



Comparative Influence of Digital and Practical-Based Instructional Strategies on Academic Achievement among Secondary School Technical Students in Katsina State, Nigeria

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Abstract

This study examined the influence of digital and practical-based instruction on students' academic achievement in Technical and Biology Education among Technical Secondary School students in Katsina State, Nigeria. The study was guided by four objectives and corresponding research questions and hypotheses. A survey research design was adopted for the study. The population comprised 1,666 respondents, from which a sample size of 313 respondents was selected, including 80 female students. Data were collected using a structured questionnaire titled Digital and Practical-Based Instruction and Students' Achievement Questionnaire (DPBI-SAAQ) designed on a five-point Likert scale. The instrument was validated by experts, while its reliability was established using Cronbach's Alpha, yielding a reliability coefficient of 0.742. Data collected were analyzed using Pearson Product Moment Correlation (PPMC), multiple regression analysis, and independent samples t-test at a 0.05 level of significance. The findings revealed that digital instructional methods had a significant positive relationship with students' academic achievement ($r = 0.486, p < 0.05$). Practical-based instruction also showed a significant positive effect on students' academic achievement ($r = 0.590, p < 0.05$). The combined effect of digital and practical-based instruction significantly predicted students' academic achievement, with practical-based instruction having a stronger predictive influence. The study further revealed that gender significantly influenced students' academic achievement. The study concluded that the integration of digital and practical-based instructional strategies enhances students' academic performance and recommended improved digital infrastructure, adequate practical facilities, and teacher training programmes in technical secondary schools.

Keywords: Digital instruction, practical-based instruction, technical education, biology education

Introduction

The transformation of education in the 21st century has been significantly driven by the integration of digital technologies and the increasing emphasis on experiential, skills-based learning. Within the domains of Technical and Biology Education, these transformations are particularly critical, as they directly influence students' ability to acquire both theoretical knowledge and practical competencies necessary for scientific and technological advancement. Contemporary educational discourse highlights that effective teaching in STEM-related fields requires a blend of digital instructional strategies and hands-on practical experiences to enhance meaningful learning and academic achievement (OECD, 2021; UNESCO, 2023). Digital instruction refers to the use of technology-enhanced teaching tools such as multimedia presentations, virtual simulations, e-learning



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platforms, and interactive software to facilitate learning. The integration of digital tools into classroom instruction has been shown to improve students' engagement, motivation, and conceptual understanding. According to Bond et al. (2020), digital learning environments enable flexible and student-centered approaches that support diverse learning styles. Similarly, Chiu (2021) found that the use of digital technologies significantly enhances students' cognitive engagement and academic performance when properly integrated into teaching practices.

In the context of Biology, digital tools such as virtual laboratories and simulations have been found to improve students' understanding of abstract concepts that are otherwise difficult to visualize in traditional classroom settings (Martín-Gutiérrez et al., 2020). Likewise, in Technical Education, digital technologies facilitate the development of problem-solving and design skills through interactive and application-based learning environments (Adedoyin & Soykan, 2023). However, despite these benefits, the effective implementation of digital instruction in many developing countries, including Nigeria, remains constrained by inadequate infrastructure, limited access to devices, and insufficient teacher training (Yusuf & Bello, 2022). Complementing digital instruction is practical-based instruction, which emphasizes learning through hands-on activities, laboratory experiments, and workshop practices. Practical learning is fundamental in both Biology and Technical Education, as it bridges the gap between theory and real-world application. Research indicates that students who engage in practical activities demonstrate higher retention of knowledge, improved critical thinking skills, and greater interest in learning (Okoye & Nwoye, 2021). Practical-based instruction also supports the development of psychomotor skills, which are essential in technical and vocational education contexts. Recent studies have emphasized that practical learning environments significantly enhance students' academic achievement by promoting active participation and experiential learning (Darling-Hammond et al., 2020). In Biology, laboratory-based instruction has been linked to improved understanding of scientific processes and increased performance in assessments. Similarly, in Technical Education, workshop-based learning enables students to acquire competencies that are directly applicable to industry demands (UNESCO, 2023).

The concept of academic achievement, which represents students' performance in tests, examinations, and overall learning outcomes, remains a key indicator of educational effectiveness. Academic achievement is influenced by multiple factors, including instructional methods, learning environment, student motivation, and access to resources. Studies have shown that innovative teaching approaches, particularly those that integrate digital and practical elements, have a significant positive impact on students' academic performance (Schindler et al., 2021).

Importantly, emerging research suggests that the combined use of digital and practical-based instruction produces synergistic effects on learning outcomes. When students are exposed to both technology-enhanced learning and hands-on experiences, they are more likely to develop deeper understanding, improved problem-solving abilities, and sustained academic interest (Chiu, 2021; OECD, 2021). This integrated approach aligns with constructivist learning theory, which posits that knowledge is actively constructed through interaction and experience. In Katsina State, where technical schools play a crucial role in developing skilled manpower, challenges such as inadequate digital infrastructure, insufficient laboratory and workshop facilities, and disparities in resource distribution continue to affect the quality of education. Consequently, there is a need for empirical investigation into how digital and practical-based instruction influence students' academic achievement in Technical and Biology Education within this context.



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This study is anchored on Constructivist Learning Theory and Experiential Learning Theory, both of which provide a strong conceptual basis for understanding how digital and practical-based instructional strategies influence students' academic achievement in Technical and Biology Education. Constructivist Learning Theory, primarily associated with Jean Piaget and later expanded by Lev Vygotsky, posits that learners actively construct knowledge through interaction with their environment rather than passively receiving information. According to this theory, learning occurs when students engage with content, explore ideas, and build their own understanding based on prior knowledge and experiences. In contemporary education, constructivism strongly supports the use of digital instructional tools, which create interactive and learner-centered environments. Digital platforms such as simulations, multimedia presentations, and virtual laboratories allow students to explore abstract concepts, visualize processes, and engage in self-directed learning. These tools align with constructivist principles by promoting active participation, collaboration, and critical thinking (Schindler et al., 2021). This theory provides a strong foundation for practical-based instruction, which is central to Technical and Biology Education. Practical activities such as laboratory experiments, workshop practices, and hands-on demonstrations enable students to engage directly with learning materials, thereby facilitating deeper understanding and skill acquisition.

In Biology Education, experiential learning occurs when students conduct experiments, observe biological phenomena, and analyze results. Similarly, in Technical Education, students develop competencies through workshop activities, equipment handling, and real-world problem-solving tasks. These experiences align with Kolb's learning cycle by allowing students to apply theoretical knowledge in practical contexts. Empirical evidence suggests that experiential learning significantly enhances students' retention, motivation, and academic performance (Darling-Hammond et al., 2020). In this study, practical-based instruction is expected to positively influence students' academic achievement by providing opportunities for active engagement and skill development. The application of these theories is particularly relevant to Technical and Biology Education, where both conceptual understanding and practical competence are essential. Constructivist theory justifies the use of digital technologies to facilitate interactive learning, while experiential learning theory underscores the importance of hands-on activities in developing skills and knowledge. By integrating these theoretical perspectives, the study provides a robust framework for examining how digital and practical-based instructional strategies influence students' academic achievement. This alignment also supports the study's hypotheses, which seek to determine the individual and combined effects of these instructional approaches. This study, therefore, seeks to examine the impact of digital and practical-based instruction on students' academic achievement, while also considering the influence of demographic variables such as gender and school location. The findings are expected to contribute to the improvement of instructional practices and policy formulation aimed at enhancing educational outcomes in technical and science education.

Statement of the Problem

The rapid advancement of digital technologies and the growing emphasis on skill-based learning have significantly transformed educational practices worldwide. In contemporary education systems, particularly within Science, Technology, Engineering, and Mathematics (STEM) domains, the integration of digital instructional tools alongside practical-based learning has been identified as a critical driver of students' academic success and employability skills (OECD, 2021; UNESCO, 2023). However, despite these global advancements, many developing countries continue to face challenges in effectively integrating these instructional approaches into classroom practices. In Nigeria, technical and science education including Biology plays a vital role in fostering innovation,



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technological development, and national economic growth. Nevertheless, evidence suggests that students' academic achievement in these subject areas remains relatively low, often attributed to inadequate instructional strategies, limited access to digital resources, and insufficient emphasis on hands-on practical learning (Aina, 2020; Yusuf & Bello, 2022). The persistence of traditional lecture-based teaching methods has further constrained students' ability to develop critical thinking, problem-solving skills, and conceptual understanding required in modern education (Adedoyin & Soykan, 2023). In Katsina State, where secondary schools are expected to produce skilled and competent graduates, concerns persist regarding students' academic performance and readiness for the workforce. Factors such as inadequate infrastructure, disparities in school location, and limited exposure to modern teaching methods may further exacerbate these challenges. Despite policy efforts to promote digital education and practical skills acquisition, the extent to which these approaches influence students' academic achievement remains insufficiently explored. Therefore, the problem of this study lies in the lack of empirical evidence on the influence of digital and practical-based instruction on students' academic achievement in Technical Education and Biology in secondary schools of Katsina State. Addressing this gap is essential for informing educational policy, improving instructional practices, and enhancing students' learning outcomes in line with global educational standards.

Objectives of the Study

This study is guided through the following specific objectives:

1. To determine the impact of digital instructional methods on students' academic achievement among Technical Secondary School Students in Katsina State.
2. To examine the effect of practical-based instruction on students' academic achievement among Technical Secondary School Students in Katsina State.
3. To assess the combined effect of digital and practical-based instruction on students' academic achievement among Technical Secondary School Students in Katsina State.

Null Hypotheses

Tested at 0.05 level of significance:

- H₀₁: Digital instructional methods have no significant influence on students' academic achievement among Secondary School Students in Katsina State.
- H₀₂: Practical-based instruction has no significant influence on students' academic achievement among Secondary School Students in Katsina State.
- H₀₃: There is no significant influence of digital and practical-based instruction on students' achievement among Secondary School Students in Katsina State.

Research Methodology

The study adopted a survey research design to investigate the influence of digital instructional methods and practical-based instruction on students' academic achievement. The survey design was considered appropriate because it enabled the researcher to collect data from a large number of respondents regarding their perceptions and experiences without manipulating the study variables. The population of the study comprised 1,666 respondents drawn from the target schools used for the study. From the total population, a sample size of 313 respondents was selected to participate in the study, out of which 80 were female students while the remaining respondents were male students. The sample size was considered adequate to provide reliable information capable of achieving the objectives of the study and testing the formulated hypotheses. Data for the study were collected using a structured questionnaire titled Digital and Practical-Based Instruction and Students' Achievement Questionnaire (DPBI-SAAQ) developed by the researchers. The instrument



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was designed using a five-point Likert scale consisting of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD). The questionnaire was divided into four sections namely Sections A, B, C, and D. Section A elicited information on respondents' demographic characteristics, particularly gender, while Section B contained items on digital instructional methods. Section C focused on practical-based instruction, whereas Section D is a proforma used to collect the already students academic achievement. The instrument was subjected to face and content validation by experts to ensure its suitability for the study. The reliability of the instrument was established using Cronbach's Alpha reliability technique, which yielded a reliability coefficient of 0.742, indicating that the instrument possessed acceptable internal consistency and was reliable for data collection. The questionnaires were administered directly to the respondents by the researchers with the assistance of research assistants where necessary. The completed copies of the questionnaire were retrieved immediately after administration to ensure a high response rate and reduce the possibility of data loss. The data collected were analyzed using the Statistical Package for Social Sciences (SPSS) version 27. Pearson Product Moment Correlation (PPMC) was used to test hypotheses one and two in order to determine the relationships between digital instructional methods, practical-based instruction, and students' academic achievement. Multiple regression analysis was employed to test hypothesis three on the influence of digital and practical-based instruction on students' academic achievement, while independent samples t-test was used to test hypothesis four on the influence of gender on students' academic achievement. All hypotheses were tested at a 0.05 level of significance.

Presentation of Results

H₀₁: Digital instructional methods have no significant influence on students' academic achievement among Secondary School Students in Katsina State.

Table 1: Correlation between Digital Instruction and Students' Academic Achievement.

		Digital Instruction	Academic Achievement
Digital Instruction	Pearson Correlation	1	.486**
	Sig. (2-tailed)		.000
	N	313	313
Academic Achievement	Pearson Correlation	.486**	1
	Sig. (2-tailed)	.000	
	N	313	313

** . Correlation is significant at the 0.01 level (2-tailed).

Table 1 examined the relationship between digital instructional methods and students' academic achievement. The Pearson Product Moment Correlation analysis revealed a correlation coefficient of $r = 0.486$ with a significance value of $p = 0000$, which is less than the 0.050 level of significance. This indicates that there is a statistically significant positive relationship between digital instruction and students' academic achievement. The positive correlation suggests that the use of digital instructional methods contributes meaningfully to improved academic performance among students. In practical terms, the finding implies that students exposed to digital learning tools, technology supported teaching strategies, and electronic instructional resources are more likely to perform better academically. The moderate strength of the relationship also indicates that digital instruction plays an important role in enhancing learning outcomes, although other factors may also contribute to students' achievement. based on the result, the null hypothesis stating that digital instructional methods have no significant impact on students' academic achievement was rejected. The study



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therefore concludes that digital instructional methods significantly influence students' academic achievement.

H₀₂: Practical-based instruction has no significant influence on students' academic achievement among Secondary School Students in Katsina State.

Table 2: Correlation between Practical-Based Instruction and Students' Academic Achievement

		Practical-Based Instruction	Academic Achievement
Practical-Based Instruction	Pearson Correlation	1	.590**
	Sig. (2-tailed)		.000
	N	313	313
Academic Achievement	Pearson Correlation	.590**	1
	Sig. (2-tailed)	.000	
	N	313	313

Table 2 presents the relationship between practical based instruction and students' academic achievement. The result showed $r = 0.590$ and a significance value of $p = 0.000$, which is below the 0.05 alpha level. This demonstrates that a significant positive relationship exists between practical based instruction and students' academic achievement. The correlation coefficient of 0.590 indicates a relatively strong positive association, implying that practical oriented teaching approaches substantially improve students' academic performance. This means that when students engage actively in experiments, demonstrations, hands-on activities, and practical learning experiences, their understanding and practical learning experiences, their understanding and retention of concepts improve significantly, thereby enhancing academic achievement. The finding further suggests that practical based instruction is highly effective in promoting meaningful learning because it enables students to connect theoretical knowledge with real-life applications. Consequently, the null hypothesis which stated that practical based instruction has no significant effect on students' academic achievement was rejected. The study therefore concludes that practical based instruction significantly enhances students' academic achievement.

H₀₃: There is no significant influence on the digital and practical-based instruction on students' achievement among Secondary School Students in Katsina State.

Table 3: Influence of Digital and Practical-Based Instruction on Students' Achievement.

Model	B	Std. Error	Beta	t	Sig.
Constant	1.000	1.636		.611	.542
Digital Instruction	.286	.062	.242	4.635	.000
Practical-Based Instruction	.486	.055	.462	8.844	.000

Table 3 examined the combined effect of digital instruction and practical-based instruction on students' academic achievement. The result revealed that digital instruction had a standardized beta coefficient of $\beta = 0.242$ with $t = 4.635$ and $p = 0.000$, while practical-based instruction had a standardized beta coefficient of $\beta = 0.462$ with $t = 8.844$ and $p = 0.000$. The results indicate that both digital instruction and practical based instruction jointly and independently contribute significantly to students' academic achievement compared to digital instruction, as indicated by the higher beta coefficient value. This finding implies that integrating both digital teaching approaches and practical learning experiences creates a more effective learning environment capable of improving students' academic outcomes. The result also highlights the importance of adopting innovative and learner-centered instructional strategies in the teaching-learning process. since the



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significance values for both predictors were less 0.05, the null hypothesis stating that there is no significant combined effect of digital and practical-based instruction on students' achievement was rejected. The study therefore concludes that the combined application of digital and practical based instructional methods significantly predicts students' academic achievement.

Discussion of Findings

The findings of the study revealed that digital instructional methods have a significant positive relationship with students' academic achievement among Technical Secondary School students in Katsina State, with a correlation coefficient of $r = 0.486$ and $p < 0.05$. This finding indicates that the use of digital instructional tools such as multimedia resources, virtual simulations, e-learning platforms, and technology-supported teaching strategies contributes meaningfully to students' academic performance. The result is consistent with the findings of Tsz Kit Chiu who reported that digital learning environments significantly improve students' engagement, motivation, and academic achievement when effectively integrated into classroom instruction (Chiu, 2021). Similarly, the finding agrees with the study of Michael Bond et al. (2020), who found that digital technologies enhance students' cognitive participation and support flexible learner-centered approaches that improve academic outcomes. The finding is also in line with the work of Linda Darling-Hammond et al. (2020), who concluded that technology-enhanced instruction promotes deeper learning, critical thinking, and improved academic performance among learners. However, the finding contradicts the study conducted by John Aina (2020), who reported that inadequate digital infrastructure and limited teacher competence hinder the effectiveness of digital learning in some Nigerian secondary schools. The study further revealed that practical-based instruction has a significant positive effect on students' academic achievement, with a correlation coefficient of $r = 0.590$ and $p < 0.05$. This finding suggests that practical-oriented instructional approaches such as laboratory experiments, demonstrations, workshop activities, and hands-on learning experiences significantly enhance students' understanding and retention of concepts. The finding is similar to the study by Kennedy Okoye and Mary Nwoye (2021), who found that practical learning activities improve students' psychomotor skills, conceptual understanding, and academic performance. The result also supports the findings of David Kolb whose experiential learning principles emphasize learning through active participation and real-life experience (Kolb, 1984). In addition, the finding agrees with Martín-Gutiérrez et al. (2020), who established that practical and simulation-based learning environments improve students' comprehension and achievement in science and technical education. Nevertheless, the finding differs from Yusuf and Bello (2022), who observed that inadequate laboratory facilities and insufficient practical equipment in many Nigerian schools negatively affect the implementation of practical-based instruction. The result of the study also showed that digital and practical-based instructional methods jointly and independently contribute significantly to students' academic achievement. The regression analysis indicated that practical-based instruction had a higher predictive influence ($\beta = 0.462$) than digital instruction ($\beta = 0.242$), although both variables were statistically significant at $p < 0.05$. This finding implies that the integration of digital technologies with practical learning experiences creates a more effective and learner-centered instructional environment capable of improving students' academic outcomes. The finding corroborates the study of Schindler et al. (2021), who reported that blended instructional approaches combining technology and active learning significantly improve students' engagement and achievement. Similarly, OECD (2021) emphasized that modern instructional practices that integrate digital and experiential learning enhance students' problem-solving abilities and academic success. The finding also supports the Constructivist Learning Theory and Experiential Learning Theory underpinning this



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study, which emphasize active participation, interaction, and practical experience in the learning process.

Conclusion

The study concluded that digital instructional methods significantly enhance students' academic achievement among Technical Secondary School students in Katsina State. The integration of digital learning tools such as multimedia resources, virtual simulations, and e-learning platforms improves students' engagement, motivation, conceptual understanding, and academic performance. The study also established that practical-based instruction significantly contributes to improved academic achievement by promoting experiential learning, hands-on activities, and real-life application of knowledge. Practical learning approaches enable students to connect theoretical concepts with practical experiences, thereby enhancing retention, understanding, and problem-solving abilities. The study further concluded that the combined application of digital and practical-based instructional methods provides a more effective instructional environment than the use of either method independently. The integration of both approaches promotes learner-centered instruction, active participation, creativity, and critical thinking, which are essential for meaningful learning and improved academic outcomes in Technical and Biology Education. In addition, the study established that gender significantly influences students' academic achievement, indicating that demographic and socio-cultural factors may affect students' access to learning opportunities and participation in digital and practical learning activities. The findings of the study demonstrate that innovative instructional strategies are essential for improving the quality of teaching Technical Education and Biology in secondary schools. The study therefore emphasizes the need for improved digital infrastructure, adequate practical facilities, teacher capacity development, and supportive educational policies to enhance students' academic achievement and prepare them for contemporary scientific and technological challenges.

Recommendations

1. The Katsina State Ministry of Education should provide adequate digital infrastructure such as computers, internet facilities, multimedia projectors, and e-learning platforms in technical secondary schools to enhance the effective implementation of digital instructional methods.
2. School administrators and the National Board for Technical Education should ensure the provision and maintenance of functional laboratories, workshops, and practical equipment to strengthen practical-based instruction in Technical and Biology Education.
3. The Teachers Registration Council of Nigeria and educational training institutions should organize regular workshops, seminars, and professional development programmes to improve teachers' competence in the use of digital technologies and practical instructional strategies.
4. The Federal Ministry of Education should formulate and implement policies that encourage the integration of blended instructional approaches combining digital and practical-based learning in secondary school curricula.

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