

Unlocking Opportunities Exploring Success Factors and Challenges of Digital Integration in Vocational and Technical Education in Nigeria

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ABSTRACT

Technological knowledge is increasingly vital for enhancing students' understanding of complex concepts and fostering peer collaboration. Digital integration in vocational and technology education offers opportunities to enrich teaching, boost student engagement, and prepare learners for modern workforce demands. Despite its potential, research on digital competence in vocational education and training (VET) in Nigeria remains limited. This study explores the success factors and challenges of digital integration in Nigerian vocational and technology education. It examines strategies, resources, and barriers to identify factors influencing effective adoption and utilization of digital technologies. A meta-analysis highlights key success factors, including adequate training and professional development for educators and fostering a culture of lifelong learning. Challenges include inadequate infrastructure, unequal access to digital resources, and sustainability issues in adopting digital tools. The study emphasizes the need for a collaborative effort among stakeholders to provide adequate infrastructure and ensure widespread access to digital resources. These insights aim to enhance educational practices and inform policy frameworks for successful digital integration in Nigeria's vocational and technical education sector.

Keywords: Technology, education, digital integration, innovation, collaboration.

INTRODUCTION

In today's evolving educational landscape, integrating digital technologies is crucial for fostering innovation, enhancing learning experiences, and preparing students for the modern workforce. This is especially significant in vocational and technology education, a sector bridging economy and education (Cattaneo, Antonietti, and Rauseo, 2022). The convergence of traditional skills with digital competencies is vital to meet the demands of a rapidly changing job market. Research highlights digital integration's potential to expand educational access, support multimedia-rich learning, enable personalized approaches, and enhance system resilience during crises like pandemics (Valverde-Berrios et al., 2020; Demissie, Labiso, and Thuo, 2022; Alenezi et al., 2023). In Nigeria, a growing youth population and rising demand for skilled labour underscore the urgent need to harness digital tools in vocational education (Toyo, 2017). Yet, challenges persist. For example, only 35% of Nigerian vocational institutions have reliable access to digital tools (National Bureau of Statistics, 2023), contrasting with Europe, where over 80% of schools utilize digital platforms (European Commission, 2018). This study explores digital integration in Nigeria's vocational and technology education, focusing on success factors and challenges. It aims to inform policy, enhance educational practices, and guide stakeholders. Key questions include: What are the success factors and challenges of digital integration in this context, and how do they impact practices, learning outcomes, and policies?

The study therefore aims to achieve the following objectives:

- To explore the critical success factors driving the effective integration of digital technologies in vocational and technology education in Nigeria.
- To determine the challenges and barriers that impede the seamless adoption and implementation of digital tools and platforms in this educational context.
- To identify the strategies and interventions that can be devised to overcome existing hurdles and maximize the benefits of digital integration for students, educators, and industry stakeholders alike.

LITERATURE REVIEW**Conceptualizing Digital Education**

Digital education involves the innovative use of technologies to enhance teaching and learning. Alenezi, Wardat, and Akour (2023) define it as the creative application of digital tools in education, while Al-Abdullatif and Gameil (2021) describe it as the integration of digital resources to achieve educational objectives. Demissie et al. (2022) highlight that digital integration encompasses hardware, software, internet-based tools, and multimedia content seamlessly embedded into teaching processes. Hrastinski (2019) emphasizes blended learning, combining traditional instruction with online activities, offering flexibility and personalization. Dziuban et al. (2018) note that digital integration in education encourages diverse learning styles which fosters engagement and critical skills like problem-solving and collaboration (Widjaja and Chen, 2017).

Valverde-Berrocoso (2021) asserts that digital integration promotes equity by bridging the digital divide, ensuring resource accessibility regardless of socioeconomic or geographic barriers. The COVID-19 pandemic highlighted the significance of digital tools in maintaining education continuity. Alenezi (2021) stresses the role of digital integration in fostering global collaboration, cultural exchange, and diverse perspectives in education sectors. The European Commission (2018) underscores the need for digital competence, including critical and responsible technology use. Portillo et al. (2020) argue that educators should go beyond basic skills, leveraging technology to connect and engage students effectively.

Importance of Digital Integration in Modern Education Systems

Technology has become inevitable for teaching purposes to address the diverse needs of the current generation and to improve their learning environment (Alenezi, Wardat, and Akour, 2023). Teachers according to Demissie et al. (2022) are not only knowledge transmitters but support students by acting as mentors and facilitators in student learning in the digital era. The current use of digital technologies allows teaching to be more interactive and attractive, where students freely access various sources of information as opposed to the traditional teaching model (Demissie et al. 2022).

Silverstone, Phadungtin, and Buchanan (2009) emphasize that technology integration, including digital skills, is a key competency for 21st-century educators, especially for implementing technology-enhanced classrooms. Digital integration in vocational and technology education improves teaching experiences, student engagement, and workforce preparedness (Al-Abdullatif and Gameil, 2021). Understanding factors influencing successful integration and addressing challenges can enhance educational practices and improve vocational education quality in Nigeria (Toyo, 2017). Digitization reduces costs related to materials and minimizes environmental impacts (Statti and Torres, 2020).

Digitalization presents opportunities for economic growth and competitiveness (Cattaneo, Antonietti, and Rauso, 2022). Leveraging technology in vocational education is critical for national and global competitiveness (Aduwa-Ogiegbaen, 2009), bridging gaps in access to quality education, particularly in underserved areas (Alenezi et al., 2023). However, disparities in access to digital resources may widen existing inequalities (Romanova et al., 2020). Digitalization has transformed teaching, with emerging technologies making information exponentially accessible (Silverstone, Phadungtin, and Buchanan, 2009). Diversified tools, such as smart boards and online platforms, support equitable education delivery (Yildiz, 2022). The Digital Classroom Initiative in Lagos State improved student engagement and test scores by 30% (Toyo, 2017),

showcasing the potential of digital tools to enhance learning and promote equitable access across diverse communities.

Impact of Digital Integration on Learning Outcomes

Digital integration extends beyond traditional classroom settings, providing opportunities for lifelong learning through online courses, virtual communities, and self-paced tutorials, and its impact on learning outcomes is multifaceted and largely depends on how effectively technology is implemented and utilized within educational settings (Al-Abdullatif and Gameil, 2021; European Commission, 2018). Digital integration according to Greenhow, Graham and Koehler (2022) provides students with access to a vast array of resources that may not be available in traditional classrooms. Online textbooks, educational websites, multimedia content, and interactive simulations can enrich the learning experience and cater to different learning styles (Humpl and Andersen, 2022).

Hamutoglu, Gemikonakli, Duman, Kirksekiz and Kiyici (2019) claim that technology enables personalized learning experiences tailored to individual student needs. Adaptive learning platforms according to Johnson, White and Smith (2016) can adjust content and pacing based on students' strengths, weaknesses, and learning preferences, leading to improved engagement and mastery of concepts. Greenhow et al. (2022) on the other hand, assert that digital tools facilitate collaboration among students and between students and teachers regardless of geographical boundaries. Online forums, video conferencing, and collaborative documents allow for asynchronous and synchronous communication, fostering peer learning, discussion, and knowledge sharing. Similarly, European Commission (2018) professes that by engaging with digital tools and resources, students develop essential digital literacy skills necessary for success in the 21st century workforce. They learn how to navigate online information, evaluate sources, and adapt to new technologies, preparing them for lifelong learning and professional development.

Harrell and Bynum (2018) claim that one of the roles of digital integration to learning is that it enables more timely and detailed feedback on student work. According to these authors, automated assessment tools, online quizzes, and grading software can streamline the evaluation process, providing immediate feedback to students and informing instructional decisions for teachers. Hamutoglu et al. (2019) submits that technology can support the development of critical thinking and problem-solving skills through activities such as simulations, virtual experiments, and scenario-based learning. Students can explore complex concepts in a risk-free environment and apply their knowledge to real-world situations.

Overview of Digital Integration in Education

The digital revolution has brought rapid growth of information and communication technologies that have fundamentally changed how people communicate and work to earn a living (Demissie et al., 2022). Digital integration in education continues to evolve rapidly, shaping the future of learning and teaching worldwide (Humpl and Andersen, 2022). Several institutions in the world have undergone several significant changes recently due to societal and technological tendencies toward modernization. Alenezi, Wardat and Akour (2023) emphasized that most educational institution assume digitization has a prerequisite for drawing and attracting more and stronger students as it helps in enhancing the quality of their institutional courses, instructional materials, and training programmers (Alenezi et al., 2023). Digital integration according to Greenhow et al. (2022) facilitates global collaboration and cross-cultural exchange among students and educators from different countries and backgrounds. Online platforms, virtual classrooms, and collaborative projects enable cultural exchange, language learning, and the sharing of diverse perspectives and experiences (Widjaja and Chen, 2017). Nations that prioritize digital integration in education are better positioned to compete globally, fostering innovation, entrepreneurship, and economic growth through a highly skilled workforce (Waheed, Xiaoming, Ahmad and Waheed, 2020). Martin (2020) asserts that the proliferation of online learning platforms and different learning websites have democratized access to education. These platforms offer a wide range of courses, from academic subjects to vocational training, catering to diverse learners.

Global and Nigerian Trends in Digital Integration

Santos and Castro (2021) assert that digital integration in education has seen significant trends and developments globally, driven by advancements in technology, changing pedagogical approaches, and evolving societal needs. Hamutoglu et al. (2019) identify Virtual Reality (VR) and Augmented Reality (AR) technologies as digital trend in education that offer immersive and interactive learning experiences, allowing students to explore virtual environments, simulate real-world scenarios, and visualize complex concepts. Montebello (2018) added that AI-powered tools and applications are revolutionizing education by automating administrative tasks, providing personalized learning recommendations, and facilitating adaptive assessment and feedback mechanisms. This author claims that the adoption of these technologies enhance engagement, retention, and understanding of subject matter across various disciplines.

In the United States, a 2021 study by Greenhow et al. (2022) found that blended learning platforms increased student engagement by 65% in vocational education. Case studies from South Korea demonstrate the potential of simulation-based learning, with 75% of vocational institutions integrating VR tools (Montebello, 2018). In Europe, reported reveals that over 80% of schools had adopted digital tools to enhance learning outcomes by 2020, emphasizing equity in digital access across urban and rural areas (European Commission, 2018). Conversely, a survey by Nwachukwu, Johnson, and Amadi (2020) showed that only 35% of vocational institutions in Nigeria have reliable access to digital tools, with significant disparities between urban (50%) and rural areas (20%).

The ubiquity of smartphones and mobile devices according to Racz, Johnson, Bradshaw and Cheng (2017) has facilitated the rise of mobile learning. Educational apps, digital textbooks, and interactive multimedia content enable anytime, anywhere learning, making education more accessible and convenient for learners of all ages. The author further added that gamification techniques and game-based learning platforms engage students by incorporating elements of gameplay into educational activities. These approaches promote active learning, collaboration, and problem-solving skills while fostering motivation and enjoyment in the learning process.

Success Factors of Digital Integration

Promoting digital literacy and providing training programs are crucial for effective digital integration in education. Statti and Torres (2020) emphasize aligning vocational and technological curricula with the digital economy by integrating topics like programming, cybersecurity, and digital marketing. Racz et al. (2017) highlight the need for affordable access to devices like smartphones and tablets, recommending subsidies to enhance accessibility. Albion et al. (2015) stress the importance of hands-on learning experiences and access to modern technology in vocational schools to develop practical skills. Edutopia (2007) adds that students should have opportunities to choose tools that help them access, analyze, and professionally present information.

Moreover, Valli (2016) assumes that vocational education programs can remain relevant to evolving industry trends and requirements when they see the need to establish partnerships with industry stakeholders, including technology companies, startups, and industry associations. Nurhas et al. (2022) advised that the stakeholders in vocational education should provide adequate infrastructure and resources, such as well-equipped laboratories, computer facilities, and educational materials, is essential for delivering effective vocational and technological education. However, the World Bank (2021) reported that only 30% of Nigerian schools have reliable electricity, a critical barrier to digital integration. Additionally, 15% of schools in rural areas reported having any form of internet access (Johnson et al., 2016). A study comparing learning outcomes from digitally integrated and traditional classrooms in Nigeria revealed a 20% improvement in problem-solving skills among students exposed to digital tools (Harrell and Bynum, 2018). However, the study also highlighted increased disparities between students with and without access to technology, particularly in rural areas. Irele (2022) however proposed that to encourage digital integration in Nigeria educational system, the government should establish recognized certification programs and accreditation standards for vocational and technological education as this has the capacity of enhancing the credibility and value of vocational qualifications in the labor market. The author added that employers are more likely to hire graduates with recognized certifications that demonstrate their proficiency in digital skills. Cantabrana, Rodríguez, and Cervera (2019) therefore suggest that teachers should link their digital-age skills or competencies with their professional practice.

Challenges and Issues of Digital Integration in Nigeria

In Nigeria, effective integration of digital technologies in education faces challenges such as the cost and accessibility of technological tools, time constraints, and a lack of knowledge about using technology for diverse subjects (Irele, 2022). While some teachers innovate using ICT, these efforts are isolated and lack systemic support for lifelong learning. Teacher training and professional development play a significant role, accounting for 23.53% of success factors in the integration process (Demissie et al., 2022), yet only 40% of Nigerian educators feel confident with digital tools, and just 25% have formal training (Irele, 2022).

Key barriers include low digital literacy, insufficient evaluation of students' digital competencies, and outdated curricula that fail to adapt to new tools (Nwachukwu et al., 2020; Fafunwa, 2018). These issues contribute to what Bonilla-Molina (2020) calls a "Global Pedagogical Blackout," characterized by inadequate investment in digital technologies and a reduced emphasis on pedagogical innovation. Internal factors, such as teachers' attitudes, beliefs, and resistance to technology, further impede progress. Teachers unfamiliar with digital tools often prefer traditional methods, feeling less in control and hesitant to explore new instructional strategies (Waheed et al., 2020; Aduwa-Ogiegbaen, 2009). Many also lack confidence, as they were educated in environments without access to technology (Fafunwa, 2018). Constant technological advancements demand ongoing professional development to keep educators updated (Demissie et al., 2022).

Connectivity issues are another significant hurdle. Nigeria relies on costly and inadequate satellite infrastructure, limiting internet access (Irele, 2022). Without reliable ICT infrastructure, integrating technology into classrooms is unfeasible. Access to devices like printers, projectors, and computers is often limited, with a low computer-to-student ratio further reducing instructional efficiency (Ajiboye, 2020; Johnson et al., 2016). Addressing these barriers requires investment in training, infrastructure, and resources to support teachers and create a digitally inclusive educational environment.

Theory Underpinning Technology Integration in Education

This study adopts Technology Acceptance Model (TAM), developed by Fred Davis in the late 1980s and further extended by Venkatesh and Davis in the 2000s. TAM is used in the study to help understand and predict individuals' acceptance and usage of technology particularly in the vocational and technical education in Nigeria. TAM posits that users' behavioral intentions to use a technology are determined by their perceived usefulness (PU) and perceived ease of use (PEOU) of the technology (Qingxiong, 2005). Perceived usefulness refers to the degree to which a person believes that using a particular technology will enhance their job performance or productivity. Perceived ease of use, on the other hand, refers to the extent to which a person believes that using the technology will be free from effort (Chau, 1996). In the context of digital integration in vocational and technology education in Nigeria, TAM can provide valuable insights into the factors influencing educators' and students' acceptance and utilization of digital tools and platforms.

By examining perceptions of usefulness and ease of use, the key success factors that facilitate the effective integration of technology into teaching and learning practices can be identified (Malhotra and Galletta, 1999). In addition, TAM can help pinpoint potential issues and barriers related to technology adoption, such as lack of access, inadequate training, or resistance to change. Furthermore, Malhotra and Galletta (1999) assert that TAM can be adapted to incorporate socio-cultural and contextual factors that are particularly relevant to the Nigerian educational context. This includes considerations such as infrastructure limitations, socio-economic disparities, and cultural attitudes towards technology. By integrating these contextual elements into this study, the TAM helps to develop a more nuanced understanding of the challenges and opportunities associated with digital integration in vocational and technology education in Nigeria.

METHODOLOGY

The study focuses on conducting a comprehensive meta-analysis of existing secondary data related to the success factors and challenges surrounding the digital integration in vocational and technology education in Nigeria. Through systematic review and synthesis of relevant literature, this research aims to identify common themes, trends, and patterns across various studies, providing a synthesized understanding of the key success

factors and issues pertinent to digital integration in vocational and technology education within the Nigerian context. Using an advanced research option that utilizes the Boolean feature, limit the field of search, and define the publication period, the data spanning 2016- 2024 were obtained from different journals based on certain criteria (Table 1). These inclusion and exclusion criteria are intended to ensure that the meta-analysis captures relevant and high-quality studies that contribute meaningfully to understanding the success factors and challenges of digital integration in vocational and technology education specifically within the Nigerian context. The collected data were analyzed using descriptive statistics of simple frequency counts and percentages. The review was conducted in three phases, namely, data collection, data analysis, and synthesis.

Table 1: Systematic Review Inclusion and Exclusion Criteria Used in Data Collection

Criteria	Inclusion	Exclusion
Research Topic	- studies must investigate digital integration in vocational and technology education within the Nigerian context.	- studies not directly related to digital integration in vocational and technology education in Nigeria. - multiple publications reporting on the same dataset or study are excluded to avoid duplication of findings
Publication Types	- peer-reviewed journal articles, conference papers, government reports, and other scholarly publications are eligible for inclusion.	- grey literature, unpublished theses, dissertations, and non-peer-reviewed sources are excluded.
Research Design	- both quantitative and qualitative studies are considered, including experimental, quasi-experimental, correlational, case studies, surveys, interviews, focus groups, and mixed-methods designs.	- reviews and conceptual papers
Outcome Measures	- studies must address success factors and/or issues related to digital integration, such as technology adoption rates, effectiveness of digital tools, impact on learning outcomes, challenges faced, and strategies for overcoming barriers.	- studies lacking sufficient data or methodological details necessary for inclusion in the meta-analysis
Geographical Scope	- studies focusing on Nigeria vocational and technology education.	- studies conducted outside of Nigeria or focusing solely on general education settings without specific relevance to vocational and technology education.
Scope	Studies between 2016- 2024	- studies before 2016 were excluded to ensure relevance to current practices and technologies.

ANALYSIS AND DISCUSSION

This chapter is devoted to the presentation and analysis of the data collected for the study, using the studies that cover the period between 2016 and 2024. Based on the inclusion and exclusion criteria (Table 1), secondary data was obtained from ten (10) different databases, and the relevant papers were located by searching for all publications with the keywords. As shown in Table 2, the initial searches resulted in a total of 189 publications of various types, while total number of the adopted is 110.

Table 2: Breakdown of the Reviewed Articles from Different Database

Database	No of Related Articles	No of Irrelevant Citations	No of Retained Articles
ScienceDirect	23	12	11
Emerald	9	5	4
Springer	12	5	7
SCOPUS	4	2	2
Web of Science	7	2	5
ResearchGate	34	10	24
Sage	7	5	2
Taylor Francis	9	8	1
Elsevier	11	4	7
Google Scholar	73	26	47
Total	189	79	110

The analysis phase started by arranging the obtained articles base on the research variables to provide a sense of structure and perceive idea development on factors that enhance success and those that hinder digital integration in Nigeria vocational and technical education over time. Each article was set for full-thematic analysis to capture the needed data. The analysis outcome of each article was summarized in an electronic database (Microsoft Excel) and the themes categorized on the basis of the research objectives.

The reporting and dissemination stage was finally performed. We ensured the clear and understandable representation of findings and conclusions through suitable graphs and tables. The themes were discussed to provide a significant answer to the research question supported by justifications and evidence. We attempted to translate the findings and conclusions of this systematic review into guidelines for practice.

Success Factors of Digital Integration in Vocational and Technical Education in Nigeria

Table 3: Distributions of Studies based on Themes Related to Success Factors of Digital Integration in Vocational and Technical Education in Nigeria

Themes	2016-2018	2019-2021	2022-2024	Total 2016-2024	(%) of total 2016-2014
Infrastructure and resources availability	0	2	1	3	4.41
Teacher training and professional development	2	4	10	16	23.53
Curriculum design, alignment and integration	1	3	7	11	16.18
Supportive policies and initiatives	1	2	2	5	7.35

Industry and Stakeholder collaboration and partnerships	4	2	1	7	10.29
Lifelong learning and skill development	1	4	9	14	20.59
Quality assurance	2	5	3	10	14.71
Equitable access to digital resources	0	1	1	2	2.94
Total	11	23	34	68	100.00

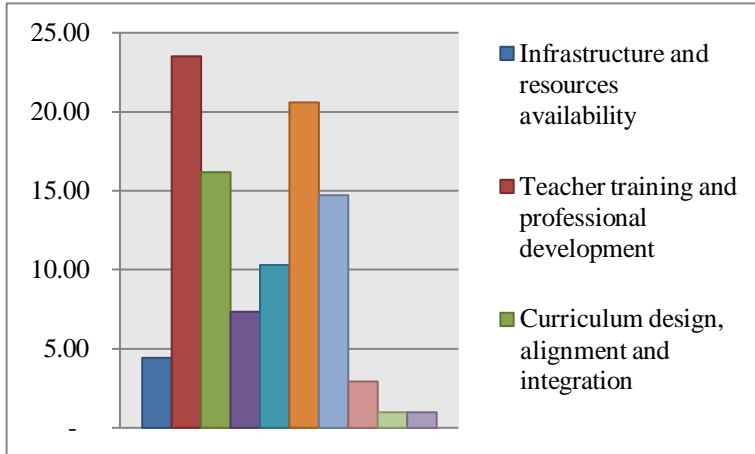


Figure 1: Bar chart showing the distribution of Studies based on Themes Related to Success Factors of Digital Integration in Vocational and Technical Education in Nigeria

DISCUSSIONS

Table 3 presents the distribution of studies based on themes related to the success factors of digital integration in vocational and technical education in Nigeria. The findings indicate that 23.53% (16 studies) identified quality teacher training and professional development as the primary factor driving successful digital integration. Lifelong learning and skill development among teachers and instructors followed closely, highlighted by 20.59% (14 studies). Additionally, 16.18% (11 studies) emphasized the importance of efficient curriculum design, alignment, and integration as critical contributors to digital integration. Quality assurance in pedagogical delivery was noted as a key factor in 14.71% (10 studies), while 10.29% (7 studies) recognized industry and stakeholder collaboration and partnerships as essential. Supportive government or managerial policies and initiatives were identified by 7.5% (5 studies), and infrastructure and resource availability by 4.41% (3 studies). Lastly, 2.94% (2 studies) pointed to equitable access to digital resources across different regions as a crucial factor for successful digital integration.

Challenges of Digital Integration in Vocational and Technology Education in Nigeria

Table 4: Distribution of Studies Based on Themes Relating to Challenges of Digital Integration in Vocational and Technology Education in Nigeria

Themes	2016-2018	2019-2021	2022-2024	Total 2016-2024	(%) of total 2016-2024
Digital divide and access issues	3	5	8	16	16.49
Technological infrastructure limitations	5	7	8	20	20.62

Pedagogical challenges and resistance to change	2	4	3	9	9.28
Financial constraints	2	4	1	7	7.22
Cultural and societal factors	0	1	0	1	1.03
Curriculum development	1	3	2	6	6.19
Quality of digital content	1	1	2	4	4.12
Policy and funding	3	4	6	13	13.40
Assessment and evaluation	1	3	3	7	7.22
Maintenance and Sustainability issue	2	5	7	14	14.43
Total	20	37	40	97	100.00

Source: Review of Literature

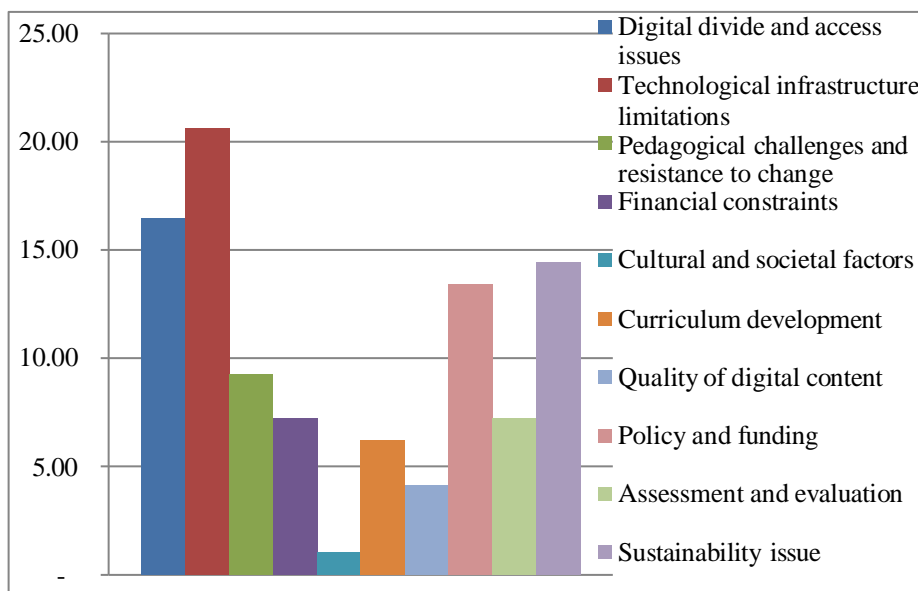


Figure 2: Bar Chart Showing the Distribution of Studies Based on Themes Relating to Challenges of Digital Integration in Vocational and Technology Education in Nigeria

Source: Review of Literature

DISCUSSION

An analysis of the challenges to digital integration in vocational and technical education in Nigeria, as shown in Table 4, reveals that 20.62% (20 studies) identified technological infrastructure limitations as the primary barrier to successful integration. This finding aligns with the World Bank (2021) report that only 30% of Nigerian schools have reliable electricity. Following this, 16.49% (16 studies) highlighted digital divide and access issues as major challenges. Additionally, 14.43% (14 studies) pointed to the sustainability of digital adoption as a key issue, while 13.40% (13 studies) identified ineffective policies and inadequate funding as significant hindrances. Pedagogical challenges and resistance to change were noted by 9.28% (9 studies) as obstacles to digital integration. Financial constraints and issues related to assessment and evaluation were identified by 7.22% (7 studies) each, while 6.19% (6 studies) cited inefficient curriculum development as a primary barrier. A smaller proportion, 4.12% (4 studies), mentioned the quality of digital content, and 1.03%

(1 study) pointed to cultural and societal factors as key challenges to digital integration in Nigeria's vocational and technical education.

Impact of Digital Integration on Learning Outcomes

Factors Affecting and Promoting Digital Integration and Traditional Education Approaches in Nigeria

Table 5: Differences in Learning Outcomes between Digitally Integrated and Traditional Educational Approaches Matrix

	Digital Integration	Traditional Educational
Advantages	<ul style="list-style-type: none"> - It provides access to a wealth of resources beyond what is available in traditional classrooms. - offer more interactive and engaging learning experiences through multimedia content, simulations, and virtual labs - tailor learning experiences to individual student needs through adaptive learning algorithms and personalized feedback mechanisms - It enhances students' communication and teamwork skills, which are increasingly important in today's interconnected world 	<ul style="list-style-type: none"> - It often relies solely on textbooks and limited classroom resources - It reduces student's participation and motivation - It follows a one-size-fits-all model, which may not cater to the diverse learning styles and paces of students - It offers limited opportunities for collaborative learning, mainly restricted to in-person group discussions and activities
Disadvantages	<ul style="list-style-type: none"> - It causes high disparity in access to digital resources and infrastructure in different regions. - It requires teachers to possess digital literacy skills and undergo training to effectively utilize technology in the classroom - It offers immediate feedback mechanisms through automated quizzes, grading systems, and data analytics, enabling students to track their progress in real-time 	<ul style="list-style-type: none"> - The gap in learning outcomes between students in different regions and socioeconomic backgrounds is minimal. - It relies more on established teaching methods with which instructors are familiar - It relies on periodic exams and assignments for assessment, with feedback provided after a delay.

Source: Review of Literature

Summary of the Approaches

It could be deduced from Table 5 that while digitally integrated educational approaches hold the potential to revolutionize learning outcomes by providing access to a vast array of resources and fostering interactive and personalized learning experiences, like the case of the Osun Tech Hub Pilot Project, which provided coding and robotics training to over 2,000 students in vocational schools, resulting in a 50% employment rate among graduates within six months (2023 State Report), and that of the Lagos E-Learning Program, which equipped 100 vocational schools with tablets and projectors, leading to a 45% increase in student enrollment in technology-based courses. This study is in line with the study conducted by Harrell and Bynum (2018) where learning outcomes from digitally integrated and traditional classrooms in Nigeria were compared and the study revealed a 20% improvement in problem-solving skills among students exposed to digital tools. Nevertheless, this study also reveals that their effectiveness in Nigeria may be limited by challenges such as infrastructure gaps, access issues, and the need for comprehensive teacher training and support.

CONCLUSION

This study aims to explore the key success factors driving digital integration in vocational and technical education in Nigeria, identify challenges impeding the adoption of digital tools, and recommend strategies to overcome these barriers for the benefit of students, educators, and industry stakeholders. The meta-analysis of success factors reveals that adequate training and professional development for educators are essential for successful digital integration. Promoting a culture of lifelong learning and skill development is crucial to ensure educators and students adapt to the digital age. Integrating digital technologies into vocational programs helps students gain the digital literacy required for today's workforce. Additionally, quality assurance mechanisms, such as monitoring and evaluating digital tools, are keys to maintaining integration standards and improving learning outcomes. Collaboration between educational institutions and industry stakeholders is also vital for aligning programs with current industry needs and trends. However, the study identifies significant challenges, including inadequate infrastructure, such as unreliable internet and a lack of devices, which hinder effective digital integration, especially in rural areas. Another challenge is the digital divide, with urban areas having better access to digital resources compared to underprivileged regions, widening the gap in learning outcomes. The sustainability of digital adoption is also a concern, as many vocational colleges lack the maintenance culture necessary to support long-term investment in technology.

RECOMMENDATIONS

Having discovered the challenges associated with digital integration in Nigeria vocational and technical education, addressing these requires a holistic approach involving collaboration between government, educational institutions, industry stakeholders, and the broader community. The following recommendations are therefore put forward for consideration towards the improvement and sustainability of the sector in Nigeria:

- Introduce gamified learning and virtual reality (VR) tools for vocational training, inspired by South Korea's VR simulations in manufacturing and engineering education, which enhanced skill retention by 40%.
- Implement national training programs aimed at equipping teachers with digital skills, modeled after Ethiopia's successful teacher development initiatives that boosted digital tool usage by 45%.
- Expand initiatives similar to the Digital Classroom Initiative in Lagos State, where student engagement increased by 30% (Toyo, 2017), with a focus on underserved regions nationwide.
- Foster public-private partnerships to improve internet infrastructure and provide affordable digital devices, particularly in rural areas, drawing from Kenya's Digital Literacy Programmed, which distributed over 1.2 million tablets to primary schools.
- Establish community ICT hubs in underserved areas, modeled after the successful pilot projects in Osun State's Tech Hub, which resulted in a 50% employment rate for ICT-trained students, to give students and teachers access to digital tools and training beyond school hours.

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