Effects of Scaffolding and Inquiry Teaching Strategies on Motor Vehicle Mechanics Work Students' Academic Performance and Retention in Government Science and Technical Colleges of Gombe State, Nigeria

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ABSTRACT

This study examined the effects of scaffolding instructional strategy and inquiry teaching method on Motor Vehicle Mechanics Work (MVMW) students' academic performance and retention in Government Science and Technical Colleges (GSTCs) of Gombe State, Nigeria. The study was guided by two research questions and two null hypotheses tested at a 0.05 significance level. A quasi-experimental non-equivalent research design was adopted, involving 34 NTC II MVMW students purposively selected from three GSTCs. Three different lesson plans were used (Scaffolding, Inquiry, and Conventional Teaching Strategies). Three instruments were used for data collection: Motor Vehicle Mechanics Work Performance Test (MVMWPT), Motor Vehicle Mechanics Work Retention Test (MVMWRT), and Cognitive Style Inventory (CSI). The MVMWPT and MVMWRT had reliability coefficients of 0.788 (KR-20) and 0.780 (Cronbach's Alpha), while the CSI had a reliability coefficient of 0.80. Data were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA). Findings revealed that the scaffolding strategy produced the highest mean gain (66.68), followed by the inquiry method (48.36) and the demonstration method (34.00). Regarding retention, scaffolding showed the smallest decline (-4.125), followed by inquiry (-4.000), and demonstration (-10.428). There was a significant difference in performance among students taught using the three methods, $F(2, 33) = 2660.847$, $p = 0.000$. The study concluded that the scaffolding instructional strategy is the most effective method for improving both academic performance and retention among MVMW students. It was recommended that MVMW teachers actively adopt a scaffolding strategy in their daily lessons, and that the Gombe State Ministry of Education organize regular training workshops to equip teachers with practical skills for designing scaffolded lessons and inquiry activities.

Keywords: Scaffolding, Inquiry, Demonstration, Academic Performance, Retention, Motor Vehicle Mechanics Work

INTRODUCTION

Technical and Vocational Education and Training (TVET) Institutions, especially Government Science and Technical Colleges (GSTCs) in Nigeria, are crucial for developing essential skills for industrial growth. These colleges aim to equip students with knowledge and practical training in fields like Motor Vehicle Mechanics Work (Okoye & Arimonu, 2021). However, concerns arise regarding student performance in technical subjects, attributed to ineffective instructional strategies and the prevalence of conventional teacher-centered approaches (Okwelle, 2020; Chika & Iwuchukwu, 2022).

The conventional teaching method, while effective for large classes and extensive content coverage, has faced criticism for being overly teacher-centred and failing to accommodate individual learner differences. Scholars like Hussaini et al. (2022) and Sultana and Zaki (2021) argue that this method, particularly in technical colleges, does not achieve desired learning outcomes or ensure quality instruction. Recent reports indicate a decline in

student academic performance, attributed to the reliance on ineffective traditional instructional approaches, as noted by Ogundola et al. (2020).

Scaffolding, a pedagogical approach offering temporary support that diminishes as student competence grows, has gained attention for improving academic performance, particularly in STEM fields (Nwikina & Nwanekezi, 2021; Johnson & Ifeoma, 2022; Asuquo, Eyo, & Idaka, 2023). It enhances problem-solving and conceptual understanding. Similarly, inquiry-based instruction promotes active participation and critical thinking, allowing learners to ask questions and develop new insights through evidence-based reasoning (Adedokun et al., 2020; Enemali & Moses, 2022; Ndudim, 2023).

Strategies like scaffolding and inquiry-based instruction are effective but affected by learner characteristics, especially cognitive styles such as concreteness and abstractness. Concrete learners prefer hands-on experiences, while abstract learners favor theoretical representations (Akpan, 2022; Obot & Ndem, 2021; Uka, 2023). In fields like automobile mechanics, recognizing the interaction between teaching strategies and cognitive styles is essential for enhancing learning outcomes, suggesting that tailored instructional interventions can improve academic results and retention.

Retention of learned concepts is vital for evaluating instructional strategies in technical education, determining how well learners internalize and apply knowledge in real-world contexts (Olaoluwa & Adewale, 2021; Ezenwosu, Ogbu, & Ibe, 2022; Yusuf & Mohammed, 2024). In automobile education, the ability to recall procedures and guidelines is essential, and assessing scaffolding and inquiry strategies is crucial for understanding their long-term educational value.

Statement of the Problem

In Gombe State, low academic performance in automobile technology programs, particularly Motor Vehicle Mechanics Work (MVMW) in Government Science and Technical Colleges (GSTCs), has raised concerns among educators and policymakers. The Gombe State Ministry of Education reported poor results in the NABTEB Examination, leading to a decrease in candidates qualifying for tertiary institutions. Over five years, student participation in NABTEB for MVMW showed minimal variation, with 12 candidates in 2020, 14 in 2021, 20 in 2022, 16 in 2023, and 15 in 2024.

Over the past three years (2018-2023), students at the Government Science and Technical College, Kwami, have shown significant failure rates in the MVMW examination. In 2018, out of 12 candidates, only 1 passed; in 2020, 4 out of 5 passed; in 2021, 3 students passed; in 2022, 1 out of 11 passed; and in 2023, none of the 17 candidates passed. Overall, student performance in MVMW trades has been unsatisfactory, with numerous students scoring below 50%. Reports highlight consistently low scores in both theoretical and practical automobile subjects, raising concerns about the quality of technical college graduates in Nigeria, their mastery of automotive principles, and their capabilities to address real-life technical problems, which negatively impact the goals of technical and vocational education.

The problem is multi-dimensional, primarily stemming from the reliance on teacher-centered instructional strategies, like demonstration and lecture, which fail to engage students and foster deep understanding (Olowoye & Ajayi, 2022). Many students also struggle with abstract concepts in automobile technology, particularly in the absence of supportive instructional structures and inquiry-based learning opportunities (Okolie et al., 2023). Consequently, learners often lack the cognitive strategies necessary for retaining and transferring essential technical skills for workplace readiness.

Graduates from technical colleges may enter the labor market with inadequate competencies, impacting their employability and national industrialization efforts (Danladi & Umar, 2024). Poor performance in technical subjects, such as automobile technology, risks declining enrollments and a weakening skilled workforce (Yusuf, Audu, & Gimba, 2022). This study aims to investigate interactive, student-centered instructional strategies like scaffolding and inquiry-based teaching to enhance academic performance and retention in Government Science and Technical Colleges in Gombe State, Nigeria.

REVIEW OF RELATED LITERATURE

This study is anchored upon several interconnected theoretical pillars that provide a foundation for understanding how the instructional strategy of scaffolding and inquiry-based learning influences academic performance and knowledge retention among Motor Vehicle Mechanics Work (MVMW) students.

Sociocultural Theory, proposed by Vygotsky (1978), emphasizes that learning and cognitive development occur through social interaction and cultural context. Knowledge is co-constructed with more knowledgeable individuals, such as teachers or peers, using cultural tools and language. A key concept is the Zone of Proximal Development (ZPD), which defines the difference between what learners can do independently and what they can achieve with support. Effective teaching targets this zone, often utilizing scaffolding, temporary guidance that teachers provide until learners gain competence (Nwikina & Nwanekezi, 2021).

Constructivist Theory, as proposed by Piaget and Bruner, posits that learners build knowledge through prior experiences and environmental interactions. Inquiry-based instruction exemplifies this by promoting exploration, problem-solving, and reflection (Ndudim, 2023). In automobile education, this approach could involve students diagnosing simulated vehicle system faults by investigating causes and testing solutions.

Scaffolding Teaching Strategy and Students' Academic Performance

Scaffolding as a teaching strategy is based on Vygotsky's Zone of Proximal Development (ZPD), indicating that learners achieve more with temporary support. It involves structured assistance from teachers, peers, or materials, which is gradually reduced as learners gain competence, fostering autonomy and mastery (Johnson & Ifeoma, 2022).

Scaffolding in technical and vocational education is crucial for mastering complex psychomotor and cognitive tasks. For example, in automobile mechanics, students start with step-by-step guidance on disassembling a differential unit. Through repeated practice and reduced teacher intervention, they eventually achieve independent task performance, embodying the core principles of scaffolding: support, guided practice, and self-sufficiency.

Research highlights the benefits of scaffolding in Technical and Vocational Education and Training (TVET) contexts, including: improved academic performance through structured support leading to higher test scores (Awodun, 2024); enhanced retention via deeper cognitive engagement (Olaoluwa & Adewale, 2021); promotion of learner independence, especially in practical fields like automobile mechanics (Asuquo et al., 2023); and the development of higher-order skills through strategies like guided questioning, which encourage critical thinking and creativity (Zuo et al., 2023).

Inquiry-Based Teaching Method and Students' Academic Performance

Inquiry-based instruction (IBI) is a teaching method that prioritizes student engagement through questioning, exploration, and evidence-based reasoning, in contrast to traditional teacher-led instruction (Ndudim, 2023). In technical education, IBI enables learners to tackle real-world problems by applying theoretical knowledge to practical tasks, such as diagnosing automobile faults or evaluating braking system efficiency.

Inquiry-based instruction enhances technical education by fostering higher-order thinking skills, promoting long-term knowledge retention, aligning with real-world skills, and increasing student motivation and engagement (Enemali & Moses, 2022). This approach encourages students to analyze, evaluate, and synthesize information while simulating workplace scenarios to better prepare them for employment in technical fields (Ezenwosu, Ogbu, & Ibe, 2022) (Okolie, Nwajiuba, & Chinelo, 2023; Haruna *et al.*,2023) (Ndudim, 2023).

Demonstration Teaching Method and Students' Academic Performance

The demonstration method is a teacher-centered approach where educators explain and demonstrate processes for students to imitate, prevalent in technical and vocational education, particularly in workshop settings like

automobile technology. Its strengths include: clarity of procedures, enabling learners to observe exact steps; time efficiency, allowing complex tasks to be communicated to many students simultaneously; and safety assurance, as teachers model safety precautions during demonstrations. (Okwelle, 2020; Olowoye & Ajayi, 2022; Chika & Iwuchukwu, 2022).

Despite its advantages, the demonstration method faces criticism for several limitations: it is teacher-centered, making learners passive observers (Okwelle, 2020); it limits critical thinking as students often merely imitate (Chika & Iwuchukwu, 2022); and it results in weak retention rates compared to active learning strategies (Ezenwosu, Ogbu, & Ibe, 2022).

Concrete and Abstract Learners in MVMW

Cognitive learning styles encompass the preferred methods through which learners perceive and organize information. Distinct from intelligence, which assesses capacity, cognitive styles reflect individual preferences in problem-solving (Obot & Ndem, 2021). In technical and vocational education, recognizing these styles is crucial, as students show varied abilities in understanding abstract theories versus practical applications. Learners are generally classified as concrete or abstract, with the former favoring hands-on, visual learning, while the latter excels in theoretical and conceptual instruction (Uka, 2023). For instance, in Motor Vehicle Mechanics Work, concrete learners thrive in practical tasks like engine disassembly, whereas abstract learners may perform better in theoretical analyses such as interpreting wiring diagrams.

Cognitive learning styles significantly affect students' responses to instructional strategies (Obot & Ndem, 2021). Concrete learners prefer hands-on methods like demonstration and practical inquiry, while abstract learners thrive on lectures and theoretical discussions (Uka, 2023). Research indicates that a mixed approach that accommodates both types leads to improved outcomes in diverse classrooms (Yusuf & Mohammed, 2024). Thus, effective instructional design in technical colleges must account for these variations to enhance academic performance and retention.

Table 1: **Comparative Effectiveness of Scaffolding and Inquiry Methods in Other Vocational Subjects (Trades)**

Author(s)	**Vocational/Technical Subject (Trades)**	**Context/Location**	**Key Effectiveness Finding**
Numgwo, et al. (2017)	Basic Electronics	North-Central Nigeria (Science & Technical Schools)	Scaffolding and collaborative instructional approaches significantly improved student achievement in Basic Electronics over conventional methods.
Fakorede, S. O. A., & Lemo, O. O. (2019).	Automechanics Technology	Lagos State, Nigeria (Technical Colleges)	Students taught with scaffolding techniques showed a significant difference in academic achievement compared to those taught with the conventional lecture method.
Okolie, et al (2023)	Electrical Installation, Motor Listrik	SMKN 2 Probolinggo, Indonesia (Vocational School)	A comparison of Brain-Based Learning + Scaffolding vs. Argument Driven Inquiry + Scaffolding showed that the Brain-Based Learning + Scaffolding model was more effective in improving student

			activity and learning outcomes for Electric Motor Installation.
Kagara et al. (2020)	Blocklaying, Bricklaying & Concreting (BBC)	Niger State, Nigeria (Technical Colleges)	While the study identified constraints to using student-centered strategies, it highlights the recognized potential of these methods for the BBC trade.
Yang, X., & Khechornphak, T. (2026).	General Vocational Skills	Jiangxi Transportation Vocational and Technical College, China	Students in a dance art program showed significantly higher post-test choreography abilities after participating in scaffolding learning activities, along with high levels of student satisfaction.

METHODOLOGY

The study adopted a quasi-experimental non-equivalent research design using intact classes where random assignment was not possible, involving 34 NTC II MVMW students purposively selected from three Government Science and Technical Colleges in Gombe State. Three instruments were used for data collection: a 50-item Motor Vehicle Mechanics Work Performance Test (MVMWPT) with a KR-20 reliability coefficient of .788, a Motor Vehicle Mechanics Work Retention Test (MVMWRT) with Cronbach's Alpha of .780, and a Cognitive Style Inventory (CSI) with a reliability coefficient of 0.80. The instruments were validated by three experts from Modibbo Adama University, Yola, and Federal College of Education (Technical), Gombe. Data were collected over six weeks through pre-test, treatment, post-test, and retention test administration, with research assistants trained on the instructional strategies. The data were analyzed using mean and standard deviation for research questions, while Analysis of Covariance (ANCOVA) was employed to test the null hypotheses at a 0.05 significance level.

Summary of Scaffolding Lesson Activities and Teaching Procedures on Engine Lubrication Systems (80 Minutes)

This 80-minute scaffolding lesson on engine lubrication systems progresses through five structured phases designed to gradually shift responsibility from teacher to student. It begins with a 15-minute introduction where the teacher activates prior knowledge by showing seized engine components and using simple analogies (door hinge with/without oil) to define lubrication principles.

The 25-minute structured practice phase employs temporary supports including colored diagrams (red=friction reduction, blue=cooling, green=cleaning, yellow=sealing), fill-in-the-blank worksheets, and viscosity testing activities. During the 20-minute collaborative application**,** students are divided into three specialized groups (lubrication types, full-flow systems, by-pass systems) with assigned roles (Recorder, Presenter, Technician, Questioner) and provided sentence starters to complete system analysis and deliver peer presentations.

The 15-minute guided problem-solving phase implements gradual release of responsibility through think-aloud modeling, diagnostic scenarios of increasing complexity (low oil pressure, contamination, filter bypass failure), and maintenance checklists with fading teacher support.

The lesson concludes with a 5-minute independent demonstration where students complete assessment tasks, receive immediate feedback, and consolidate learning through summary frameworks and reference materials for future application.

Concise Summary of Inquiry-Based Lesson Activities and Teaching Procedures on Engine Lubrication Systems (80 Minutes)

This 80-minute inquiry-based lesson follows the 5E instructional model (Engage-Explore-Explain-Elaborate-Evaluate) to engage students in discovering engine lubrication systems. The 10-minute engagement phase presents a dramatic scenario, "an engine seized after 5 minutes without oil," using seized components to stimulate curiosity and generate student questions.

During the 25-minute exploration, students are divided into four investigation groups examining lubrication principles, functions, system types, and filtration methods through hands-on activities with oil samples, components, and cutaway models while documenting findings. In the 20-minute explanation phase, groups present their discoveries using technical terminology while the teacher facilitates conceptual understanding through animated diagrams and formalizing vocabulary like viscosity, boundary lubrication, and hydrodynamic lubrication.

The 15-minute elaboration phase applies learning to real-world diagnostic scenarios (low oil pressure warning, contamination issues, filter bypass failures) where students analyze symptoms, propose diagnostic sequences, and practice oil pressure testing.

The lesson concludes with a 10-minute evaluation involving practical identification exercises and scenario analysis, with immediate feedback provided to consolidate understanding and identify areas needing reinforcement.

Concise Summary of Demonstration Method Lesson on Engine Lubrication Systems (80 Minutes)

This 80-minute demonstration-based lesson employs a teacher-centered approach across five phases to deliver content on engine lubrication systems. The 10-minute introduction presents the lesson objectives and a real-world scenario that uses seized engine components to illustrate the consequences of lubrication failure, while students observe and take notes.

During the 25-minute structured demonstration**,** the teacher systematically demonstrates lubrication principles through metal-friction demonstrations, oil-film formation, viscosity testing with hot/cold samples, and temperature effects. At the same time, students observe, handle materials passed around, and copy chalkboard diagrams.

The 20-minute system demonstration phase features teacher-led presentations of three lubrication types (petrol, splash, pressure) using cutaway models and transparent containers, with students sketching systems and recording comparison notes. In the 15-minute filtration demonstration, the teacher presents full-flow and bypass systems using filter cutaways, flow diagrams, and bypass valve operation, while students' complete comparison tables from the chalkboard.

The lesson concludes with a 10-minute evaluation involving oral questioning, a quick written quiz, a homework assignment, and summary note-taking, with students passively receiving information throughout.

RESULTS AND DISCUSSION

Research Question 1: What is the mean difference in the post-test academic performance of MVMW students taught using scaffolding instructional strategy, inquiry, and demonstration methods in GSTCs of Gombe State?

Table 2: Pre-Test, Post-Test, and Mean Gain Scores of MVMW Students Taught Using Scaffolding, Inquiry, and Demonstration Methods

Teaching Method	N	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Gain
Scaffolding	16	29.875	2.825	96.562	1.590	66.687
Inquiry	11	29.363	1.206	77.727	1.678	48.364
Demonstration	7	29.285	1.380	63.285	4.029	34.000

Note: n=Number of students, SD=Standard deviation, Mean Gain = Post-test Mean – Pre-test Mean

Table 2 presents the Pre-Test and Post-Test academic performance of MVMW Students exposed to the scaffolding instructional strategy, inquiry method, and demonstration method. The 16 students taught using a scaffolding instructional strategy had a Pre-Test Mean of 29.87 with a corresponding SD of 2.82 and a Post-Test Mean of 96.56 with a corresponding SD of 1.59, giving a mean gain of 66.68. While the 11 students taught using the Inquiry Method produced a Pre-Test Mean score of 29.36 with a corresponding SD of 1.20 and a Post-Test Mean score of 77.72 with a corresponding SD of 1.67, giving a Mean gain of 48.36. And 7 learners taught in the Demonstration group had recorded a Pre-Test Mean score of 29.28 (SD = 1.38) and a Post-Test Mean score of 63.28 (SD = 4.02), giving a Mean gain of 34.00. Thus, all three methods led to an increase in academic performance from Pre-Test to Post-Test.

Based on the data presented and analyzed so far, there is clear evidence that the scaffolding method recorded the highest Mean Gain of 66.68, followed by the inquiry method with 48.36, and the demonstration method with 34.00. This suggests that the Scaffolding Strategy was more effective for improving MVMW Students' performance in GSTCs, Gombe State, within this study.

Research Question 3: What is the mean difference in the post-test academic performance of concrete learners and abstract learners among MVMW students taught using scaffolding instructional strategy, inquiry, and demonstration methods in GSTCs of Gombe State?

Table 3: Post-Test and Mean Gain of Concrete and Abstract Learners taught using Scaffolding, Inquiry, and Demonstration Method

Teaching Method	Learning Style	N	Post-Test Mean	Post-Test SD	Mean Gain
Scaffolding	Concrete	11	97.454	0.934	2.854
	Abstract	5	94.600	0.547	
Inquiry	Concrete	3	75.666	0.577	2.834
	Abstract	8	78.500	1.195	

Demonstration	Concrete	5	61.000	1.000	8.00
	Abstract	2	69.000	1.414	

Note: n=Number of students, SD=Standard deviation, Mean Diff = Concrete Mean – Abstract Mean

Table 3 reveals the mean difference in the post-test performance of concrete and abstract learners taught using the Scaffolding instructional strategy, Inquiry method, and Demonstration Method in GSTCs of Gombe State. For the Scaffolding group, 11 students (Concrete Learners) had a post-test mean of 97.45 with a corresponding standard deviation of 0.93, while their counterparts, 5 Abstract Learners taught using Scaffolding, had a post-test mean score of 94.60 with a corresponding standard deviation of 0.54. The mean gain between their Learning Styles stood at 2.85 in favour of Concrete Learners. For Inquiry, the 3 Concrete Learners had a post-test mean of 75.66 with a corresponding standard deviation of 0.57; their counterpart, the 8 Abstract Learners, had a post-test mean score of 78.50 with a corresponding standard deviation of 1.195. The mean gain in their Learning Style stood at 2.83 in favour of Abstract Learners. For demonstration, 5 Concrete Learners had a post-test mean of 61.00 with a corresponding standard deviation of 1.00; their counterpart, 8 Abstract Learners, had a post-test mean score of 69.00 with a corresponding standard deviation of 1.41. The mean gain in their Learning Style stood at 8.00 in favour of Abstract Learners.

Based on the data presented so far, it is clear that both concrete and abstract learners in all three methods led to an increase in academic performance. The scaffolding instructional strategy recorded the highest mean gain for both concrete and abstract students, followed by the inquiry method, and then the demonstration method.

Hypotheses

H_{01}: There is no significant difference in the performance of MVMW students taught using the scaffolding instructional strategy, inquiry, and demonstration methods in GSTCs of Gombe State.

Table 4: ANCOVA Summary for Effect of Teaching Method on Post-Test Scores with Pre-Test as Covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6098.021[a]	6	1016.337	1246.820	.000
Intercept	853.214	1	853.214	1046.705	.000
Pre-Test	4.585	1	4.585	5.625	.025
Teaching Method	4337.942	2	2168.971	2660.847	.000
Error	22.009	27	.815		
Total	243845.000	34			
Corrected Total	6120.029	33			

a. R Squared = .996 (Adjusted R Squared = .996)

The data in Table 4 present the analysis of covariance used to test the hypothesis of no significant difference in the performance of MVMW students taught using the scaffolding instructional strategy, inquiry, and demonstration methods, with pre-test scores as a covariate. F (2, 33) = 2660.847, p = 0.000, tested at the 0.05 level of significance. The computed p-value is less than the alpha level. Hence, the null hypothesis H_{01} is rejected. Thus, this concludes that there is a significant difference in the performance of MVMW students taught using scaffolding instructional strategy, inquiry, and demonstration methods in GSTCs of Gombe State.

$H0_2$: There is no significant difference in the performance of concrete and abstract learners among MVMW students taught using scaffolding instructional strategy, inquiry, and demonstration methods in GSTCs of Gombe State.

Table 5: ANCOVA Summary for Effect of learner's style on performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6098.021[a]	6	1016.337	1246.820	.000
Intercept	853.214	1	853.214	1046.705	.000
Pre-Test	4.585	1	4.585	5.625	.025
Learning Style	38.181	1	38.181	46.839	.000
Error	22.009	27	.815		
Total	243845.000	34			
Corrected Total	6120.029	33			

a. R Squared = .996 (Adjusted R Squared = .996)

The data in Table 5 present the analysis of covariance used to test the hypothesis of no significant difference in the performance of MVMW students taught using the scaffolding instructional strategy, inquiry, and demonstration methods, with pre-test scores as a covariate. F (1, 33) = 46.839, p = 0.000, tested at the 0.05 level of significance. The computed p-value is less than the alpha level. Hence, the null hypothesis $H0_2$ is rejected. Thus, this concludes that there is a significant difference in the performance of concrete and abstract learners among MVMW students taught using the scaffolding instructional strategy, inquiry, and demonstration methods in GSTCs of Gombe State.

DISCUSSION OF FINDINGS

Findings from research question 1 revealed that all three methods improved students' academic performance from pre-test to post-test. Scaffolded students recorded the highest Mean Gain of 66.68, followed by the inquiry method at 48.36 and the demonstration method at 34.00. This suggests that the Scaffolding Strategy was most effective in improving MVMW Students' performance in GSTCs in Gombe State. This result aligns with Nwikina and Nwanekezi (2021), who found that students exposed to scaffolding techniques performed significantly better than those taught with a conventional method. It also supports Johnson and Ifeoma (2022) and Awodun (2024), whose studies reported that scaffolding significantly improved students' achievement in basic science and physics, respectively. Therefore, scaffolding helps students bridge gaps between prior knowledge and new concepts, thereby boosting performance. The superior performance of the inquiry group

over demonstration is also consistent with Bello and Sani (2024) and Ndudim (2023), both of whom reported that inquiry-based learning led to significantly higher academic achievement than traditional methods. Based on these findings, it can be concluded that instructional methods significantly influence academic performance. The scaffolding strategy is most effective, followed by inquiry, while demonstration is the least effective for improving performance in MVMW among GSTC students in Gombe State.

Findings from research question 2 revealed that Concrete learners achieved a higher mean score under the scaffolding strategy (M=97.45) compared to abstract learners (Mean = 94.60), whereas abstract learners outperformed concrete learners under both the inquiry method (Mean = 78.50 vs 75.66) and demonstration method (Mean = 69.00 vs 61.00). This finding aligns with Uka (2023), who found that concrete learners performed significantly better with hands-on, structured strategies than abstract learners. The better performance of abstract learners under inquiry supports Bello, Hassan, and Sani (2024) and Ndudim (2023), who reported that inquiry-based learning significantly improved academic achievement and retention compared to traditional methods. Okolie, Nwajuba, and Chinelo (2023) further noted that while inquiry-based learning is perceived as highly effective, its impact is moderated by learner characteristics and contextual factors such as class size and teacher training. The finding also corroborates Awodun (2024) and Poorahmadi (2019), who demonstrated that scaffolding significantly enhanced student performance and comprehension. Additionally, Yusuf and Mohammed (2024), and Olaoluwa and Adawale (2021) established that differentiated and active learning strategies improve both immediate achievement and retention, reinforcing the need to match instruction to learner style. Based on these findings, it can be concluded that learners' style significantly moderates the effect of teaching methods on academic performance. Scaffolding is most effective for concrete learners, while inquiry is more effective for abstract learners. A one-size-fits-all approach is therefore inadequate for optimizing learning outcomes in MVMW among GSTC students.

Findings from Research Hypothesis 1 revealed that there was a significant difference in the performance of MVMW students taught using scaffolding instructional strategy, inquiry, and demonstration methods, $F(2, 33) = 2660.847$, $p = 0.000$, tested at the 0.05 level of significance. The teaching method significantly affected students' performance in GSTCs, Gombe State. This result aligns with Nwikina and Nwanekezi (2021), who found that students exposed to scaffolding techniques performed significantly better than those taught with a conventional method. It also supports Johnson and Ifeoma (2022) and Awodun (2024), whose studies reported that scaffolding significantly improved students' achievement in basic science and physics, respectively.

Findings from Research Hypothesis 2 revealed that there was a significant difference in the performance of concrete and abstract learners among MVMW students taught using the scaffolding instructional strategy, inquiry, and demonstration methods, $F(1, 33) = 46.839$, $p = 0.000$, tested at the 0.05 level of significance; therefore, learners' style significantly affected students' performance in GSTCs of Gombe State. This finding aligns with Uka (2023), who found that concrete learners performed significantly better with hands-on, structured strategies than abstract learners. The better performance of abstract learners under inquiry supports Bello, Hassan, and Sani (2024) and Ndudim (2023), who reported that inquiry-based learning significantly improved academic achievement and retention compared to traditional methods. Okolie, Nwajuba, and Chinelo (2023) further noted that while inquiry-based learning is perceived as highly effective, its impact is moderated by learner characteristics and contextual factors such as class size and teacher training.

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

This study investigated the effectiveness of the scaffolding instructional strategy and inquiry method on academic performance and retention of MVMW students in GSTCs, Gombe State, Nigeria. The study was driven by the persistent underperformance of MVMW students, alongside a noted deficiency in workplace readiness among technical college graduates. To address these challenges, the main purpose of this study was to examine how scaffolding and the inquiry teaching method influence students' learning outcomes and long-term memory retention in MVMW. 2 research questions were formulated to determine mean performance gains and retention differences. Two null hypotheses were formulated to test for statistical significance at an alpha level of 0.05.

The study adopted a quasi-experimental design, specifically a non-equivalent control group design. The total population comprised all 118 NTC II MVMW students. Through multi-stage sampling that combined purposive and simple random sampling techniques, a final sample size of 34 NTC II MVMW students were selected for active participation. The sampled participants were distributed across three independent, intact groups: Experimental Group 1 was exposed to scaffolding, Experimental Group 2 was taught using inquiry, and the Control Group received instruction via the conventional demonstration method. The experiment lasted for six weeks. Data were collected using 3 instruments developed by the researcher: the 50-item Motor Vehicle Mechanics Work Performance Test (MVMWPT), the Motor Vehicle Mechanics Work Retention Test (MVMWRT), and the cognitive style inventory (CSI). The KR-20 reliability coefficient and Cronbach's Alpha reliability methods confirmed that the instruments were highly consistent and suitable for use.

The data collected were analyzed using descriptive and inferential statistics. Means and standard deviations were used to answer research questions, while ANCOVA was used to test the null hypotheses at the 0.05 level of significance. The key finding of the study reveals that Scaffolding is the most effective instructional strategy for improving academic performance (Mean Gain: 66.68) and long-term retention in Motor Vehicle Mechanics Work, significantly outperforming inquiry-based and traditional demonstration methods. The study concluded that traditional, teacher-centered demonstration methods contribute to the ongoing underperformance and weak retention rates seen among MVMW students in Gombe State. The study recommends that Teachers in GSTCs across Gombe State should actively adopt and integrate the scaffolding strategy into their daily MVMW lessons to improve general performance and retention.

Conclusion

This study investigates how teaching methods directly affect the academic performance and knowledge retention of Motor Vehicle Mechanics Work (MVMW) students. The traditional demonstration method is not effective enough to fix students' underperformance or prepare them for the workplace. In contrast, student-centered approaches significantly improve learning and help students remember what they were taught. Specifically, the scaffolding strategy is the most powerful tool for teaching complex mechanical concepts as it breaks difficult steps into small, manageable parts. In conclusion, technical colleges must move away from traditional demonstration methods and adopt student-centered approaches to maximize success in MVMW programs.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. MVMW teachers in Government Science and Technical Colleges (GSTCs) in Gombe State should actively use scaffolding and inquiry methods instead of relying only on the traditional method (demonstration).
2. The Gombe State Ministry of Education should organize regular training/workshops to equip teachers with practical skills to design scaffolded lessons and inquiry activities.
3. Technical college teachers should use flexible teaching styles that match the individual learning styles of different students in their classrooms.

Suggestions for Further Studies

To expand on this research, the following areas are suggested for future studies:

1. A study on the effects of scaffolding and inquiry-based teaching methods on MVMW students' performance and retention in technical colleges in Osun State, Nigeria.
2. Investigation into the impact of digital and computer-aided scaffolding on student performance and retention in MVMW within Gombe State.
3. A study examining how gender and learning styles interact to affect student academic performance in MVMW within technical colleges in Adamawa State, Nigeria.
4. A replication of this study to test the effects of scaffolding and inquiry-based methods on MVMW student outcomes in technical colleges in Sokoto State, Nigeria.

REFERENCES

1. Abdullahi I. Haruna, R. Sankar, and Abdullahi Samaila (2023). Design and Development of an Instructional Mobile Robot for Effective Learning of Material Handling in Mechanical Workshop in Universities.
   In Press. *Materials Today: Proceedings. Elsevier.*https://doi.org/10.1016/j.matpr.2023.05.617
2. Abubakar, M., & Ibrahim, A. (2021). Assessment of students' academic performance in technical subjects in northern Nigeria. *Nigerian Journal of Technical Education*, 18(2), 55–64.
3. Atsumbe, B. N., Emmanuel, R., Owodunni, S. A., & Uduafemhe, M. E. (2017) Effects of Scaffolding and Collaborative Instructional Approaches on Science and Technical School Students' Achievement in Basic Electronics in North-Central States of Nigeria. https://www.semanticscholar.org/author/A.-B.-Numgwo/101792724
4. Adedokun, O. A., Olanrewaju, T. M., & Dada, O. (2020). Enhancing student engagement through inquiry-based instructional strategies in science education. *Journal of Educational Research and Practice*, 10(2), 34–45.
5. Akpan, E. A., Okon, B. I., & Udo, S. E. (2022). Influence of cognitive learning styles on academic achievement of technical college students in Akwa Ibom state. *Nigerian Journal of Technical Education*, 5(1), 45–53.
6. Amoer, A. K. (2016). Relevance of the acquisition of practical skills to the economic Empowerment of Nigerian Youths. *Rivers Conference Journal*, 3(2), 59–60.
7. Asuquo, P. N., Eyo, E. E., & Idaka, I. I. (2023). The effect of scaffolding strategy on students' academic performance in electrical installation and maintenance work. *Journal of Technical and Vocational Education*, 14(1), 72–85.
8. Awodun, A. O. (2024). Effects of scaffolding teaching strategy on students' academic performance in secondary school physics in Ekiti State. *Ipho Journal of Advanced Research in Education & Literature*, 2(2), 8–20.
9. Bello, A., Hassan, M., & Sani, I. (2024). Effects of inquiry-based learning on students' conceptual understanding and retention in computer craft practice. *Nigerian Journal of Educational Technology*, 17(2), 102-115.
10. Chika, O. V., & Iwuchukwu, O. E. (2022). Teacher-centered versus student-centered approaches in teaching technical education in Nigerian colleges: implications for practice. *International Journal of Educational Innovation*, 9(3), 118–127.
11. Danladi, Y., & Umar, B. (2024). Challenges of skill acquisition in automotive technology in Nigerian technical colleges. *Journal of Vocational Studies*, 9(1), 20–31.
12. Enemali, C., & Moses, J. U. (2022). Inquiry-based learning and the development of higher-order thinking skills in Nigerian technical colleges. *Nigerian Journal of Science and Technical Education*, 8(2), 89–98.
13. Ezenwosu, S. U., Ogbu, J. I., & Ibe, M. N. (2022). Retention ability of senior secondary school students taught physics using an inquiry teaching strategy in Nsukka. *Journal of Science Education and Technology*, 31(4), 712–722. DOI: https://doi.org/10.1007/s10956-022-09942-8
14. Fakorede, S. O. A., & Lemo, O. O. (2019). Effects of scaffolding instructional techniques on the academic achievement of automechanics technology students in Lagos State technical colleges. *Islamic University Multidisciplinary Journal*, *6*(3), 104–109. https://ir.unilag.edu.ng/handle/123456789/13322
15. Freire, P. (1970). *Pedagogy of the Oppressed*. Herder and herder.
16. Gombe State Ministry of Education. (2024). *NABTEB examination performance record of motor vehicle mechanics work students (2019–2021)*. Gombe: Department of Planning, Research and Statistics.
17. Hussaini, I., Inamullah, H. M., & Naseerud Din, M. (2022). Teachers' students' verbal interaction at the secondary school level. *Journal of College Teaching & Learning*, 5(9), 41–43.
18. Johnson, T. M., & Ifeoma, C. A. (2022). Effect of scaffolding teaching strategy on students' academic achievement in basic science. *African Journal of Educational Research and Development*, 14(2), 101–111.

19. Kagara, A. B., Ibrahim, D., Alhassan, N., & Sikirulahi, A. G (2020) Constraints to effective utilization of student-centered instructional strategies for teaching Blocklaying, Bricklaying and Concreting (BBC) at technical colleges in Niger State, Nigeria. https://www.semanticscholar.org/author/A.-B.-Kagara/100773079
20. Lawal, S., & Usman, K. (2022). Teaching challenges and student performance in technical subjects: a case study of Gombe State GSTCS. *West African Journal of Educational Practice*, 6(3), 110–122.
21. National Business and Technical Examinations Board (NABTEB). (2021). *Chief examiners' report: motor vehicle mechanic work.* Benin City: NABTEB.
22. Ndudim, M. E. (2023). Inquiry method and students' academic achievement in physics in Nigerian secondary schools. *African Journal of Curriculum and Instruction*, 11(1), 32–40.
23. Nwikina, C. G., & Nwanekezi, A. U. (2021). Effectiveness of the scaffolding technique on students' performance in introductory technology in Rivers State. *Journal of Educational and Social Research*, 11(5), 55–65. DOI: https://doi.org/10.36941/jesr-2021-0108
24. Obot, M. A., & Ndem, J. U. (2021). Cognitive styles and academic performance of students in technical subjects: implications for teaching strategies. *Journal of Vocational Education and Innovation*, 6(2), 40–48.
25. Ogundola, I. P., Popoola, A. A., & Oke, J. O. (2020). Effect of constructivist instructional approach on teaching practical skills to mechanical-related trade students in Western Nigeria technical colleges. *International NGO Journal*, 5(3), 59–64.
26. Okolie, U. C., Nwajiuba, C. A., & Chinelo, O. (2023). Innovative pedagogies in Nigerian TVET: a case for inquiry-based learning. *Journal of education and practice*, 14(4), 90–102.
27. Okoye, K. R. E., & Arimonu, M. O. (2021). Technical and vocational education and training (TVET) in Nigeria: issues, challenges, and a way forward. *Journal of Education and Practice*, 12(4), 53–62. DOI: https://doi.org/10.7176/JEP/12-4-07
28. Okolie, U. C., Nwajiuba, C. A., & Chinelo, O. (2023). Innovative pedagogies in Nigerian TVET: A case for inquiry-based learning. *Journal of Education and Practice*, *14*(4), 90–102.
29. Okwelle, P. C. (2020). Instructional strategies and students' academic achievement in Nigerian technical colleges. *International Journal of Innovative Education Research*, 8(1), 12–21.
30. Olaoluwa, O. O., & Adewale, A. S. (2021). Enhancing retention of learned concepts through active learning strategies among vocational students in Nigeria. *Nigerian Journal of Educational Technology and Innovation*, 3(1), 66–78.
31. Olowoye, T. A., & Ajayi, F. T. (2022). Rethinking instructional strategies for teaching automobile technology in Nigerian technical schools. *International Journal of Technical Education*, 11(2), 45–58.
32. Poorahmadi, M. (2019). The effect of employing scaffolding strategies and classroom tasks in teaching reading comprehension. *Journal of Teaching English as a Foreign Language and Literature*, 1(3), 87–106.
33. Sultana, D. & Zaki, S. (2021). Failure of conventional methods to deliver quality instruction in vocational colleges. *Journal of College Teaching & Learning*, 4(9):44-46.
34. Uka, A. O. (2023). Influence of abstract and concrete learning styles on the academic performance of technical college students. *Journal of Psychology and Education Studies*, 15(2), 91–100.
35. Vygotsky, l. S. (1978). *Mind in society: the development of higher psychological processes*. Harvard University Press.
36. Yang, X., & Khechornphak, T. (2026). Development of scaffolding learning activities to enhance choreography ability for vocational students. *วารสารการบริหาร การจัดการและการพัฒนาที่ยั่งยืน*, *4*(1), 218–227. สืบค้น จาก https://so15.tci-thaijo.org/index.php/jamsd/article/view/234
37. Yusuf, A., Audu, H., & Gimba, A. (2022). Enrollment and retention trends in technical colleges in north-east Nigeria: policy implications. *African Journal of Educational Research and Development*, 13(1), 70–82.
38. Yusuf, M. S., & Mohammed, L. M. (2024). Retention and achievement in automobile technology using differentiated instruction in Nigerian technical colleges. *Journal of Technical Education and Training*, 16(1), 25–36.

39. Zuo, H., He, W., & Wu, X. (2023). The impact of cognitive load theory on scaffolding design in online learning environments. *Educational Technology Research and Development*, 71(2), 701–721. DOI: https://doi.org/10.1007/s11423-023-10205-4