



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

Effects of Project-Based learning Strategy on Performance and Retention in Metalworks among Students in Technical Colleges of Katsina state, Nigeria

AMINU, Aliyu¹

aminualiyuchargy12@gmail.com

08061754640

NASIRU, Mukhtar²

nmukhtar.stc@buk.edu.ng

09035722487

¹ & ²Department of Industrial and Technology Education, Faculty of Education,
Bayero University, Kano, Nigeria

Abstract

The strategic importance of Technical and Vocational Education and Training (TVET) in national economic growth and development is globally acknowledged. In Nigeria, particularly in Katsina State, students' academic performance in Metalwork Technology, especially in welding and fabrication, has remained unsatisfactory. This study investigated the effect of Project-Based Learning (PjBL) on performance and retention in Metalwork among students in technical colleges in Katsina State, Nigeria. The study was guided by two research questions and two null hypotheses. A quasi-experimental design involving pretest, post-test, and post-posttest nonequivalent, non-randomized control groups was adopted. The population comprised 72 NTC II students, out of which 51 were purposively selected as the sample. The Welding and Fabrication Achievement Test (WFAT) served as the main instrument for data collection. The instrument was validated by six experts and yielded a reliability coefficient of 0.828 using the Kuder-Richardson 20 (KR-20) method. Data were analyzed using mean and standard deviation to answer the research questions, while ANCOVA was used to test the hypotheses. The findings revealed a significant difference in the mean achievement scores between students taught with PjBL and those taught with the demonstration method, with the PjBL group performing better academically. However, the PjBL group showed lower retention in the delayed post-test. The study concluded that PjBL enhances learning outcomes in Metalwork more effectively than the demonstration method. It was recommended that Metalwork teachers adopt PjBL and that educational authorities organize workshops to strengthen teachers' capacity for effective implementation.

Key words: Project-Based Learning, Performance, Retention, Metalwork, Welding and Fabrication.

Introduction

Technical and Vocational education Training (TVET) has continued to receive global attention because of its strategic position in national economic growth and development. Okoye and Arimonu (2016) described technical and vocational education as a comprehensive term in the educational process involving, in addition to general education, the study of technologies and related sciences and acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. Vocational and technical education equips the recipients with practical and applied skills as well as basic scientific knowledge. According to Kehinde and Adewuyi (2015), TVET is fundamental to the development and industrialization of nations. This is because, the saleable skills and competencies that are required for economic growth and development of the nation are embedded in vocational and technical education. In affirmation, Salihu and Nordin (2019) cited United Nations Educational, Scientific and Cultural Organization (UNESCO) (2001) which stated that TVET when properly developed provides the youths with knowledge, skills and training that satisfy the human resource demand of the nation.



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

National policy on education of Federal Republic of Nigeria (2014) enumerated the objectives of TVET in Nigeria to include: (i) provision of trained manpower in applied science, technology and commerce particularly at sub professional grades, (ii) provision of technical knowledge and vocational skills necessary for agricultural, industries, commerce economic development, (iii) provision of people who can apply specific knowledge to the improvement and solution of environmental problems for the use and convenience of man, (iv) giving an introduction of professional studies in engineering and other technologies, (v) giving training and impact the skills leading to the production of craftsmen, technicians and other skilled personnel's who will be enterprising and self-reliant and (vi) enabling our young men and women to have intelligent understanding of the increasing complexity of technology. TVET training is received at various levels including vocational training centers, technical colleges, and tertiary technical institutions.

Technical Colleges also known as technical schools, vocational schools, or career colleges, are institutions that provide specialized training and education in a specific technical field or industry (Hansen, 2017). These colleges focus on providing students with practical skills and hand-on experience to prepare them for immediate entry into the workforce (Gray & Herr, 2018). Technical College education centers around the performance in the psychomotor domain with relevant emphasis on cognitive and affective domains (Federal Government of Nigeria and National Board for Technical Education FGN 2004 and NBTE 2007). Technical College is viewed as an institution where vocational training is given to students. These skills will enable them to gain entry into various occupations like Automobile, Electrical/Electronic, and Mechanical Engineering Craft. Macdelyn Mosalagae and Bekker (2021) defined Technical College as the principal vocational institution that gives vocational training intended to prepare students for entry into various occupations as craftsmen and technicians. Both definitions are geared towards training for skill acquisition in different occupations. Hence, a Technical College can be described as an institution where students are trained in various occupations to acquire employable skills that will enable them to function well in the occupation in the world of work. By implication, much attention is focused on psychomotor performance or practical learning. The psychomotor component requires the appropriate use of workshop tools, equipment, and training materials that are necessary for effective training of the craftsman in his/her chosen trade. According to Federal Republic of Nigerian, (FRN, 2013), the students of technical colleges upon graduation are expected to either be employable in the industry or be self-employed. In order to achieve this goal, technical college curriculum was split into different trades with corresponding modules so as to enable learners choose and accomplish trade of their interest successfully. Technical colleges offer the following trades; Block laying, Bricklaying and Concreting; Carpentry and Joinery, Electrical/Electronic, Fabrication/Welding, Mechanical Engineering Craft Practice, Automobile Woodwork and Metalwork.

Metalwork has played a crucial role in human history, and it has been an essential driving force in the development of human society. It is a craft that is crucial in helping different societies to develop wealth, essential technologies and useful tools throughout history. According to Aluwong (2018), the contribution of metalwork technology to the development of a nation cannot be disputed as this profession is embraced and recognized worldwide. Danjuma and Umaru (2019) stated that Metalwork Technology is the activity of making objects/products out of metals. Metalwork is generally called Metalwork Technology because it involves modern ways of making metal products using different tools, equipment, and machines. According to Ahmad and Ahmad (2017), metalwork technology involves activities that entail designing products which include metal furniture,



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

automobile parts, and home-use metal products. In Nigeria, metalwork trade as a vocational training programme is offered in Technical Colleges, companies and designated skills acquisition centers. The various components of metalwork technology curriculum in technical colleges include General metalwork, Sheet metalwork, technical drawing and welding and fabrication. Welding and fabrication as an engineering craft practice offered at the technical colleges deal with the processes of forming and bonding of metals to form a useable object or structure. It is a trade in the mechanical engineering and Metalwork craft practice which gives the recipient the opportunity to exploit the entrepreneurial potentials of technical college trades. Welding and fabrication involve metals and the joining actions caused by the application of heat, pressure, and with or without filter materials (American Welding Society, 2013). Welding and fabrication programmes are designed to produce skilled craftsmen with good knowledge of the application of the equipment, materials, techniques and safety practices in metal projects. Welding and fabrication skill give the individual the ability to use their head and hands to build and construct metal structures from engineering specifications. People who enter into this trade normally develop specialized talents in structural fabrication or pressure related construction. It also instilled practical skills on individuals to be productive, high sense of self innovative, competitive, strong sense of determination, and creative in facing the challenges of the nation as well as globalization (Overton, 2015 in Aikhionbare, 2016). Furthermore, American Welding Society (2013) classified welding process into the following: forge welding, gas welding, metal arc welding, resistance welding, underwater welding, Thermit welding and induction welding.

In the context of this study, the researcher focuses on the two most commonly practiced types of welding; gas and electric arc welding. Gas welding is a welding process that uses fuel gases and oxygen during welding operation. Arc welding on the other hand, is a method of welding that uses an electric power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. Arc welding involves a process whereby coalescence is produced by heating the work piece with an electric arc set up between a flux coated electrode and the work piece. The metal arc welding is one of the most types of arc welding highly versatile and can be performed with relatively inexpensive equipment. Pipeline and structural welders use this method the most because of its deep penetration (how much it digs into the base metal), and pressure handling capabilities. Also, the electric arc welding is used due to stable supply of electricity and it's feasible. The arc welding may be done using direct current (DC) or alternating current (AC) but for this purpose AC may be more preferable. The AC could be better preferred to DC because it reduces the risks of environmental pollution in the sense that more carbon oxides will be emitted to the environment while using DC (Idibia, Thomas & Ugoji 2022).

Despite the overall relevance and importance of fabrication and welding for national development, the performance of metalwork students in Technical Colleges of Katsina State in not encouraging (Adeyemi, 2020; Afolabi, 2020 & Hassan 2023). Several researchers blamed the teaching approaches adopted by teachers as inappropriate (Adeyemi 2020). Most teachers in technical College employed demonstration and lectures learning in teaching practical based courses such as fabrication and welding (Hassan 2023) which have resulted in low academic performance of students in internal examination. National Business and Technical Examination Board (NABTEB) (2019-2023) have also shown that the percentage of students who passed metalwork at credit level and above fluctuates, and have not increased as expected. This study, therefore, intends to employ the use of project-based



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

learning in teaching fabrication and welding to observe if students' skills acquisition, academic performance, and retention would improve.

Project based learning (PjBL) is a method of instruction which involves knowledge and skills learnt by students through practical handling of problems in natural setting. According to Sunday, Owadara and Iwu (2016), PjBL is a teaching approach that actively engages students in sustained, collaboration, real world investigation. Akpan (2018) added that PjBL enhance students' knowledge of the content of a subject and the skills therein. During project-based learning, project is organized around a driving question and students participate in a variety of task that seek to meaningfully address this question. Sunday, et al (2016) opined that projects are complete tasks, based on challenges questions or problems that involve students in design, problems-solving decision making or investigative activities or an opportunity to work relatively autonomously over extended period of time. In a project- based learning, the central activities of the project must involve the transformation and construction of knowledge on the part of students. According to Josiah, Usman, Mallo, Umar and Inyang (2018), Project -based involves the construction or making of actual projects by the students. Such projects are students-centered, following standard, parameters, and milestones clearly identified by the teacher. Students have control over the planning, refining, presentation, and reflecting of the project. Through projects students are engaged in innovation and creativity. Project-based learning involved assignments that are call for students to produce something, such as process or products design (Josiah et al, 2018). Projects are usually done by students' groups but they may also be assigned to individuals to avoid many logistical and interpersonal problems, although doing so may cut down on the range of skills that can be developed through the project.

Project-based learning (PjBL) is grounded in constructivist learning theories, which emphasize student-centered and inquiry-based approaches to learning (Silver, 2017; Savery, 2015). PjBL involves students in exploring real-world problems and challenges, promoting deeper learning and critical thinking (Thomas, 2017; Wiggins & McTighe, 2019). Inquiry-based learning, a key component of PjBL, focuses on developing students' metacognitive skills, creativity, and problem-solving abilities (Larmer, Mergendoller, & Boss, 2015). Research has shown that PjBL can lead to improved student learning outcomes, including increased factual knowledge and deeper understanding of subject matter (Martinez, McGrath, & Foster, 2020). PjBL also enhances students' academic performance, motivation, retention and skill acquisition.

Academic performance refers to the level of achievement students attain in their studies, often measured through test scores, grade, or standardized assessments. Within the context of metal work, academic performance is shaped by practical skills, cognitive understanding and method (Aina & Olainipekum, 2015). Metalwork, as a technical subject, combines theoretical and practical components. Students' performance reflects their knowledge of materials, tools, and fabrication techniques, as well as their ability to apply this knowledge in practical setting (Ogbuanya & Umeh 2017). Yahaya and Nordin (2019) noted that students' academic performance is one of the current educational problems of public interest based on current low level of students' academic performance especially in various Technical Colleges. Over the years, the achievement of students in metalwork technology has continued to decrease and this has been an issue of concern to major stake holders in TVET in Nigeria and North-west Nigeria in particular. Low academic achievement, according to Aremu and Sokan (2023), is a performance that is adjudged by the examinee/testee as falling below an expected standard. Igberadja (2016) acknowledged the worrisome level of low academic



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

achievement of students in TVET subjects in Nigeria. May, Ajayi, Arogundadade and Ekundayo (2019) observed that TVET is very much still neglected which consequently is robbing the country of the economic development to be contributed by students of technical and vocational education. Similarly, Yahaya and Nordin (2019) reported that students' prospects for career pursuits in Metalwork is being hampered by their low performances. In quest for solution of the problem of low achievement of students in TVET, Igberadja (2016), noted that various factors related to teachers' qualification, age, experience, and inadequate teaching strategies may affect the academic performance of students in technical education. The report of National Board for Technical Education (NBTE) (2012) showed that factors that worsen low academic performance of students in metalwork are poor background of students, truancy, teaching and learning among others. Hence, it is clear that academic achievement of students in metalwork technology is greatly influenced by an interplay of some factors and socioeconomic variables.

Retention of learning is simply the ability to remember what has been learnt. Ezenwafor, and Obidile (2016) stated that retention is the ability to retain the knowledge of what is learnt and to be able to recall it when it is required. Retention has to do with the ability to recall and apply earlier learnt behaviour. Accordingly, Andriotis (2017) maintained that knowledge retention is the process by which novel information is transferred from one short term to long term memory. It is a learning that continues beyond the initial unit or a lesson that is assessed with test administered in two or more weeks after the information has been taught and tested. This implies that a student who recurrences an acquired piece of knowledge with less mistake is said to have retained the material taught. Okwelle, Dighobo and Patrick (2018) discovered that for long time retention of knowledge to be achieved, motivation of the learners must be sustained through the usage of appropriate teaching method. Such method should be capable of equipping the students with critical thinking skills. Thus, the ability of students to retain learnt skills for a long period of time would enable Fabrication and welding engineering craft personnel to remain relevant in today's world of work.

Research by Abdullahi and Yusuf (2022) found that students taught using Project-Based Learning (PjBL) retained more knowledge in foundry courses than those exposed to traditional lecture methods. The study suggested that engaging students in real-world problem-solving activities significantly improved their retention rates. According to Eze and Okonkwo (2021), co-teaching models positively influenced students' academic performance and retention in general metalwork. The findings demonstrated that collaborative teaching approaches help reinforce key concepts, leading to better long-term retention of technical knowledge. Afolabi and Akinyemi (2023) reported that interactive engagement strategies, such as hands-on learning and project-based activities, contributed to higher retention rates among metalwork students. Students involved in practical tasks demonstrated a deeper understanding of concepts, making their learning more sustainable. Upon this background, this study investigated the effects of PjBL on Skills Acquisition, Academic Performance, and Retention in Metalwork in Technical Colleges of Katsina State.

Statement of the Problem

In recent years, low academic performance among Nigerian students has become a major concern, particularly in technical education, as it hinders technological advancement. In subject like General Metalwork many graduates lack practical skills, sustained interest, and mastery for workplace success. Adeyemi (2020) asserted that technology education has recorded low academic performance of students in various technical course at most of the level of our educational system over the years. In view of these deteriorating trends in the performance of students generally in schools and colleges,



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

there is no doubt that the situation needs urgent attention. Studies like Adeyemi (2020), Afolabi (2020) and Hassan (2023) have shown low academic performance of students in internal examinations. National Business and Technical Examination Board (NABTEB) chief examiners report (2019-2023) have also shown that the percentage of students who passed metalwork at credit level and above fluctuates, and have not increased as expected. Low academic performance in Metal Work trade could be attributed to many factors among which the teachers teaching strategy is considered a major factor. This implies that the mastery of metalwork concepts might not be fully achieved without the use of appropriate instructional strategy. The teaching of metalwork trade without the use of instructional materials may certainly result in low academic performance of the students as shown in table 1

Table 1 NABTEB Performance of Students in Metalwork Examination (2019-2023) in Technical Colleges in Katsina State

Years	No.of Students Registered	No.of Students passed	No.of Students failed	% Pass	% Fail
2019	151	103	48	68%	32%
2020	157	103	54	65%	35%
2021	118	43	75	36%	63%
2022	129	60	69	47%	53%
2023	120	53	67	44%	56%

Source: Examination Officers of Respective Technical Colleges of Katsina State (2023).

Table 1 shows the dwindling performance of Metalwork students in NABTEB examinations. The table shows that students had a percentage pass higher than that of failure in only two (2) sessions (2019 & 2020) among the five (5) sessions considered in this study. This low performance has been attributed to so many factors among them is the teaching strategy employed by teachers which are mostly based on behavioral theorists. It could also be noted that the low performance can lead to students not adequately acquiring the right practical skills required in metalwork technology. This has been supported by the work of Jovita and Joseph (2020). Furthermore, low performance could be linked to low motivation as asserted by Muhammad (2022), which in turn affects the retention level of the students. Consequently, therefore this study is set to investigate the effects of projects-based learning on students’ skills acquisition, academic performance, motivation and retention in metalwork in technical colleges of Katsina state.

Research Questions

1. What is the difference in the mean academic performance scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught using demonstration method in Technical Colleges of Katsina State, Nigeria?
2. What is the difference in the mean retention scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught using demonstration method in Technical Colleges of Katsina State, Nigeria?

Null Hypotheses

The null hypotheses formulated for the study were tested at 0.05 levels of significance.

H₀₁: There is no significant difference in the mean academic performance scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught demonstration method in Technical Colleges of Katsina State, Nigeria.



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

H02: There is no significant difference in the mean retention scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught using demonstration method in Technical Colleges of Katsina State, Nigeria.

Methodology

This study adopted pre-test, post-test and post post-test, nonequivalent, non-randomized quasi-experimental design. The population of this study comprised 72 NTC II students, while 51 were purposively selected as the sample. The data were collected using Welding and Fabrication Achievement Test (WFAT) and was face and content validated by experts in the field. The reliability of the instrument was established through pilot testing using Kudar-Richardson-20(KR_20) with reliability of 0.828 Mean and standard deviation were used in answering the research questions, while analysis of covariance (ANCOVA) was used for testing the hypotheses at 0.05 levels of significance using statistical product and services solution version 25.

Presentation of Results

Research Question 1: What is the difference in the mean academic performance scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught using Demonstration methods in Technical Colleges of Katsina State, Nigeria?

Table 2: Pre-test and Post-test Mean Scores of Academic Performance of Metalwork Students Taught Arc and Gas Welding Using Project Based Learning and Those Taught Using Demonstration Method

Groups	N	Pre-test		Post-test		Mean Gain
		\bar{x}	SD	\bar{x}	SD	
Demonstration Group	26	14.96	3.21	19.85	2.98	4.89
PjBL Group	25	15.24	2.86	24.68	2.57	9.44
Mean Difference		0.28		4.83		4.55

The result presented in Table 2 shows that the experimental group that were taught arc and gas welding using PjBL had a mean score of 15.24 and SD of 2.86 in pre-test and a mean score of 24.68 and SD of 2.57 in the post-test making a pre-test, post-test mean gain in this experimental group to be 9.44. The control group that were taught using demonstration method had a mean score of 14.96 and SD of 3.21 in pre-test and mean score of 19.85 and SD of 2.98 in the post-test making pre-test, post-test mean gain of 4.89. These results indicated that both project based learning and demonstration method are effective in enhancing academic performance of metalwork students in arc and gas welding. But the results indicated that the effect of PjBL on academic performance of metalwork in arc and gas welding is higher than that of demonstration method. Therefore, PjBL is more effective than Demonstration method.

Hypothesis 1: There is no significant difference in the mean academic performance scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught using conventional Method.

Table 3 Analysis of Covariance (ANCOVA) of the Test of Significance Difference of Student Academic Performance Taught Arc and Gas Welding Using Project Based Learning and Those Taught Using Demonstration Method in Technical Colleges of Katsina State, Nigeria.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2438.57 ^a	2	1219.29	26.87	.000	.529
Intercept	14280.92	1	14280.92	315.03	.000	.868
Pretest	382.74	1	382.74	8.45	.006	.150
Group	1841.38	1	1841.38	40.60	.000	.461
Error	2178.91	48	45.39			
Total	180675.00	51				
Corrected Total	4617.48	50				

a. R Squared = .528 (Adjusted R Squared = .504)

The result presented in Table 3 shows that the type III sum of square is 1841.38 at df of 1, F-calculated value is 40.60 with a significance of F at .000 which is less than 0.05. The result revealed that there is a significant difference between the effects of treatments (project based learning and demonstration method) on metalwork students' academic performance in arc and gas welding. The null hypothesis is therefore rejected at .05 level of significance. Therefore, there is significant difference in the mean academic performance scores of metalwork students taught arc and gas welding using project-based learning and those taught using demonstration methods in favor of PjBL group. The Partial Eta Square (0.461) indicates a large effect size, meaning that approximately 46.1% of the variation in posttest performance was explained by the teaching method used.

Research Question 2: What is the difference in the mean retention scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught using Demonstration methods in Technical Colleges of Katsina State, Nigeria?

Table 4 Post-test and Post Post-test Mean Scores of Metalwork Students Taught Arc and Gas Welding Using Project Based Learning and Those Taught Using Demonstration Method

Groups	N	Post-test		Post-posttest		Mean Gain/ loss
		\bar{X}	SD	\bar{X}	SD	
Demonstration Group	26	19.85	2.98	16.34	3.10	3.51
PjBL Group	25	24.68	2.57	22.10	2.64	2.58
Mean Difference		4.83		5.76		0.93

The result presented in Table 4 shows that the experimental group that were taught arc and gas welding using project based learning had a mean score of 24.68 and SD of 2.57 in post-test, a mean score of 22.10 and SD of 2.64 in the post-posttest making a post-test, post-posttest mean loss to be 2.58. The control group that were taught using demonstration method had a mean score of 19.85 and SD of 2.98 in post-test and a mean score of 16.34 and SD of 3.10 in the post-posttest making post-test, post-posttest mean loss of 3.51. These results indicated that both project based learning and demonstration method are effective in retention of metalwork students in arc and gas welding. But the results indicated that, the students mean score taught in experimental group is higher than those taught in control group, suggesting that PjBL is more effective in improving the retention of Students than Demonstration method.



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

Hypothesis 3: There is no significant difference in the mean retention scores of metalwork students taught arc and gas welding using Project-Based Learning and those taught using Demonstration methods in Technical Colleges of Katsina State, Nigeria.

Table 5 Analysis of Covariance (ANCOVA) of the Test of Significance Difference of Student Retention Taught Arc and Gas Welding Using Project Based Learning and Those Taught Using Demonstration Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Corrected Model	1795.48 ^a	2	897.74	23.84	.000	.498
Intercept	12984.21	1	12984.21	345.24	.000	.878
Post-test (Covariate)	314.62	1	314.62	8.37	.006	.149
Group	1478.13	1	1478.13	39.31	.000	.450
Error	1804.74	48	37.60			
Total	169845.00	51				
Corrected Total	3599.12	50				

R Squared = .498 (Adjusted R Squared = .474)

The result presented in Table 5 shows that the type III sum of square is 1478.13 at df of 1, F-calculated value is 39.31 with a significance of F at .000 which is less than 0.05. The result revealed that there is a significant difference between the effects of treatments (project based learning and demonstration method) on metalwork students' retention in arc and gas welding. The null hypothesis is therefore rejected at .05 level of significance. Therefore, there is significant difference in the mean retention scores of metalwork students taught arc and gas welding using project-based learning and those taught using demonstration methods in favor of PjBL group. The Partial Eta Squared (0.450) indicates a large effect size, meaning that approximately 45.0% of the variation in posttest retention was explained by the teaching method used.

Discussion of Findings

The finding of Research Question 1 shows that students taught Arc and Gas Welding concepts using Project-Based Learning performed better academically than those taught using the conventional lecture method. This implies that active participation in project-based tasks deepens conceptual understanding and improves cognitive performance. The finding agrees with the works of Zechariah and Tumba (2024), Aydin and Mutlu (2023), and Eze, Onwusuru and Ginigeme (2021), who revealed that PjBL enhances students' academic achievement by linking theory with practice. Likewise, Eze et al (2023) found that students taught with PjBL achieved higher examination scores as a result of increased participation and critical thinking skills. However, the finding contradicts the studies of Kizkapan and Bektas (2017) and Sabri and Nasri (2022), who reported no difference between the academic achievements of students taught using PjBL and those taught using traditional methods. These authors suggested that teachers' lack of expertise in managing project-based activities and the short duration of the intervention may have limited its effectiveness.

Hypothesis 1 reveals that there is significant difference in the academic performance scores of metalwork students taught Arc and Gas Welding using PjBL and those taught using the lecture method, in favor of the PjBL group. This finding supports the work of Aydin and Mutlu (2023) and Kokotsaki, Menzies and Wiggins (2016) confirm that PjBL facilitates higher achievement through experiential learning and student-centered engagement.



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

The finding of Research Question 2 revealed that students taught concepts using Project-Based Learning retained knowledge and skills better than those taught through the lecture method. This suggests that active involvement in real-life project tasks promotes long-term understanding and memory. This finding is in agreement with the studies of Ginigeme (2020), Aydin and Mutlu (2023), and Ishaku (2024), who observed that learners exposed to PjBL demonstrated higher post-test retention scores than those taught through conventional instruction. Similarly, Onyebuenyi (2023) reported that retention improves when learners apply concepts in real-life contexts. However, this finding disagrees with the studies of Condliffe (2017), Aminu (2021), and Bala (2022), who reported no significant difference in retention between PjBL and conventional groups. They attributed this to poor follow-up activities and inadequate feedback after the project phase.

Hypothesis 2 reveals that there is significant difference in the mean retention scores of students taught metalwork using Project-Based Learning and those taught using the lecture method, in favor of the PjBL group. This finding aligns with the works of Aydin and Mutlu (2023) and Ishaku (2024), confirming that PjBL reinforces understanding, encourages reflection, and enhances long-term retention of knowledge in metalwork education.

Conclusions

Based on the findings of this study, it was concluded that

1. Technical College Metalwork Students taught Arc and Gas Welding using PjBL demonstrated high skills acquisition than the conventional methods
2. Project-Based Learning enhanced students' academic performance in Metalwork than Demonstration method.
4. Project-Based Learning better improved retention of knowledge and skills in Metalwork as compared to the Demonstration Method.

Recommendations

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

1. Adoption of Project-Based Learning (PjBL): It is recommended that Project-Based Learning should be adopted as an instructional strategy for teaching metalwork in technical colleges. Metalwork teachers and technical college administrators are responsible for implementing this approach. Teachers should incorporate PjBL activities into lesson plans and workshop practices, allowing students to engage in real-life metal fabrication projects that promote skill acquisition, motivation, and knowledge retention.
2. Teacher Training and Professional Development: There should be regular training and retraining of Metalwork teachers to enhance their competence in applying Project-Based learning effectively. The Ministry of Education, Science and Technical Education Board, and school managements should take the lead in organizing such capacity-building programs. This can be achieved through workshops, seminars, and continuous professional development programs focusing on PjBL design, implementation, and assessment techniques.
3. Provision of Adequate Teaching and Learning Resources: Adequate facilities, tools, and materials should be provided for the effective implementation of Project-Based Learning in Metalwork workshops. Government agencies, Technical Education Boards, and school proprietors should be responsible for this provision. They should allocate specific budgetary funds for the procurement and maintenance of welding machines, consumables, and safety equipment necessary for conducting practical projects.



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

4. Curriculum Review and Enrichment: The curriculum for Technical and Vocational Education should be enriched to integrate Project-Based Learning as a core instructional approach. The National Board for Technical Education (NBTE) and curriculum development agencies should take action on this recommendation. The NBTE should review existing syllabi to embed project-based components in every module, ensuring that students undertake practical projects that build entrepreneurial and technical competencies.

Reference

- Abdullahi, A. M., & Yusuf, I. B. (2022). Effects of problem-based learning on the students' retention of pre-service technology teachers in foundry in North-West Nigeria. *International Journal of Research and Innovation in Social Science* (IJRISS), 6(8), 230–241. <https://rsisinternational.org>
- Adeyemi, T. O. (2020). Effects of traditional teaching methods on students' achievement in metalwork technology. *Journal of Education and Practice*, 11(3), 1–10.
- Ahmad, A., & Ahmad, B. (2017). Entrepreneurial skills required by metalwork technology students for workforce sustainability in technical colleges in Lagos State. *International Journal of Social Science and Education Research Studies*. <https://ijssers.org/wp-content/uploads/2023/11/06-1511-2023.pdf>
- Afolabi, F. (2020). Technical and vocational education and training (TVET) for sustainable development in Nigeria. *Journal of Education and Human Development*, 9(1), 1–9.
- Afolabi, O. A., & Akinyemi, A. S. (2023). Effect of interactive engagement strategy on secondary school students' performance in metalwork in Ekiti State, Nigeria. *International Journal of Research and Innovation in Social Science* (IJRISS), 7(5), 120–129. <https://rsisinternational.org>
- Aina, J. K., & Olanipekun, S. S. (2015). A review of technical education in Nigeria: Challenges and way forward. *Journal of Education and Practice*, 6(22), 128–132.
- Akpan, I. M. (2018). Teachers' motivational strategies and academic performance of social studies students in junior secondary schools in Uyo Local Government Area. *GASPRO International Journal of Eminent Scholars*, 11(1), 124–133.
- Aminu, I. (2021). Retention outcomes of students taught technical subjects using project-based learning. *Journal of Industrial Education*, 13(1), 34–45.
- American Welding Society. (2013). Advancing the science, technology, and application of welding and allied joining and cutting processes worldwide. <https://www.google.com>
- Andriotis, N. (2017, January 10). Make your eLearning stick: 8 tips and techniques for learning retention. TalentLMS. <https://www.talentlms.com/blog/8-tips-techniques-learning-retention>
- Aremu, A., & Sokan, B. (2023). A multi-causal evaluation of academic performance of Nigerian learners: Issues and implications for national development. University of Ibadan.
- Aydın, G., & Mutlu, O. (2023). Project-based learning and the flipped classroom model supported project-based learning's impact on academic success, retention, and individual innovation competence. *International Journal of Contemporary Educational Research*, 10(4), 823–833. <https://doi.org/10.52380/ijcer>
- Bala, Y. (2022). Influence of project-based learning on academic retention among technical college students. *Nigerian Educational Research Review*, 20(2), 99–113.
- Condliffe, B., Quint, J., Visher, M. G., Bangser, M. R., Drohojowska, S., Saco, L., & Nelson, E. (2017). Project-based learning: A meta-analysis of outcomes. *Educational Research Review*, 22, 1–15. <https://doi.org/10.1016/j.edurev.2017.03.001>
- Danjuma, A. O., & Umaru, R. I. (2019). Availability and utilization of metalwork technology equipment in technical colleges in Nasarawa State, Nigeria. *Benue State University Journal of Education*. <https://bwjournal.org/index.php/bsjournal/article/view/313>



Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

- Eze, C. O., & Okonkwo, J. N. (2021). Effect of co-teaching model on academic achievement and retention of students in general metalwork. *Journal of Technical and Vocational Education Research*, 9(3), 112–125.
- Eze, T. I., Ezenwafor, J. I., & Obidile, J. I. (2016). Effect of gender on students' academic performance and retention in financial accounting in technical colleges. *British Journal of Education, Society and Behavioural Science*, 18(4), 1–9.
- Eze, T. I., Onwusuru, I. M., & Ginigeme, O. O. (2021). Gender-relative effect of project-based learning method on academic achievement and retention of technical college students in basic electricity. *NAU Journal of Technology & Vocational Education*, 6(1), 91–102. <https://doi.org/10.12928/jtved.v6i1.94>
- Federal Republic of Nigeria. (2004). National policy on education (4th ed.). Nigerian Educational Research and Development Council.
- Federal Republic of Nigeria. (2013). National policy on education (6th ed.). NERDC Press.
- Federal Republic of Nigeria. (2014). National policy on education (6th ed.). Government Printing Press.
- Gray, K. C., & Herr, E. L. (2018). Workforce education: A review of the literature. *Journal of Career and Technical Education*, 33(1), 1–23.
- Hansen, M. (2017). The role of technical colleges in workforce development. *Journal of Technical Education and Training*, 9(1), 1–12.
- Igberadja, S. (2016). Effects of teachers' gender and qualification on students' performance in vocational technical education. *Journal of Technical Education and Training*, 8(1), 34–42.
- Josiah, M. M., Usman, I. S., Mallo, Y. I., Umaru, M. G., & Inyang, U. S. (2019). Effects of project-based learning on students' achievement in secondary school physics in Bokkos Local Government Area, Plateau State. *Journal of Public Health*, 765–773. <https://doi.org/10.70135/seejph.vi.1560>
- Jovita, J., & Joseph, A. (2020). Gender influence on motivation and performance in technical subjects. *Technical Education Review*, 12(1), 15–22.
- Kehinde, T. M., & Adewuyi, L. A. (2015). Vocational and technical education: A viable tool for transformation of the Nigerian economy. *International Journal of Vocational and Technical Education Research*, 1(2), 22–31.
- Kizkapan, B., & Bektas, F. (2017). The effectiveness of vocational training programs on skill acquisition in technical education. *Journal of Vocational Education and Training*, 19(3), 204–217.
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, 19(3), 267–277.
- Lanmer, J., Mergendoller, J., & Boss, J. (2015). Setting the standard for project-based learning: A proven approach to rigorous classroom instruction. Genny Ostertag.
- Martinez, M. E., McGrath, D., & Foster, M. (2020). Project-based learning in STEM education: A systematic review. *Journal of STEM Education*, 21(1), 1–14.
- May, A. I., Ajayi, A., Arogundade, B. B., & Ekundayo, H. T. (2019). Assessing realities and challenges of technical education in Imo State secondary school education system in Nigeria. *Journal of Educational Administration and Planning*, 7(3), 2007.
- Mosalagae, M., & Bekker, T. L. (2021). Education of students with intellectual disabilities at technical vocational education and training institutions in Botswana: Inclusion or exclusion? *African Journal of Disability*, 10, 1–12. <https://doi.org/10.4102/ajod.v10i0.790>
- Muhammad, A. (2022). Technical education and economic growth. *Journal of Education and Human Development*, 11(1), 1–9.
- National Board for Technical Education. (2012). Vocational and technical education in Nigeria. Kaduna, Nigeria.
- Ogbuanya, T. C., & Umeh, E. A. (2017). Influence of learning environment on students' academic achievement in technical education. *International Journal of Educational Research*, 3(4), 54–62.



www.foefugusau.com.ng
des@fugusau.edu.ng

DOI: <https://doi.org/10.64348/zije.2025192>

Effects of Project-Based Learning Strategy on... Aminu, A. & Nasiru, M. (2025)

- Okoye, R. S., & Arimonu, M. O. (2016). Technical and vocational education in Nigeria: Issues, challenges and a way forward. *Journal of Education and Practice*, 7(3), 113–118.
- Okwelle, P. C., Dighobo, H., & Patrick, S. (2018). Gender participation in technical and vocational education and training in technical colleges in Rivers State, Nigeria. *International Journal of Innovative Social & Science Education Research*, 6(3), 118– 127. <https://www.seahipaj.org>
- Overton, W. F. (2015). Processes, relations, and relational-developmental-systems. In W. F. Overton & P. C. M. Molenaar (Eds.), *Theory and method* (7th ed., Vol. 1, pp. 9–62). In R. M. Lerner (Ed.-in-Chief), *Handbook of child psychology and developmental science*. Wiley.
- Sabri, N. M., & Nasri, N. M. (2022). The impact of project-based learning implementation in the classroom: Systematic literature review. *International Journal of Academic Research in Progressive Education and Development*, 11(3), 1–14. <https://doi.org/10.6007/IJARPED/v11-i3/14223>
- Salihu, Y., & Nordin, M. S. (2019). Socio-economic determinants of students' academic achievement in building technology in North-Central Nigeria. *Jurnal Pendidikan Teknologi dan Kejuruan*, 25(1), 10–20. <https://doi.org/10.21831/jptk.v25i1.20630>
- Sunday, A., Owadara, A. B., & Iwu, A. O. (2016). Effect of project-based method on students' achievement in physics: Implication for global competitiveness. *JORIND*, 14(1), 1–12.
- Thomas, J. W. (2017). A review of research on project-based learning. *Journal of Experiential Education*, 40(1), 5–20.
- Ugoji, P. C., Idibia, C., & Thomas, C. G. (2022). Impediments to effective school public relations in technical vocational education and training tertiary institutions in Nigeria. *International Research Journal of Modernization in Engineering Technology and Science*, 4(4). <https://www.irjmets.com>
- UNESCO. (2001). Mechanical engineering craft: National Technical Certificate (NTC) curriculum. <https://unesdoc.unesco.org/ark:/48223/pf0000161353>
- Wiggins, G., & McTighe, J. (2018). *Understanding by design* (3rd ed.). Association for Supervision and Curriculum Development.
- Zechariah, I., & Tumba, I. (2024). Effects of project-based instructional strategies on colleges of education students' achievement and retention in electronics technology in North-East Nigeria. *African Multidisciplinary Journal of Sciences and Artificial Intelligence*, 1(1), 264–280. <https://doi.org/10.58578/amjsai.v1i1.3535>