministries of Education from European countries. Its primary focus is on developing and implementing innovative methods and strategies for teaching and learning. European Schoolnet fosters the integration of technology in education, provides assistance in teacher training, and encourages the exchange of exemplary methods throughout Europe (European Schoolnet, 2020).

The United States has made significant investments in educational technology, including the implementation of the Connect-ED program, which seeks to improve digital learning in schools. The primary objective of this initiative is to offer expedient internet connectivity and digital equipment to both students and teachers (U.S. Department of Education, 2013).

Finland is renowned for its exceptional education system, which prioritizes the integration of technology to facilitate student-centered learning. Finnish schools include digital resources into their curricula, fostering the development of critical thinking, creativity, and problem-solving abilities (Sahlberg, 2015).

China has made notable progress in integrating technology into education, namely by leveraging AI and big data. The Chinese government is prioritizing "smart education" to create intelligent

learning environments that improve the efficiency of teaching and learning (Zhang & Lu, 2020).

In numerous African nations, the incorporation of technology in education is motivated by the need to enhance both access and quality. The eLearning Africa conference is an initiative that aims to encourage the utilization of Information and Communication Technology (ICT) to enhance education and training throughout the continent [17].

The integration of technology in education is a worldwide occurrence that has great potential for boosting learning experiences, increasing access to education, and empowering instructors. Despite ongoing obstacles such as the digital divide, infrastructure restrictions, and the need for sufficient teacher preparation, numerous global efforts showcase the beneficial effects of technology on education. Countries may fully utilize technology to revolutionize education and create optimal learning environments for all students by implementing comprehensive plans that take into account local circumstances and allocate the required resources.

Overview of Technology Integration in Education: The Context of Nigeria

The incorporation of technology into education has emerged as a prominent priority in Nigeria, motivated by the need to boost educational achievements, optimize teaching and learning methods, and narrow the gap in access to digital resources. Nigeria has made significant progress in incorporating technology into its educational system to improve learning results and tackle diverse difficulties. This section of the article offers a comprehensive analysis of the current state, advantages, difficulties, future possibilities, and efforts made to promote the use of technology in education specifically in Nigeria.

Nigeria, being the most populated country in Africa and having the greatest economy, has substantial obstacles in its educational domain, such as deficient infrastructure, limited financial resources, and a considerable disparity between rural and urban areas. Nevertheless, there has been a significant rise in endeavors to utilize technology in order to enhance the accessibility and quality of education. Internet connectivity and availability to digital devices have been steadily improving throughout the country. The National Broadband Plan and similar initiatives seek to enhance broadband infrastructure, which is essential for facilitating digital learning [8]. The Nigerian government has created policies to facilitate the incorporation of technology into the education system. The National Policy on Education prioritizes the utilization of Information and Communication Technology (ICT) to improve the effectiveness of teaching and learning methods (FRN, 2013). The National Digital Innovation and Entrepreneurship Policy seeks to create a favorable atmosphere for innovation and promote digital literacy [18]. Nigerian schools and colleges are implementing a range of digital learning platforms and tools. Platforms such as Edmodo, Google Classroom, and Khan Academy are utilized for the purpose of disseminating educational material, promoting cooperation among students, and evaluating their academic advancement.

Benefits of Technology Integration in Nigerian Education

The incorporation of technology in Nigerian education has numerous important benefits:

Enhanced accessibility to High-Quality Education: Technology facilitates the availability of educational resources and content that may not be easily accessible through conventional means. This is especially advantageous for students in distant and underprivileged regions to overcome geographical obstacles and have access to high-quality educational resources. Electronic learning platforms, internet-based courses, and mobile educational solutions facilitate broader access and inclusiveness [19].

Improved learning experiences and results: Digital technologies facilitate interactive and customized learning experiences, accommodating a wide range of learning styles and individual needs. Learning is enhanced by the use of digital technologies such as interactive whiteboards, educational software, and multimedia materials, as they increase engagement and interactivity. These tools facilitate various learning styles and aid in the visualization of intricate topics [20]. This can result in enhanced academic achievement and increased student involvement.

Teacher Professional Development: Technology enables teachers to engage in ongoing professional development through online training programs, webinars, and digital resources. By enhancing instructors' abilities and knowledge, they are able to provide more effective instruction (Yusuf & Balogun, 2011).

Personalized Learning: Adaptive learning systems have the ability to customize educational content in order to cater to the specific needs of each learner, hence enabling differentiated instruction. This methodology facilitates individualized learning trajectories and enhances student achievement (Egbokhare, 2020).

Initiatives and Strategies

The Nigerian government, in collaboration with multiple partners, has developed numerous efforts to foster the incorporation of technology in education:

1. The National Policy on Information and Communication Technology (ICT) in school provides a comprehensive plan for incorporating ICT into the school system. It emphasizes the need for infrastructure development, teacher training, and curriculum enhancement [21].
2. The Universal Basic Education Commission (UBEC) has implemented several initiatives to facilitate the incorporation of information and communication technology (ICT) in primary and secondary schools. These programs encompass the distribution of digital gadgets, access to internet connectivity, and provision of ICT training for teachers (UBEC, 2020).
3. Contributions from the business sector and NGOs: Numerous corporate organizations and non-governmental organizations (NGOs) have made significant contributions to the efforts of integrating technology. For instance, the "Opon Imo" project in Osun State implemented a scheme where children were given tablets that already included educational material [22].
4. The emergence of e-learning platforms, such as uLesson and Tuteria, has significantly transformed the availability of education in Nigeria. These platforms provide digital courses, tutorials, and customized learning opportunities to meet diverse educational requirements [23].

Challenges of Technology Integration

Notwithstanding the advancements achieved, there are some obstacles that impede the successful incorporation of technology in the Nigerian education system

- **Infrastructure deficiencies:** Numerous schools, particularly those located in remote regions, suffer from a lack of fundamental infrastructure, including electricity, internet connectivity, and digital equipment. The capacity to fully adopt technology-based learning is constrained [7].
- The digital divide refers to a notable inequality in technological access between urban and rural locations, as well as between pupils from affluent backgrounds and those who are less privileged. The digital divide worsens disparities in schooling [24].
- **Teacher Preparedness:** Numerous educators exhibit a deficiency in the essential competencies and self-assurance required to proficiently use technology into their instructional methodologies. Professional development programs frequently lack adequacy or accessibility [25].
- **Expense:** The exorbitant cost of digital devices, software, and internet services presents a significant obstacle to the widespread integration of technology in educational institutions. The situation is further complicated by budget constraints at both government and family levels [26].
- **Cultural Resistance:** Resistance to the adoption of new technology may arise from cultural values and a preference for old teaching techniques. To overcome this reluctance, it is necessary to conduct awareness campaigns and provide concrete evidence of the advantages of integrating technology [27].
- **Quality Assurance:** The task of ensuring the high standard of digital content and online courses continues to be a difficult endeavor. Standardized norms and evaluation procedures are necessary to uphold educational standards.

Future Prospects and Recommendations

In order to optimize the advantages of using technology into Nigerian education, various suggestions might be taken into account:

- **Infrastructure Investment:** Sustained allocation of resources towards broadband infrastructure and renewable energy solutions would enhance internet accessibility and dependability.
- **Teacher Training and Support:** Elaborate training programs should be created to provide teachers with the essential ICT skills and pedagogical understanding.
- **Collaborations between the public and private sectors:** The synergy between government, corporate sector, and non-profit groups can expedite the implementation of technology and the development of new ideas in the field of education.
- Localization of content is the process of developing and modifying digital information to correspond with the curricula and cultural settings of Nigeria. This will improve the relevance and efficacy of the content.
- **Monitoring and Evaluation:** Creating strong monitoring and evaluation systems to evaluate the influence of technology integration on educational outcomes and fairness in education.

The incorporation of technology in Nigerian education presents significant potential for enhancing accessibility, quality,

and fairness in education. Although progress has been made via different efforts and strategies, it is crucial to tackle obstacles like as inadequate infrastructure, the gap in digital access, and the need for better teacher training. Nigeria may optimize the potential of technology to revolutionize its educational system by allocating resources to infrastructure, implementing extensive teacher training programs, and promoting collaborations between the public and private sectors.

The TPACK framework

The TPACK (Technological Pedagogical Content Knowledge) framework is a methodology designed to assist educators in effectively incorporating technology into their teaching practices. The development of this notion, known as Pedagogical Content Knowledge (PCK), was carried out by Mishra and Koehler in 2006, building upon Shulman's original work in 1986. The TPACK framework delineates three fundamental types of knowledge (Content, Pedagogy, and Technology) and the points where they meet, which are crucial for successful integration of technology in teaching. Below is an elaborate elucidation of each constituent and its interconnections:

Technological knowledge (TK)

Technological knowledge encompasses the comprehension of how to effectively utilize technological tools and resources. This encompasses expertise in both hardware, such as laptops, tablets, and interactive whiteboards, as well as software, including educational apps, online resources, and other digital tools. For example, an educator proficient in operating a learning management system (LMS), creating multimedia presentations, and utilizing online collaborative tools.

Pedagogical Knowledge (PK)

Pedagogical Knowledge refers to the comprehension of instructional techniques and procedures. This encompasses tactics for managing the classroom, devising lesson plans, and using diverse instructional approaches. It is fundamentally the understanding of pedagogy. For instance, a proficient educator who possesses expertise in many instructional methodologies such as cooperative learning, inquiry-based instruction, and formative assessment procedures.

Content knowledge (CK)

Content Knowledge encompasses a deep comprehension of the specific subject matter that is intended to be taught. This encompasses the empirical data, abstract ideas, scientific principles, and systematic methods within a specific field of study. For example, a mathematics instructor with a profound comprehension of algebraic principles and expertise in solving problems.

Pedagogical Content Knowledge (PCK)

PCK refers to the convergence of Pedagogical Knowledge and Content Knowledge. It entails possessing the knowledge and skills to effectively instruct a certain subject in a manner that is comprehensible and captivating for students. This encompasses a comprehension of the factors that contribute to the ease or difficulty of learning particular subjects, as well as the ability to effectively deliver those subjects. An example would be a history educator who possesses the ability to convey historical events by means of storytelling and project-based learning,

so rendering them more approachable and captivating for students.

Technological Content Knowledge (TCK)

Refers to the understanding and expertise a person possesses in using technology to enhance their knowledge and understanding of specific content areas. TCK refers to the comprehension of how technology might generate novel representations and methodologies for comprehending certain subject matter. It entails understanding the utilization of technology for educational purposes and content representation. For instance, a science educator who employs simulations to illustrate intricate scientific phenomena or utilizes digital microscopes to boost visual comprehension.

Technological Pedagogical Knowledge (TPK)

Refers to the understanding and expertise that educators possess in integrating technology effectively into their teaching practices. TPK refers to the understanding of how the process of teaching and learning can be influenced by the specific use of certain technologies. It requires comprehending the educational advantages and limitations of different technology instruments. For instance, an instructor who possesses the ability to effectively utilize online discussion forums to cultivate student collaboration and enhance critical thinking skills, as well as the proficiency to employ instructional games to inspire and captivate students.

Technological, Pedagogical, and Content Knowledge (TPACK) refers to the integration of technology, pedagogy, and content knowledge in education. TPACK represents the convergence of three distinct knowledge domains: Technological, Pedagogical, and Content Knowledge. It signifies a profound comprehension of how to effectively utilize technology in teaching to improve student learning and involvement. Teachers that possess proficient Technological Pedagogical Content Knowledge (TPACK) are capable of creating and executing lessons that incorporate technology to increase learning, while effectively integrating subject matter expertise and successful teaching strategies. An illustration would be a literature instructor who employs a blend of digital storytelling tools, interactive discussion platforms, and content-specific multimedia materials to construct an engaging educational encounter centered on a novel.

The TPACK framework was created to assist educators in navigating the intricate interaction among technology, pedagogy, and content. The work of Mishra and Koehler (2006) highlights the importance of having a comprehensive understanding of the three domains and their intersections in order to effectively integrate technology in education. Technological Pedagogical Content Knowledge (TPACK) is a complete framework that delineates the knowledge educators require to proficiently incorporate technology into their teaching methodologies [8]. By comprehending and using the TPACK framework, educators can enhance their readiness to address the varied requirements of their students in a learning environment that is abundant in

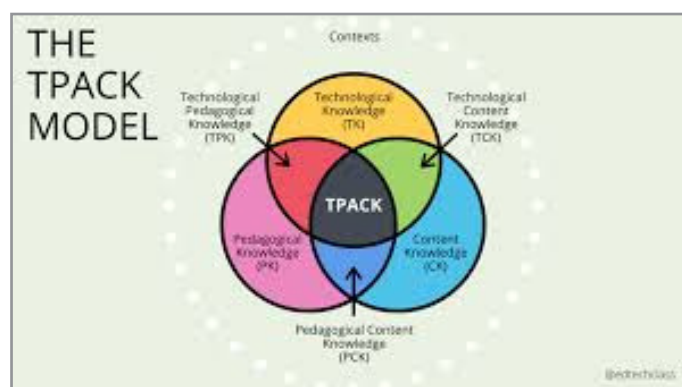


Figure 1:

technology. The picture below shows the interconnection in the TPACK framework.

The Importance and Application of TPACK in Educational Research

The Technological Pedagogical Content Knowledge (TPACK) framework has emerged as a crucial model in educational research for comprehending and enhancing the use of technology in teaching. The significance of this framework stems from its holistic integration of technology, pedagogy, and content, which is essential for the development of impactful teaching tactics in the digital era.

The importance of (TPACK) in educational research.

1. **Holistic Integration Framework:** The TPACK paradigm expands upon Shulman's (1986) idea of Pedagogical Con-

tent Knowledge (PCK) by include technology, thereby providing a comprehensive approach to integrating technology into education [8]. This complete paradigm facilitates researchers and educators in comprehending the intricate interplay among technology, pedagogy, and topic understanding.

2. **PACK** provides a fundamental framework for creating professional development programs for educators. These programs aim to assist instructors in acquiring the essential skills to effectively incorporate technology into their teaching methods by emphasizing the connections between content, pedagogy, and technology [9].
3. **Improving Instructional Design:** The TPACK framework facilitates the development of instructional materials that utilize technology to optimize learning outcomes. Researchers utilize the Technological Pedagogical subject

Knowledge (TPACK) framework to create and assess educational interventions that effectively combine technological tools, pedagogical tactics, and subject requirements [9].

4. **Encouraging Reflective Practice:** TPACK invites educators to contemplate their teaching methods by considering how technology may be incorporated to enhance pedagogy and content. Engaging in reflective practice is crucial for ongoing enhancement and adjustment to emerging technology breakthroughs (Niess, 2011).

Application of (TPACK) in Educational Research

- Curriculum Development: Researchers utilize the Technological Pedagogical Content Knowledge (TPACK) framework to guide curriculum development, ensuring that the integration of technology is in line with educational objectives and standards. By integrating TPACK, curriculum designers can develop unified and all-encompassing educational experiences that leverage technology to improve learning [28].
- TPACK is implemented in teacher education programs to provide prospective educators with the necessary skills to meet the technology requirements of contemporary classrooms. By incorporating TPACK into the curriculum, these programs can provide teacher candidates with the necessary abilities to seamlessly integrate technology into their teaching practices [29].
- Researchers employ the TPACK framework to assess the efficacy of technology integration in educational environments. This assessment assists in identifying optimal methodologies and areas requiring refinement, so adding to the general improvement of pedagogical and educational processes [30].
- The development of assessment tools is guided by TPACK, which evaluates instructors' technological, pedagogical, and subject expertise. These instruments offer significant data for study and assist in directing professional development endeavors [31].
- The TPACK framework enables the creation of collaborative learning environments that leverage technology to enhance interaction and cooperation among students. The research in this field investigates the utilization of technology to enhance collaborative teaching methods and enhance student achievements [32].

The TPACK framework is an essential instrument in educational research, providing a complete method to comprehending and executing technology integration in teaching and learning. The significance of it resides in its capacity to steer professional growth, enrich instructional design, and foster introspective practice. TPACK's applications in curriculum creation, teacher education, evaluation, assessment, and collaborative learning demonstrate its adaptability and significance in current educational research. As technology advances, the TPACK framework will continue to be crucial in helping educators and academics properly incorporate technology into education.

Previous Studies on Technology Integration in Higher Education

Research on the integration of technology in higher education has greatly expanded in recent decades, reflecting the growing significance of digital tools and resources in the process of

teaching and learning. Below is a concise overview of significant discoveries and recurring topics from prior research conducted by scholars:

Influence on Student Engagement and the Results of their Learning

Multiple studies have shown that using technology into higher education can increase student involvement and enhance academic achievements. An illustrative instance is a meta-analysis conducted by Schmid et al. (2014), which revealed that the utilization of interactive learning technologies, such as simulations and educational games, had a substantial positive impact on student motivation and academic achievement. found that the implementation of technology-supported active learning methodologies resulted in a decrease of more than 50% in failure rates for STEM courses [33].

Attitudes of Faculty Members and Obstacles to Adoption

A multitude of elements that impact teacher attitudes towards technology integration have been uncovered through research. conducted a study that revealed that although faculty members acknowledge the potential advantages of educational technology, they also identify obstacles such as time constraints, poor technical assistance, and insufficient training [34]. This is consistent with the research conducted by, which emphasized the significance of institutional support and professional growth in facilitating the adoption of technology [35].

Continuing Education and Skill Enhancement

Efficient and impactful professional development is essential for achieving successful integration of technology. Polly and Hannafin (2010) stressed the need of professional development programs being continuous, cooperative, and centered on both technical expertise and instructional approaches. In their study, Lawless and Pellegrino (2007) discovered that long-term, immersive professional development has a more significant effect on faculty members' capacity to incorporate technology compared to brief workshops [36].

Blended and Internet-based Education

Extensive research has been dedicated to the emergence of blended and online learning paradigms. Research has demonstrated that these models can be equally, if not more, successful than conventional in-person training. Means et al. (2013) did a meta-analysis and found that students in online and blended learning circumstances performed somewhat better than those receiving face-to-face teaching. In addition, emphasized the capacity of blended learning to integrate the most advantageous elements of online and in-person education, fostering more profound learning and increased adaptability [5].

Technological Tools and Innovations

Several technological tools and advancements have been examined to assess their influence on higher education. For instance, research has demonstrated that the utilization of Learning Management Systems (LMS) such as Blackboard and Moodle can effectively streamline course administration and improve the exchange of information between students and teachers [37]. Furthermore, research conducted by Wu et al. (2012) suggests that the utilization of mobile devices and applications in education can offer tailored and situationally appropriate teaching experiences.

Fairness and Availability in the Integration of Technology

found notable discrepancies in technology access and digital literacy proficiency across pupils of varying socioeconomic statuses. The inequalities can affect pupils' capacity to excel in technology-enhanced educational settings. Hence, it is imperative for higher education institutions to tackle digital disparities and guarantee fair and equal access to technology [38].

The existing body of research on technology integration in higher education emphasizes the potential advantages and difficulties linked to the utilization of digital resources in teaching and learning. Although technology has the potential to increase engagement, enhance learning outcomes, and offer flexible learning possibilities, successful integration necessitates overcoming obstacles linked to faculty attitudes, offering continuous professional development, and assuring equal access to technological resources. Ongoing research and investment in these fields are crucial for optimizing the advantages of technology in higher education.

Studies Involving the TPACK Framework in Similar Contexts with Students' Experiences with Technology Integration

The TPACK framework has gained significant traction in educational research as a means to investigate and improve the integration of technology in teaching and learning. This framework facilitates the comprehension of how educators might proficiently incorporate technology into their teaching methods and dissemination of subject matter. Various research has utilized the TPACK framework to examine students' encounters with technology integration in diverse educational settings. Below is a synopsis of these studies:

Exploring Students' Perceptions of Technology Integration

Research Study 1: Pre-Service Teacher Education

conducted a study to investigate the progress of pre-service teachers in developing Technological Pedagogical Content Knowledge (TPACK) and their perspectives on integrating technology [29]. The study revealed that students who underwent instruction on TPACK principles shown noteworthy enhancements in their capacity to incorporate technology into their instructional strategies. The researchers employed surveys and interviews to collect data on the students' experiences, uncovering that pre-service teachers exhibited greater confidence and proficiency in utilizing technology to augment their teaching methodologies.

Research study 2: Learning Environments Focused on Student Engagement

investigated the application of Technological Pedagogical Content Knowledge (TPACK) in educational settings that prioritize student-centered learning [39]. Their research concentrated on tertiary education students who were enrolled in a course that emphasized the incorporation of technology. The results suggested that students valued the practical experiences and practical applications of technology in their academic studies. The study also emphasized the significance of offering kids the chance to engage in technological experimentation within a nurturing setting.

Research study 3: Science Education Improved by Technology

conducted a study that investigated the use of TPACK in a science education setting that incorporates technology [32]. The in-

vestigation encompassed secondary school students and sought to evaluate their encounters with utilizing digital resources for acquiring scientific concepts. The findings indicated that students perceived the incorporation of technology as captivating and advantageous for comprehending intricate subjects. The study highlighted the necessity for instructors to possess a robust Technological Pedagogical Content Knowledge (TPACK) base in order to proficiently assist learning that is enhanced by technology.

Assessing the Impact of Technology Integration on Student Learning

Research study 4: Interactive Learning Technologies

In their study, Schmid et al. (2014) performed a meta-analysis to assess the influence of interactive learning technologies on student learning outcomes. Their research encompassed studies that utilized the TPACK framework to evaluate the impact of technology integration on student engagement and academic performance. The results indicated that the incorporation of interactive technologies, in conjunction with pedagogical expertise and knowledge of the subject matter, resulted in enhanced learning achievements. Students exhibited elevated levels of motivation and comprehension of the subject matter.

Research Study 5: Blended Learning Environments

Means et al. (2013) investigated the impact of blended learning environments on student achievement. The study employed the TPACK framework to create and execute blended learning courses in higher education. The findings demonstrated that students in blended learning environments outperformed their counterparts in traditional face-to-face settings. The study emphasized the significance of synchronizing technology tools with educational tactics and material expertise to optimize the advantages of blended learning.

Research study 6: Mobile Learning Applications

In their study, Wu et al. (2012) examined the patterns observed in mobile learning research, specifically investigating the incorporation of mobile technology in different educational settings through the utilization of the TPACK framework. Their evaluation determined that mobile learning applications provide individualized and contextually appropriate learning experiences for pupils. Students expressed favorable encounters with mobile learning, namely in relation to its adaptability and availability. The study highlighted the capacity of mobile technology to facilitate various learning requirements.

Challenges and Barriers to Effective Technology Integration

Research Study 7: Teacher Training and Advancement

Polly and Hannafin (2010) examined the difficulties linked to teacher training and professional growth within the framework of Technological Pedagogical Content Knowledge (TPACK). Their research revealed that some educators had challenges in incorporating technology into their teaching practices as a result of insufficient and thorough training. The researchers highlighted the importance of continuous, cooperative professional development initiatives that concentrate on both technology proficiency and educational approaches. The study found that students indicated that teachers who were highly skilled and knowledgeable were more successful in incorporating technology into their teaching.

Research study 8: Equality and Inclusion

Buzzetto-Hollywood et al. (2018) investigated matters about fairness and availability in the incorporation of technology by

utilizing the framework of TPACK. The survey revealed substantial discrepancies in students' availability of technology and proficiency in digital literacy. The discrepancies have an impact on the students' encounters and results in technology-enhanced educational settings. The researchers advocated for focused measures to tackle the digital divide and guarantee fair access to technical tools for every student.

Research conducted using the TPACK framework has yielded useful insights into students' experiences with the incorporation of technology in different educational settings. These studies emphasize the significance of thorough teacher education, conducive learning conditions, and fair availability of technology. Through comprehending the interaction of technology, pedagogy, and content knowledge, educators may provide more efficient and captivating learning experiences for students.

Gaps in the Literature

The majority of research on Technological Pedagogical Content Knowledge (TPACK) and the integration of technology in education mostly examines the viewpoints of teachers, while paying little attention to the experiences and outcomes of students, particularly in the Nigerian context. Research is required to investigate the impact of technology integration on student engagement and learning outcomes in educational settings in Nigeria. This encompasses qualitative research that captures the perspectives and lived experiences of students. Additionally, it is imperative to do research on the extent of digital literacy abilities among Nigerian students and the impact of these skills on their capacity to derive advantages from technology-enhanced learning environments.

Methodology

Research Design

The study is of a qualitative nature and specifically focuses on the material aspect. Consequently, the analysis detected differences in the frequency of occurrence without providing a specific measurement. The author employed a qualitative technique, following the guidelines set by Creswell (2007), to gather information through face-to-face interactions and phone talks with participants. Face-to-face interviews provide significant benefits since they allow researchers to observe social cues such as vocal tone, intonation, and nonverbal gestures. Furthermore, they enable the chance to delve further into respondents' answers by posing more inquisitive inquiries. Nevertheless, phone interviews also possessed other benefits that were widely recognized as a valid tool for contemporary research. The advantages include its ease of access, decreased financial resources, and shorter travel time (Bryman 2016: 484). Conducting telephone interviews offered a sense of comfort for the participant and diminished the level of formality during the session. One disadvantage of doing phone interviews is the inability to observe physical clues, such as the informant's body language (Bryman 2012: 488). Nevertheless, the participant's body language in this specific study was not particularly important, as the participant's knowledge held far larger value than other attributes. Both interview procedures, however, effectively obtained the required data to meet the research inquiries of this study. Therefore, the selected approach for this inquiry gave more importance to the articulation of opinions and outlooks rather than offering explanations.

Study Population

The population of a study in organized research is decided by the specific problem under investigation (Nworgu 1991; Kassu, 2019; Johnson et al., 2020). A population comprises specifically chosen elements for the purpose of a study. The term "population" refers to the complete set of individuals who meet the criteria for inclusion in a survey (Barridam, 2001). The study especially targeted students from several faculties in government-owned universities. A total of fifteen students from various universities across the country, each situated in distinct geographical regions, took part in the event. These individuals were recommended by acquaintances who have brothers or relatives studying in government-owned higher education institutions in Nigeria. There were six male males, aged between 18 and 25 years. To preserve the anonymity of the participants, they are allocated labels ranging from S1 to S15.

Sample and Sampling Techniques

To choose the sample, the study used Cluster Sampling, a probabilistic approach. This method entails splitting the population into groups (typically geographically) and randomly picking entire clusters for sampling. This is effective when the population is vast and dispersed across a large area [40]. The reason for picking these students for this study is that government universities are spread across Nigeria, and these students attend some of the country's government-owned institutions. The sample's goal was to enable random selection so that every member of the population had an equal chance of being included in the sample. This technique aids in the generation of representative samples and enables results to be generalized to the entire population. Probability sampling strategies are critical for reducing selection bias while assuring the validity and dependability of study findings.

The sample size of 15 respondents was sufficient for this paper. The chosen participants come from a variety of academic backgrounds and institutions. They all, however, have one similar goal: to provide a thorough grasp of their perspectives on the incorporation of technology into their educational lives. Qualitative research frequently focuses on relatively small samples that are explored in more depth, making the cluster sampling method suited for this study.

Sources of Data

The study used both primary and secondary sources. The primary data sources were collected through semi-structured open-ended interviews. The goal of the open-ended questions was to encourage participants to respond freely, as the interviews were conducted with students at all levels of the university, with diverse understandings and backgrounds. Secondary sources include of journal articles, books, government papers, and newspaper pieces. There were also references to institutional and official documentation from organizations. United Nations reports and other relevant documents about the research problem were used.

Instrumentation

The author conducts a case study semi-structured interview with the students. The purpose of this interview was to study the participants experiences and opinions with technology in their educational context, as well as the efficacy of technology into their learning experiences. The interview protocol included

the following guiding questions: (1) What are Nigerian students' thoughts on the incorporation of technology in their education? (2) How do students perceive the efficacy of technology integration within the TPACK framework?

Validity/Reliability of the Research Instrument

To test the research instrument's validity, a pilot study was done with some Nigerian students who traveled outside the country to further their studies. During this procedure, an interview guide was created with the help of the research Supervisor. Based on the supervisor's recommendation, the research instrument, the semi-structure, was given to a qualitative methods specialist, who reviewed and approved it. Following the analysis, the results were reviewed with some of the respondents. During the process, representatives from various of Nigeria's universities were also picked. Furthermore, the respondents contacted agreed with the study's conclusions.

Method for Data Analysis

During the research, data was gathered using qualitative methodologies. Thematic analysis was used to analyze the qualitative data collected. Thematic analysis was used to analyze the semi-structured interview based on the themes raised throughout the conversations, in accordance with the study's objectives. Furthermore, the use of qualitative approaches in data collection and analysis enables researchers to conduct studies with people in their natural settings, focusing on the subjective interpretations they make of events in their surroundings (Denzin and Lincoln, 2000; Spicer, 2004). As a result, this technique allowed for a thorough knowledge of these students' personal experiences and perspectives on the use of technology in their higher education institutions. Eckstein (1975:121) defines this emphasis on interpreting meanings as "comprehending the significance of actions and interactions" from individual viewpoints. Using this approach, the research relied heavily on the participants' true viewpoints rather than the researcher's predetermined notions and categories.

Quantitative methods have long been valued for their apparent rigor and scientific excellence. In contrast, qualitative methods have been used to reveal meanings, relationships, and interactions that quantitative approaches may fail to capture.

Results

The viewpoints of Nigerian students regarding the integration of technology in their education

Accessibility and Convenience

The availability of internet materials and learning platforms facilitates studying from any location, particularly in the midst of the pandemic. The advent of technology has significantly facilitated the accessibility of instructional resources. I have the ability to access and retrieve textbooks, view educational presentations, and actively engage in virtual conversations, all from the convenience and ease of my own residence. According to S1,5,8,12, and 4.

I find it advantageous to acquire lecture notes and view recorded sessions at my own preferred speed. Online learning platforms provide me the opportunity to engage in self-paced study. I have the ability to review lectures at any time, which has really facili-

tated my comprehension of challenging subjects. S 6, 2, 15, and 3 state... "Advancements in technology have facilitated the accessibility of a diverse array of resources that are not accessible through traditional library collections." Thanks to technology, I can access the library and participate in classes without the need for extensive travel. This leads to time and cost savings. According to the majority of the participants' opinions

Quality of Course Materials

There is a plethora of high-quality educational videos and tutorials accessible on the internet. I believe that the internet provides me with the opportunity to acquire top-tier education, as indicated by sources S10 and S7. E-learning systems have enhanced the caliber of education by offering interactive and captivating content. The numbers S4 and 13. "Through the utilization of technology, we are able to engage in virtual laboratories and simulations, thereby augmenting our comprehension of intricate topics." S 5, 1, 9, and 11. The interactive element of certain online courses, featuring quizzes and immediate feedback, enhances the engagement and efficacy of the learning process. S 2, 3, 7, 9, and 15

The majority of students indicated that their research talents have been greatly enhanced by their access to online journals and e-books.

Technical Difficulties Associated with the use of Technology

"There exists a disparity between students who possess the financial means to acquire personal laptops or smartphones and those who do not, resulting in limited access to these devices for some students." The majority of participants noted that frequent power outages and inconsistent internet connection can impair online learning sessions. An important obstacle is the inconsistent power provision. Insufficient and intermittent electricity is a significant obstacle to fully utilizing technical resources. All participants have the same perspective on this matter. S8 expressed that certain learning platforms are challenging to navigate, and not all lecturers are skilled in using the technology.

All participants concur that "Internet access is a separate concern." The high cost of data and the frequent occurrence of poor and unreliable connections impede my ability to engage in online learning. The expense associated with data might be substantial, posing a challenge for certain students to maintain continuous internet connectivity.

Teacher Adaptation and Support

"Certain lecturers in our institution lack proficiency in technology, resulting in challenges for them to seamlessly incorporate technology into their teaching methods." S5-10 and S15 expressed this viewpoint. S2, S3, S4, S11, and S12 expressed the opinion that teachers require additional training in the utilization of educational technology. Occasionally, the instruments are accessible, yet they are not utilized to their maximum capacity.

The majority of students felt that support from the school administration is essential. It is imperative to provide IT support services to assist both students and teachers in resolving technical difficulties.

Digital Literacy

S 10 and 11, "The integration of technology has compelled a significant number of individuals to enhance their proficiency in digital skills, resulting in a favorable consequence." S 4, 8, and 15 advocate for the implementation of further training programs aimed at enhancing the proficiency of both students and instructors in utilizing these technologies. S 1, 3, 5, and 9 expressed that older students and those from remote areas frequently encounter difficulties with digital literacy, which can impede their educational experience.

Engagement and Motivation

Students 1, 2, 8, 9, 10, and 13 expressed that the utilization of interactive tools such as discussion forums and real-time quizzes enhances the level of engagement in the learning process. Engaging applications and educational games enhance the enjoyment of learning and sustain my motivation to engage in studying. It offers a rejuvenating departure from conventional textbooks. Says S14. Virtual classrooms are devoid of the human connection and impromptu engagement that are present in regular classes. whilst Student 15 said that coordinating group assignments online is more convenient, nevertheless, the absence of in-person interaction can have an impact on teamwork.

S 1, 3, 5, 9, 11, and 12 expressed their opinions. Virtual laboratories and simulations enhance my ability to conduct experiments and comprehend practical concepts more effectively. The practical nature of this method is highly captivating. Nevertheless, there remains a potential for diversion. Given the abundance of internet entertainment choices, maintaining concentration on educational material can prove to be difficult.

The Concept of Equity and Inclusion

All participants concur that Technology have the capacity to mitigate gaps in education, provided that all students have equitable access.

S 1, 3, 5, and 9 expressed the viewpoint that students from low-income households face a disadvantage due to their inability to buy essential technologies and internet connectivity. The majority of participants believe that institutions should offer assistance and resources to ensure that everyone may reap the benefits of technology progress.

Outlook for the Future

The participants unanimously agreed that acquiring proficiency in technology is crucial for preparing ourselves for the digital requirements of the contemporary job market. Given the global shift towards digitalization, it is imperative for our education system to stay abreast of these changes. S 8 and 12 expressed that acquiring technological abilities via school will provide us with a distinct advantage in the employment market.

Perception of Students Regarding the Efficacy of Technology Integration within the TPACK Framework

Technological Knowledge (TK)

The majority of participants expressed that there is a significant variation in our teachers' comprehension of technology. Certain individuals excel in their teaching abilities and effectively engage students, while others face difficulties in doing so.

"Our level of familiarity and utilization of diverse digital tools has experienced a substantial enhancement." Currently, we have become acquainted with learning management systems and other educational software. The utilization of technology, such as interactive applications and online assessments, has enhanced the level of engagement in learning and reduced its monotony. Participants S1, S4, S10, and S11 stated that. Nevertheless, there is a disparity in the technological proficiency of teachers, which can occasionally result in inefficiencies throughout the learning process.

S2, S12-S15, has the following statement: "Acquiring proficiency in new educational software and tools has significantly improved my learning experience, albeit necessitating a substantial amount of self-directed learning." Proficient utilization of technology by teachers significantly enhances our comprehension of the material. Acquiring knowledge of unfamiliar software and tools has been advantageous, albeit it necessitates a significant investment of time and deliberate effort to attain proficiency. S3, S5-S9 emphasized the importance of having dependable internet and the ability to use digital devices. Technology significantly improves my study practices when it is accessible.

Pedagogical Knowledge (PK)

The efficacy of technology is greatly influenced by the teacher's proficiency in incorporating it into their instructional approaches. Certain educators excel at this task. Effective instructional strategies are essential. The mere presence of technology is insufficient; its application is what truly counts. This is in accordance with the recommendation of the majority of the responders. S5 expressed that the integration of effective teaching methods and technology can enhance comprehension of complex ideas, increase student involvement, and improve information retention. S9, S11, and S15 "Educators require additional instruction on how to proficiently utilize technology to augment the learning process, skillfully merging technology with teaching methodologies, rather than merely employing it as an add-on." S 6 expresses that certain instructors effectively utilize technology to enhance discussions and promote active learning, which the student finds highly advantageous.

Content Knowledge (CK)

Is a crucial aspect of effective teaching. According to S2, S9, S11, and S15, teachers who possess deep knowledge in their subjects and are adept at utilizing technology are able to deliver the most impactful learning experiences. S1, S5, S9, and S11 believe that technology plays a crucial role in making abstract concepts more tangible, particularly in areas such as physics and math, where simulations and visual aids can greatly enhance understanding.

S3, S4, S10, and S12 expressed that the abundance of current knowledge and varied viewpoints accessible online has enhanced our comprehension of different subjects. S7 stated that technology enables them to access a diverse array of materials, which enhances their comprehension of the subject matter and improves their ability to conduct research.

Technological Pedagogical Knowledge (TPK)

S10, S6, and S4. "Teacher who incorporate technology into their instructional approaches using interactive teaching methods

effectively enhance our level of engagement and motivation." The utilization of technology to facilitate interactive and student-centered teaching approaches greatly increases my learning experience.

S3, S5, and S7 have stated that the utilization of multimedia presentations and virtual discussions has improved our engagement, interaction, and comprehension of classes. S12 states that certain educators adeptly employ technology to establish a highly interactive educational setting, resulting in numerous advantages. This approach facilitates the inclusion of various learning styles, hence proving particularly advantageous for students with specific needs.

Technological Content Knowledge (TCK)

S2, S3, S4, S6, S7, and S13: "Technology facilitates the visualization of intricate concepts that are challenging to comprehend solely through conventional teaching methods." Utilizing digital resources and tools enhances the engagement and availability of investigating unfamiliar subject areas. S1, S5, S9, S11, and S14 "In disciplines such as biology and physics, virtual labs and simulations have proven to be highly valuable tools for enhancing comprehension of complex scientific principles."

S8, S13-S15. The incorporation of technology alongside subject expertise facilitates the inclusion of practical, real-life examples in the classroom, hence enhancing the relevance of the learning experience. However, the efficacy of the teaching method relies on the teacher's aptitude in selecting the most appropriate technology tools that align with the curriculum.

Pedagogical Content Knowledge (PCK)

The majority of participants expressed the view that the integration of technology is most efficient when teachers had a profound comprehension of both the subject matter and the suitable teaching methods. Several participants believe that integrating effective pedagogical strategies, extensive subject expertise, and advanced technology enhances the entire educational experience.

S8 and S15: "Teachers must possess the essential skill of adapting their instructional approaches according to the subject matter and the available technological resources."

Obstacles to Achieving Successful Integration

The majority of participants indicated that the inconsistent quality of technology integration across various courses and lecturers is a significant problem.

All participants agree that infrastructure issues such as power outages, inadequate internet connectivity, and uneven access to technology and the internet have a negative impact on the overall learning experience.

Several participants also noted that there exists a disparity in students access to technology, which can impede the overall efficacy of integrating technology.

Suggestions for Enhancement

All participants expressed the view that there is a necessity for ongoing professional development for instructors in order to

stay abreast of technological changes and pedagogical practices. Several participants emphasized the importance of ensuring equitable access to technical resources for all students in order to maximize the effectiveness of technology integration in education.

All participants of the study unanimously believe that enhancing the efficacy of technology integration can be achieved by improving infrastructure and ensuring equal access to technology for all students.

The majority of participants proposed that obtaining regular input from students regarding their experiences with technology in the classroom can aid in refining and enhancing its utilization.

Conclusion

The incorporation of technology into education has demonstrated significant advantages, including enhanced accessibility, ease, and availability of high-quality educational resources. Nigerian students, specifically, have conveyed gratitude for these advantages, acknowledging that technology improves the caliber of their educational encounters and facilitates the acquisition of crucial digital literacy abilities. Nevertheless, the process of completely achieving these advantages is not devoid of obstacles. Nigerian students acknowledge the advantageous nature of technology in facilitating their study. The capacity to get a vast amount of information and educational materials from any location and at any moment has revolutionized their approach to studying and expanded their intellectual perspectives. The presence of interactive and captivating digital content has also played a role in creating a more dynamic and enhanced learning environment. Moreover, the use of technology has facilitated the advancement of digital literacy, equipping students for a future that increasingly requires expertise in digital abilities.

Notwithstanding the optimistic perspective, Nigerian students encounter substantial barriers that impede the realization of technology's full potential in education. Inconsistent electricity provision and sluggish, costly internet connectivity are significant obstacles that impede the seamless progression of online education. Furthermore, the digital divide persists as a critical concern, as certain pupils lack the requisite gadgets and connectivity to fully utilize technological progress. These problems emphasize the necessity of enhancing infrastructure and providing fair access to technology to guarantee that all students may fully engage in digital learning settings.

The efficacy of technology in education is greatly dependent on the adaptability and support offered to both teachers and students. Teachers have a vital role in combining technology with teaching methodologies and subject knowledge, as described in the TPACK framework. Ongoing professional development and training for teachers are crucial in order to provide them with the necessary abilities to proficiently utilize technology tools. Furthermore, it is essential to provide students with assistance in enhancing their digital skills in order to effectively utilize and optimize the advantages offered by these tools. Technology has demonstrated its ability to augment student engagement and motivation, so rendering learning more dynamic and pleasurable. Utilizing multimedia presentations, virtual debates, and interactive apps effectively engages students and actively

involves them in their courses. Additionally, these tools accommodate various learning styles, hence enhancing the inclusivity and accessibility of education for all students. Nevertheless, it is crucial to acknowledge and tackle the possible disruptions that technology might provide, guaranteeing that its use is directed towards achieving educational objectives. An important observation derived from the students' input is the necessity to guarantee that all students receive equal advantages from technological progress. This entails ensuring equitable access to devices and internet connectivity, along with customized assistance for individuals who may have difficulties with digital literacy. It is essential to tackle these equity challenges in order to optimize the beneficial effects of technology on education.

Students have a positive perception of the effectiveness of integrating technology within the Technological Pedagogical Content Knowledge (TPACK) framework. They emphasize the significance of maintaining a harmonious equilibrium between technological tools, efficient educational tactics, and profound content understanding. Teachers may enhance the learning experience and make it more interesting and relevant by carefully choosing and incorporating technology that is in line with the topic being taught.

Recommendations

In order to fully exploit the potential of technology in education, a number of suggestions might be put forward:

- **Continuous Professional Development** refers to the ongoing training provided to instructors to enhance their skills in utilizing technology effectively and integrating it with their pedagogical and content expertise.
- **Infrastructure Enhancement:** Allocating resources towards the development of a dependable electricity grid and accessible, fast internet connectivity to guarantee uninterrupted educational opportunities.
- **Ensuring fair and just access:** Supplying all students with the essential devices and connectivity required to engage in digital learning.
- **Student Support:** Providing assistance and resources to aid students in enhancing their digital literacy and proficiently navigating technology tools.
- **Input Mechanisms:** Establishing systematic channels for receiving regular input from students to enhance and optimize the utilization of technology in education

Ultimately, integrating technology into education has the capacity to greatly revolutionize learning experiences and equip students for future prospects. Nigerian students value the advantages of technology, including increased accessibility, convenience, and improved learning quality. Nevertheless, it is crucial to tackle the obstacles posed by unreliable infrastructure, the digital divide, and the necessity for ongoing teacher training in order to fully optimize these advantages. The TPACK framework offers a valuable roadmap for seamlessly incorporating technology into pedagogical tactics and topic knowledge, guaranteeing that technology enriches rather than detracts from the learning process. By prioritizing these specific areas, educational institutions may establish a learning environment that is more inclusive, captivating, and efficient for all students.

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