Impact of Integration of Emerging Technologies into Technical Education Curricula and their Influence on Students' Learning Outcomes in South West University of Education in Nigeria.

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ABSTRACT

The integration of emerging technologies is transforming technical education by redefining how students acquire knowledge and practical skills. In today's innovation-driven world, tools such as Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), robotics, and gamified learning platforms offer creative approaches to improve teaching, learning, and employability. The purpose of this study was to assess the extent of integration of emerging technologies into the technical education curriculum at the South West University of Education in Nigeria and to examine their influence on students' learning outcomes in terms of academic performance and skill acquisition. A descriptive survey design was adopted, and a validated 30-item questionnaire was administered to 116 participants (85 students and 31 lecturers) across Lagos, Ogun, and Ekiti States. The instrument yielded a reliability coefficient of 0.80, confirming strong internal consistency. The data was analyzed using descriptive and inferential statistics. Findings revealed that, although integration remains limited, the use of emerging technologies has a positive influence on students' academic performance, practical competence, and motivation. The study concludes that integrating digital tools into technical education enhances learning effectiveness and skill readiness. It recommends curriculum reform, continuous teacher training, and stronger industry partnerships to maximize the benefits of technological innovation.

Keywords: Technical Education, Emerging Technologies, Students' Learning Outcomes, skill acquisition.

INTRODUCTION

Technical education plays a fundamental role in preparing students for careers in today's evolving labor market, especially in developing countries like Nigeria. It is not only about knowledge transmission but also about equipping learners with relevant, practical, and adaptable skills. With the global economy being reshaped by technological advancements, the integration of emerging technologies into technical education curricula has become essential. Tools like Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), robotics, gamification, and other digital learning platforms are increasingly being adopted in educational systems worldwide to enhance teaching and learning (Bozalek et al., 2013; Ebekozien et al., 2022). As industries undergo rapid digital transformation, educational institutions must evolve to keep pace. Technical education is no longer confined to traditional workshops or classroom-based learning. Instead, it is becoming increasingly digital, immersive, and student-centered. These changes are especially crucial in Nigeria, where aligning education with the modern workforce's demands is vital for national development and individual empowerment (Ogbuanya & Chukwuedo, 2017). Emerging technologies are tools or systems still evolving, yet are expected to transform how we live, work, and learn. According to Bailey (2022), these technologies possess disruptive potential, often creating new markets and solving complex challenges. In technical education, they enable learners to engage in risk-free simulations of real-world tasks, thus enhancing experiential learning and safety (Abidoye et al., 2022; Hajirasouli et al., 2023).

AI, another transformative force, enables adaptive and personalized learning. By analyzing students' learning behavior, AI systems can adjust content delivery to meet individual needs, provide timely feedback, and guide learners through mastery of concepts (Maghsudi et al., 2021). This personalized approach increases efficiency and effectiveness in learning, particularly for diverse learners in technical fields. Gamification, the use of game design elements in educational settings, has also shown promising results. It enhances student engagement, motivation, and collaboration by incorporating challenges, rewards, and competitive learning environments (Flores & Santos-Guevara, 2021). These interactive strategies are especially effective in keeping students involved in hands-on, technical subjects. Robotics and automation are also reshaping both industry and education. They not only reflect current industrial practices but also help students develop critical problem-solving and teamwork skills. Robotics laboratories enable learners to apply their knowledge in designing and troubleshooting systems, reinforcing both theoretical and practical competencies (Madaev et al., 2023; Zhao & Siau, 2017). As these technologies replace traditional manual jobs, training students to use and innovate with them has become a priority.

Moreover, data-driven learning environments and analytics now influence educational delivery and assessment. Through continuous data collection and analysis, instructors can track progress, personalize instruction, and refine curricula. Despite these advances, technical education in Nigeria continues to face significant challenges. Institutions like the South West University of Education are often constrained by outdated curricula, insufficient funding, and inadequate teacher training (Aina & Adio, 2020). These limitations hinder the full integration of technologies such as 3D printing, CAD, modern welding systems like MIG and TIG, and digital modeling tools that are already standard in global industries. Central to the discussion is the concept of students' learning outcomes, what students are expected to know, do, and value after an instructional experience. These outcomes, spanning cognitive, affective, and psychomotor domains, are key indicators of educational effectiveness (OECD, 2008). Factors influencing learning outcomes include curriculum relevance, instructional strategies, and student engagement, and by introducing immersive technologies, educators can foster deeper learning and promote higher-order thinking (Fraser, 1998). Skill acquisition, the bedrock of technical education, involves the internalization of practical abilities and problem-solving skills through repetition, feedback, and real-world application. Innovations such as VR and simulation technologies are making this process more efficient by offering safe, repeatable, and engaging learning experiences (Bozalek et al., 2013).

While the Nigerian National Policy on Education (FRN, 2014) promotes functional curricula that encourage innovation and self-reliance, implementation gaps persist. There is limited research on how emerging technologies directly impact student learning outcomes across all areas: cognitive, psychomotor, and affective in Nigerian universities of education. This study, cosequently seeks to investigate the impact of integrating emerging technologies into technical education curricula on students' learning outcomes at South West University of Education in Nigeria. It aims to provide evidence on how such integration can bridge current gaps in skill acquisition and academic performance, ultimately enhancing graduate employability and contributing to national development.

LITERATURE REVIEW

The integration of emerging technologies into technical education is transforming how students learn and apply practical skills. Tools like Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), robotics, and digital learning platforms are increasingly central to modern teaching methods, promoting immersive and interactive learning environments that align with current workplace demands.

Virtual Reality stands out for its ability to simulate real-life work scenarios such as welding or machining in a safe, cost-effective environment. It allows learners to practice repeatedly, improve performance, and build confidence without the risk of injury or resource waste (tomDieck et al., 2021). Augmented Reality, on the other hand, enhances physical learning spaces by overlaying digital content on tools and systems, helping students visualize complex tasks. This has improved learning accuracy in trades like plumbing and metalwork (Kwiatek et al., 2019; Agrawal & Pillai, 2020; Papakostas et al., 2022). Isham et al. (2021) also asserted that VR-trained students outperformed peers trained through traditional methods.

Robotics and AI bring additional value by developing problem-solving and adaptability skills. AI-powered platforms track student progress and provide real-time feedback, making learning more personalized (Kong et al., 2023). Mobile learning apps and online simulations further expand access to flexible, self-paced training (Logan et al., 2021; Prasetya et al., 2023). Blended learning, integrating theory with hands-on practice, has also been shown to deepen students' understanding. Erdem & Sirinterlikci (2015) noted that integrating labs with classroom instruction strengthens links between concepts and real-world application. Gamification, too, fosters engagement by making learning more interactive and fun, particularly in tactile subjects like welding (Amiruddin et al., 2023; Vasilevski & Birt, 2020; Zulfabli et al., 2019). Technologies like VR and AR also simulate real workplace conditions, preparing students before graduation while promoting soft skills like communication, collaboration, and independent learning (Lan et al., 2013; Lavrentieva et al., 2020; Rennie, 2019; Lin & Wang, 2021).

However, Nigerian technical education faces major implementation challenges, including outdated curricula, poor infrastructure, and a lack of trained educators (Aina & Adio, 2020; Adeyemo, 2020). Ogunlade (2022) identified a gap between students' skills and market needs, prompting calls for urgent curriculum reforms (Balogun, 2024). Research affirms that emerging technologies boost engagement, technical mastery, and academic success (Yusuf et al., 2021; Aguayo et al., 2017; Sepasgozar, 2020). Rooted in constructivist theory, that emphasizes hands-on, real-world learning (Vygotsky, 1978), these innovations support both mental and manual skill development (Adegbite & Olumide, 2021). Scholars agree that digital integration is no longer optional, but is essential (Hussein, 2023; Hajirasouli & Banihashemi, 2022; Leon et al., 2021; Tumpa et al., 2022). This literature review underscores both the potential and the pressing needs within Nigerian institutions like the South West University of Education.

Statement of the Problem

Rapid technological advancement is reshaping industries and demanding new skill sets, especially in technical fields. However, technical education in Nigeria, particularly institutions in South-West University of Education, has struggled to keep pace. Despite policy commitments, many programs still rely on outdated curricula, tools, and teaching methods, resulting in a mismatch between classroom training and workplace needs (Okolie et al., 2020; Aina & Adio, 2020). Globally, emerging technologies like VR, AR, AI, and robotics are revolutionizing industrial practices (OECD, 2021; UNESCO-UNEVOC, 2022), yet their adoption in Nigeria's technical institutions remains limited. Barriers include poor infrastructure, limited teacher capacity, and slow curriculum updates (Olumorin et al., 2018; Lawal & Ibrahim, 2021). while studies highlight the benefits of technology integration (Ogbuanya & Chukwuedo, 2017; Adegbite & Olumide, 2021), evidence from universities of education in South West Nigeria is scarce. This study addresses that gap.

Purpose of the Study

The main purpose of this study is to investigate the impacts of integrating emerging technologies into technical education curricula and their influence on students' learning outcomes in South-West University of Education, Nigeria. In particular, the study aims to:

To assess the extent of integration of emerging technologies in technical education curricula in the South-West University of Education, Nigeria.

To assess the integration of emerging technologies in the technical education curriculum on students' learning outcomes in terms of academic performance and skill acquisition

Research Questions

To what extent have emerging technologies been integrated into technical education curricula in South-West University of Education in Nigeria?

How does integration of emerging technologies in technical education curriculum influence students' learning outcomes in terms of academic performance and skill acquisition in South-West University of Education in Nigeria?

Hypotheses

Ho_1: There is no significant difference between the integration of emerging technologies and students' academic performance in South-West University of Education in Nigeria.

Ho_2: Integration of emerging technologies in technical education curriculum does not significantly influence students' learning outcomes in terms of academic performance and skill acquisition in South-West University of Education in Nigeria

METHODOLOGY

This study adopted a descriptive survey research design, which is suitable for investigating current practices, perceptions, and outcomes in real-life educational settings. The purpose was to gather quantitative data that represent how emerging technologies are integrated into technical education curricula and how they influence students' learning outcomes. The target population comprised all third-year students enrolled in automobile technology, building technology, electrical/electronic technology, metalwork technology, and woodwork technology education programmes in South-West University of Education in Nigeria, and all lecturers. A stratified random sampling technique was used to ensure representation across all major technical fields. Adopting a descriptive survey design, the research utilized a 30-item questionnaire administered to all lecturers and students' in South West University of Education in Nigeria, comprising 116 participants (85 students, 31 lecturers) from Lagos, Ogun, and Ekiti States. The instruments were validated by three lecturers, one from the University of Lagos, one from Tai Solarin University of Education, Ijebu- Ode and another from Ekiti State University, Ado Ekiti. Reliability was established using Cronbach's alpha, yielding a coefficient of 0.80, indicating a high level of internal consistency. Research Questions were analyzed using mean, and standard deviation (2.50 and above indicated agreement), while an independent samples test was used to test the hypotheses at a 0.05 significance level.

RESULTS

Research Question 1: To what extent have emerging technologies been integrated into technical education curricula South- West University of Education in Nigeria**?**

Table 1:

S/N	Items Statement	X	SD	DECISION
1	Modern Technologies has been introduced into the technical education curriculum	1.39	0.74	Disagree
2	Emerging technology, such as AR, AI, IOT, and robotics, is used during instruction.	1.33	0.68	Disagree
3	There adequate arrangement for learners' to access digital tools and learning platforms	1.60	0.72	Disagree
4	Virtual or augmented reality tools are used to simulate real-world applications	1.80	0.98	Disagree
5	The integration of modern technology is reflected in classroom assessments	1.46	0.62	Disagree

6	Workshops are equipped with modern technological tools for practical learning	1.58	0.93	Disagree
7	The university provides simulation software or virtual labs for technology-based training.	1.42	0.77	Disagree
8	Emerging technologies such as 3D printing or robotics are used during instruction.	1.53	0.92	Disagree
9	Technology education curriculum reflects current global trends in technology (e.g., automation, AI, robotics).	1.36	0.74	Disagree
10	There is frequent training on the use of digital instructional tools.	1.40	0.81	Disagree
11	The use of digital tools is encouraged across all departments.	1.67	0.94	Disagree
12	Learners participate in technology-based practical workshops.	1.44	0.97	Disagree
13	Institutions collaborate with technology companies to introduce modern tools to the student and lecturer	1.76	0.92	Disagree
14	Students' are regularly exposed to hands-on training using modern technologies	1.77	0.86	Disagree
15	Government policies support the University's efforts to modernize technical education	1.62	0.79	Disagree
	Total	**23.13**	**12.39**	
	Grand Total	**1.54**	**0.82**	

The results presented in Table 1 reveal a general disagreement among respondents regarding the integration of emerging technologies into the curriculum, with a low mean score of 1.54, below the acceptable benchmark of 2.50. The standard deviation of 0.82 indicates that most respondents shared similar views. This indicate a clear and consistent concern: modern technologies such as VR, AR, and AI are not yet meaningfully incorporated into technical education at South West University. The findings highlight a significant gap in efforts to modernize the curriculum and prepare students for today's technology-driven industries.

Research Question 2: H**ow** does the integration of emerging technologies in the technical education curriculum influence students' learning outcomes in terms of academic performance and skill acquisition at the South West University of Education in Nigeria.

Table 2:

S/N	Items Statement	X	SD	DECISION
1	Emerging technologies help students understand technical concepts better.	3.71	0.56	Agree
2	Students' practical skills improved with the use of advanced technologies.	3.60	0.91	Agree
3	Students are better prepared for the labor market because of exposure to digital tools.	3.40	0.89	Agree
4	Simulation tools help students apply classroom theory to real-life	3.50	0.87	Agree

	problems.			
5	Students are more motivated to learn when classes involve modern technology.	3.57	0.80	Agree
6	Students find it easier to grasp complex topics through virtual learning platforms.	3.29	0.91	Agree
7	Emerging technologies have improved the quality of students' practical project work.	3.40	0.97	Agree
8	Exposure to current technologies improves students' chances of employment after graduation.	3.84	0.37	Agree
9	Virtual and augmented reality tools enhance students practical training experience	3.30	0.79	Agree
10	Students are capable of working independently due to tech-based skill acquisition method	3.32	0.86	Agree
11	Hands-on practice with digital tools (e.g., CAD, CMC Stimulation, etc) how improved students' technical skills	3.71	0.72	Agree
12	Students perform better academically when modern Technologies are used during instruction.	3.43	0.86	Agree
13	The integration of emerging technologies has improved students' understanding of technical education.	3.55	0.77	Agree
14	Students retain concepts better when lessons are delivered using modern technologies tools	3.20	0.98	Agree
15	Students gained better practical experience through the Use of emerging technologies in the workshop	3.50	0.77	Agree
	Total	**52.32**	**12.03**	
	Grand Total	**3.49**	**0.80**	

Table 2 reveals a high mean score of 3.49, with a standard deviation of 0.80, indicating strong agreement among respondents that emerging technologies are having a positive effect on students' academic performance and skill acquisition. Tools such as CAD, Virtual Reality (VR), Augmented Reality (AR), and other digital media were recognized for improving both theoretical understanding and practical application. The consistency in responses suggests a shared belief that integrating these technologies is significantly enhancing learning outcomes in technical education at the university.

Hypothesis 1: There is no significant difference between the integration of emerging technologies and students' academic performance in the South West University of Education in Nigeria.

Table 3: t-test analysis of whether a notable difference exists between the integration of emerging technologies and students' academic performance in the South West University of Education in Nigeria

Respondents	X	SD	N	Df	t-cal	t-crit	Sig	Decision
Students	1.54	0.82	116	114	-12.6	±1.98	0.05	Reject
Lecturer								Ho

Table 3 shows that responses from 116 students and lecturers had a mean of 1.54 and a standard deviation of 0.82. With a t-value of -12.61 (greater than the critical value of ±1.98 at 0.05 significance), the null hypothesis was rejected. This indicates a significant difference, confirming that integrating emerging technologies into the curriculum has a meaningful impact on students' academic performance in technical education at South West University.

Hypothesis 2: Integration of emerging technologies in the technical education curriculum does not significantly have any influence on students' learning outcomes in terms of academic performance and skill acquisition at the South West University of Education in Nigeria

Table 4: t-test analysis of Integration of emerging technologies in technical education curriculum does not significantly have any influence on students' learning outcomes in terms of academic performance and skill acquisition in South West University of Education in Nigeria.

Respondents	X	SD	N	df	t-cal	t-crit	Sig	Decision
Students	3.49	0.80	116	114	13.33	±1.98	0.05	Reject
Lecturer								Ho

Table 4 shows a calculated t-value of 13.33, far exceeding the critical value of ±1.98 at the 0.05 significance level. This means the null hypothesis was rejected, confirming that emerging technologies significantly influence students' academic performance and skill acquisition. With a high mean score of 3.49, both students and lecturers strongly agreed that tools like VR, AR, AI, and digital media enhance learning, improving both theoretical understanding and hands-on skills in technical education.

DISCUSSION OF FINDINGS

The findings of this study shed light on both the challenges and benefits of integrating emerging technologies into technical education at South West University of Education, Nigeria. Table 1 indicates that the overall integration of technologies like VR, AR, AI, and digital platforms remains low, with a mean score of 1.54, well below the benchmark of 2.50. The standard deviation of 0.82 shows a consistent view among respondents. This suggests a shared concern among students and lecturers that modern instructional tools are not yet fully embedded in the curriculum. These results align with earlier studies by Aina and Adio (2020) and Adeyemo (2020), which identified persistent challenges such as outdated curricula, limited infrastructure, and a shortage of trained educators in Nigerian technical institutions.

Table 2 presents strong agreement on the positive effects of emerging technologies where they have been adopted. With a mean score of 3.49 and a standard deviation of 0.80, respondents agreed that tools like CAD software, virtual labs, and simulation platforms significantly enhance both academic learning and practical skill development. These findings support previous research by Kwiatek et al. (2019), Agrawal and Pillai (2020), and Lavrentieva et al. (2020), who found that immersive technologies improve learner engagement, accuracy, and real-world readiness.

Further analysis in Tables 3 and 4 strengthens this conclusion. The t-test results showed statistically significant differences in learning outcomes based on the integration of emerging technologies. In Table 3, the calculated t-value of -12.61 exceeded the critical value of ±1.98, confirming a meaningful relationship between technology use and academic performance. Table 4 showed a t-value of 13.33, indicating a strong influence on both theoretical knowledge and practical skills. These results supported the findings of Kong et al. (2023), which noted that technology-enabled instruction boosts student engagement, retention, and skill acquisition by providing personalized feedback and flexible learning environments. Overall, while integration remains limited, the evidence clearly supports the transformative potential of emerging technologies in technical education.

CONCLUSION

This study highlights a critical gap between the growing importance of emerging technologies and their limited integration into technical education at the South West University of Education, Nigeria. Despite the clear benefits of tools like VR, AR, AI, and CAD, such as improved academic performance, deeper engagement, and enhanced skill acquisition (Kwiatek et al., 2019; Lavrentieva et al., 2020), the adoption of these technologies remains low due to outdated curricula, poor infrastructure, and lack of trained educators (Aina & Adio, 2020; Adeyemo, 2020). However, where these technologies have been applied, respondents reported meaningful improvements in both theoretical understanding and hands-on competence. The findings support calls for urgent curriculum reform and increased investment in teacher training and digital infrastructure (Ogunlade, 2022; Balogun, 2024). For technical education to remain relevant and competitive, it must embrace these innovations to better prepare students for a fast-changing, tech-driven workforce.

RECOMMENDATIONS

Based on the study's findings and insights from key scholars, the following recommendations are proposed to enhance the integration of emerging technologies into technical education:

Curriculum Reform: The University should urgently update its technical education curriculum to include modern tools like VR, AR, AI, and simulation platforms (Balogun, 2024; Tumpa et al., 2022). These technologies align learning with industry standards.

Lecturer Training and Support: Regular professional development is essential to equip educators with the skills needed to teach using digital tools effectively (Adeyemo, 2020). Without this, technologies remain underutilized.

Infrastructure and Resource Upgrade: Laboratories and workshops must be equipped with up-to-date hardware and software. Investment in these resources, along with capacity-building programs, is vital for effective implementation (Aina & Adio, 2020; Ogunlade, 2022).

Pilot Projects and Gradual Rollout: Small-scale pilot programs can help test and refine the use of new technologies before full implementation.

Stronger Industry Partnerships: Collaborations with industries can ensure that what is taught reflects real-world practices. Tools like VR and AR can help bridge the gap between the classroom and workplace (Lavrentieva et al., 2020; Leon et al., 2021).

Interactive and Gamified Learning: Integrating gamification and interactive media can boost student motivation and participation (Zulfabli et al., 2019).

Blended and Personalized Models: Hybrid learning models that combine traditional teaching with digital tools and intelligent systems support self-paced, engaging learning (Logan et al., 2021; Kong et al., 2023).

Continuous Evaluation: Regular monitoring should be embedded to track the impact of technology on learning outcomes and guide future improvements.

Therefore, integrating emerging technologies into technical education curricula is no longer optional but essential. Institutions like South West University of Education must act strategically to close the gap and prepare students for a digital future.

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