



Effects of Project-Based Learning Strategy on Skills Acquisition and Motivation in Cable Jointing among Technical College Students in Katsina State, Nigeria

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Abstract

The study investigated the effects of Project-Based Learning (PjBL) on students' skill acquisition and motivation in cable jointing in technical colleges in Katsina State, Nigeria. The study provided answers to four research questions and tested four null hypotheses. The study adopted a quasi-experimental pretest and post-test control group design. The population comprised of 47 NTC II EIMW students in Katsina State technical colleges, while the sample of the study utilized total population sampled and randomly assigned students into experimental and control groups. Three instruments were used for data collection: Cable Jointing Skill Acquisition Observational Checklist (CJSAOC) and Cable Jointing Motivation Questionnaire (CJMQ). The instruments were validated by five experts in Industrial Technology Education, Test and Measurement, Psychology and English Language, while the reliability of each instrument were established using appropriate statistical method. The reliability of Cable Jointing Skill Acquisition Observational Checklist (CJSAOC) was computed with Kendall's Coefficient of Concordance (W) which produced a reliability index of 0.97 indicating high level of agreement between the raters. The Cable Jointing Motivation Questionnaire (CJMQ) was subjected to Cronbach's Alpha which yield a reliability of 0.86 indicating higher reliability of Likert-scale items. The experimental group was taught cable jointing using the Project-Based Learning approach, while the control group received instruction through the conventional method. Data collected were analyzed using mean and standard deviation to answer the research questions, while Analysis of Covariance (ANCOVA) and Mann-Whitney U-test were employed to test the hypotheses at 0.05 level of significance. The findings revealed that students taught using PjBL achieved significantly higher post-test scores in skill acquisition and motivation than those taught Conventionally. The study concluded that Project-Based Learning is an effective instructional approach for enhancing students' cognitive and psychomotor learning outcomes in EIMW. The study recommended that technical colleges should adopt PjBL for teaching practical components of EIMW, teachers should be trained in PjBL techniques, and workshops should be equipped to support project-based activities.

Keywords: Project-Based Learning, Skill Acquisition and Motivation

Introduction

Technical Vocational Education and Training (TVET) plays an important role in equipping individuals with practical skills and technical knowledge required for employment, self-reliance, and national development. TVET refers to aspects of education that combine general education with the study of technologies, related sciences, and acquisition of practical skills for occupations in different sectors of the economy (UNESCO, 2015; NERDC, 2013). In Nigeria, TVET contributes to manpower development, entrepreneurship, productivity, and poverty reduction (Okoye & Arimonu, 2025; Salisu, Saidu, Yau & Musa, 2024). Despite its relevance, TVET in Nigeria still faces challenges such as poor funding, inadequate infrastructure, shortage of qualified instructors, outdated curriculum, and weak industry linkages, which affect the effectiveness of technical training (Oladejo, 2019; Salisu et al., 2024). Technical colleges are major TVET institutions established to provide students with technical and vocational competencies for employment and further education. According to the National Policy on Education (NERDC, 2013), technical colleges are expected to provide trained manpower in applied sciences, technology, and business, as well as equip learners with practical skills for self-reliance. These colleges offer trade programmes such as building construction, welding and fabrication, carpentry and joinery, radio and television repairs, and Electrical Installation and Maintenance Work (EIMW). Among these trades, EIMW is highly important because of its applications in residential, commercial, and industrial settings. Electrical Installation and Maintenance Work involves activities such as electrical wiring, installation of electrical devices, fault diagnosis, maintenance, and repair of electrical systems. One major component of EIMW is cable jointing, which involves connecting electrical cables safely and effectively to ensure uninterrupted power supply. Cable jointing requires technical competence, practical skills, and problem-solving ability (Moses, Wawo, Ibanga, & Musa, 2021). According to Neitzel (2017), cable



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jointing also includes cable termination, underground cable installation, and overhead line installation. Common cable joints include splice, Britannia, married, sleeve, and compression joints. Adequate understanding of these jointing methods is essential for safe and effective electrical installation practices. However, despite the importance of cable jointing and other EIMW competencies, reports from NABTEB examinations (2023; 2024) indicate that many students in technical colleges due consistently underperform in practical-related tasks. Low practical performance has been linked to limited practical skills exposure and low motivation in technical trades (Ogbuanya & Akinduro, 2017). One major factor responsible for this challenge is the persistent use of teacher-centered instructional approaches, where students depend largely on theoretical instruction with limited opportunities for practical engagement, collaboration, and critical thinking (Kim & Hwang, 2017). Such methods often fail to prepare students for real-life technical tasks and workplace demands (Serin, 2018). Educational researchers have emphasized that innovative learner-centered teaching approaches can improve students' skills acquisition and motivation (Al-Bahadli, Al-Obaydi & Pikhart, 2023; Karan & Brown, 2022; Aireruor, Aigboduwa & Enesi, 2024). One of such approaches is Project-Based Learning (PjBL).

Project-Based Learning (PjBL) is a learner-centered instructional strategy that engages students in solving real-life problems through meaningful projects and collaborative activities. The approach encourages active learning, teamwork, creativity, and critical thinking, which are important for technical and vocational education. PjBL allows students to investigate practical problems and apply knowledge to authentic situations under the guidance of the teacher (Riordan, 2021). Hartescu (2022) explained that PjBL exposes learners to real-world challenges that reflect future professional practices. The approach is also consistent with constructivist learning theory, which promotes learning through active exploration and practical experiences (Liston, Morrin, Furlong & Griffin, 2022; Sholahuddin, Anjuni, Leny & Faikhamta, 2020; Yildiz & Guler-Yildiz, 2021). Studies by Santyasa, Santyadiputra and Juniantari (2019) and Syahril, Nabawi and Safitri (2021) revealed that teachers increasingly adopt PjBL to promote 21st century skills. Furthermore, Almulla (2020) and Ananda, Rahmawati and Khairi (2023) reported that PjBL positively influences learning processes, assessment, and students' overall participation. Notably, PjBL has the ability to improve the acquisition of skills in TVET programmes and beyond. Skill acquisition remains one of the major objectives of TVET, especially in EIMW programmes (Ogbuanya & Chukwuodo, 2017; Ayonmike & Okeke, 2016). Skill acquisition refers to the development of practical competencies and task-specific abilities required for effective performance in occupational settings. In electrical and electronics education, these skills include wiring, installation, troubleshooting, use of tools, and compliance with safety procedures (Umar & Maigida, 2019). Effective skill acquisition requires active participation, repeated practice, and exposure to real-life practical activities (NBTE, 2020). Nevertheless, many technical college students still experience difficulties in acquiring industry-relevant skills because of outdated teaching methods and inadequate practical exposure (Yusuf & Soyemi, 2022). Studies have shown that PjBL can significantly improve students' practical competence in technical education. Nworgu and Otulugbu (2019) found that students exposed to PjBL performed better in cable jointing, circuit assembly, and fault diagnosis than those taught using conventional methods. Similarly, Lawal and Adeoye (2021) reported that students taught with learner-centered practical approaches demonstrated improved retention of technical skills, greater self-confidence, and higher independence in electrical practical activities. These findings suggest that practical-oriented instructional strategies are necessary for effective mastery of technical skills. Skills acquisition and Motivation are deeply intertwined. When learners successfully acquire technical skills, it boosts their confidence and motivates them to learn more. Motivation is a major factor influencing students' participation, persistence, and academic performance in technical education. According to Deci and Ryan (2000), motivation may be intrinsic, where learners participate because of interest and satisfaction, or extrinsic, where learning is driven by rewards or external outcomes. In technical education, motivated students are more likely to participate actively in practical activities and persist in solving technical problems. However, conventional teacher-centered approaches commonly used in technical colleges often fail to stimulate students' motivation because they provide limited opportunities for interaction and real-world engagement (Almulla, 2020). Empirical studies support the positive influence of learner-centered approaches on motivation. Chiang and Lee (2016) found that students taught using PjBL demonstrated higher intrinsic motivation and greater willingness to participate in learning activities compared to students in traditional classrooms. Similarly, Adebayo and Olatoye (2016) reported that students exposed to interactive and practical teaching methods showed higher motivation, better attendance, and improved practical performance. These findings indicate that instructional methods that encourage autonomy, collaboration, and practical



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engagement can strengthen students' motivation in technical education. Based on the foregoing, there is a need to explore innovative instructional strategies capable of improving students' skill acquisition and motivation in technical colleges. Therefore, this study seeks to investigate the effects of Project-Based Learning on Skill Acquisition and Motivation in Cable Jointing among Technical Colleges Students in Katsina State, Nigeria.

Statement of the Problem

The Federal Government of Nigeria recognizes Technical Vocational Education and Training (TVET) as a pivotal driver for economic growth, youth empowerment, self-reliance, and national development. In line with this, Nigeria's education policies and development plans emphasize the need to produce a skilled, competent, and innovative workforce that can support industrialization and reduce unemployment. Specifically, TVET is expected to equip learners with practical skills, problem-solving abilities, and a mindset for productivity and entrepreneurship. However, the attainment of these goals remains far from reality due to persistent challenges in the delivery of TVET, particularly in technical colleges in Nigeria. Despite the strategic role of TVET for national development, students in technical colleges especially in trades such as Electrical Installation and Maintenance Work (EIMW) continue to exhibit low levels of skill acquisition, low problem-solving abilities and low motivation in their chosen fields (Ogbuanya & Chukwuedo, 2017; Ayonmike & Okeke, 2016). These issues are linked to outdated curriculum and teacher-centered instructional approaches predominantly used by teachers in technical colleges that limit students' engagement and practical exposure (Afolabi & Adesanya, 2021). The problem is further evidenced by consistently low performance in national examinations such as those conducted by NABTEB as shown in the summary of results analysis EIMW trades students in the technical colleges in Katsina state as revealed in table 1.

Table 1: Summary of Results Analysis of EIMW students NABTEB 2019-2023 in Technical Colleges, Katsina State.

Year	No. of Students Sat	No. of Students Passed	% of Students Passed	No. of Students failed	% of Students Failed
2019	117	59	50.4%	58	49.6%
2020	101	48	47.5%	53	52.5%
2021	99	51	51.5%	48	48.5%
2022	63	26	41.3%	37	58.7%
2023	91	43	47.3%	48	52.7%

Source: NABTEB results statistics (2024)

This downward trend in performance as shown in table 1 threatens the country's capacity to produce competent technical manpower and, if not addressed, could lead to increased youth unemployment, dependence on foreign skilled labour, and continued underdevelopment of both the informal and formal sectors. Furthermore, the low performance could be as a result of low practical skill acquisition as highlighted by Nwogu and Otulugbu (2019) and low motivation toward the teaching approach (Chiang & Lee, 2016). In the light of this, the researcher explored the use of Project-Based Learning (PjBL) as an innovative instructional strategy that may enhance students' skill acquisition and motivation in EIMW students in technical colleges within Katsina State, Nigeria.

Objective of the Study

The aim of the study is to determine the effects of project-based learning on skill acquisition and motivation in Cable Jointing among technical colleges students in Katsina State. Specifically, the study sought to:

1. Determine the effect of Project-Based Learning (PjBL) on EIMW students' skill acquisition in Cable Jointing in technical colleges of Katsina State, Nigeria.
2. Assess the effect of Project-Based Learning (PjBL) on EIMW students' motivation in Cable Jointing in technical colleges of Katsina State, Nigeria.

Research Questions

The following research questions guided the study:

1. What is the difference in the mean skill acquisition scores of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria?
2. What is the difference in the mean motivation level of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria?



Research Hypotheses

The following hypotheses were tested at 0.05 levels of significance.

1. There is no significant difference in the mean skill acquisition scores of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria.
2. There is no significant difference in the mean motivation scores of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria.

Research Methodology

The study employed a quasi-experimental research design, specifically a pre-test, post-test, non-equivalent non-randomized control group design. The population for the study consisted of forty-seven (47) National Technical Certificate (NTC) II students offering EIMW in the three Government Technical Colleges in Katsina State. The sample of the study constituted 22 students from GTC Ingawa which form the experimental group while 13 students from GTC Mashu and 12 students from the GTC Funtua were merge to form the control group. Thus, the study utilized the total population sample. Data were collected using Cable Jointing Skills Acquisition Observational Checklist (CJSAOC) and Cable Jointing Motivation Questionnaire (CJMQ) which were validated by experts in the field of Electrical/Electronic Technology Education, Psychology, Test and Measurement as well as English language to evaluate the relevance, clarity, and coverage of the items in relation to the skills required for effective cable jointing and reliability of the instruments was ascertained through a pilot testing using Kendall's Coefficient of Concordance with a reliability of 0.97 for the CJSAOC, while the motivation questionnaire was achieved using Cronbach's alpha with a reliability index of 0.86 respectively. Mean and standard deviation were used to answer the research questions while ANCOVA and Mann-Whitney U-Test was used for testing the hypotheses both at 0.05 level of significance by using SPSS v20.

Presentation of Results

Research Question 1: What is the difference in the mean skill acquisition scores of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria?

Table 2: Mean and Standard Deviation of Pre-test and Post-tests Skill Acquisition Scores of Experimental and Control Groups.

Groups	N	Pre-Test Scores		Post-test Scores		Mean Gain
		$\bar{X}$	S. D	$\bar{X}$	S. D	
Project-Based Teaching	22	34.36	8.79	45.32	6.81	10.96
Conventional Teaching	25	30.32	3.30	34.48	5.72	4.16
Mean Difference		4.04		10.84		

Table 3 shows the means and standard deviations of pre-test and post-test skill acquisition scores of EIMW students administered to the experimental and control groups. For the pre-test, the experimental group is found to have a mean of 34.36 and standard deviation of 8.79, while the control group has a mean of 30.32 and standard deviation of 3.30. The standard deviations of the scores in both the groups imply that the individual scores are far away from the mean. Also, the pre-test mean difference between the two groups is 4.04 in favor of the experimental group, which implies that the two groups are almost equivalent in terms of their skill acquisition. In the post-test, the experimental group has a mean of 45.32 and standard deviation of 6.81, while the control group has a mean of 34.48 and standard deviation of 5.72. The standard deviation of the scores in the experimental and control group imply that the individual scores are far away from the mean. While the post-test mean difference between the two groups is 10.84 in favor of the experimental group, the mean gain score for the experimental group is 10.96 and that of control group is 4.16. This suggests that students taught cable jointing using Project-based teaching strategy performed better in practical skills acquisition than those taught using conventional teaching method.

H₀₁: There is no significant difference in the mean practical skill acquisition scores of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria.

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Table 3: Summary of Analysis of Covariance (ANCOVA) of Students' Pre-test and Post-test Practical Skills Acquisition Scores of Experimental and Control Groups.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial eta squared
Corrected Model	1839.110 ^a	2	919.555	31.207	.000	.587
Intercept	986.209	1	986.209	33.469	.000	.432
TotalCJSAOC_PRE	464.505	1	464.505	15.764	.000	.264
Group	828.421	1	828.421	28.114	.000	.390
Error	1296.507	44	29.466			
Total	76665.000	47				
Corrected Total	3135.617	46				

Levels of Significance = 0.05

Table 4 shows the result of the ANCOVA test of significant difference for the post-test mean skills acquisition scores of the experimental and control groups. The observed significant value of the treatment is 0.000 which is less than the significant level of 0.05 with $df = 1$. The null hypothesis one (1) is therefore rejected because sig-value (0.000) is less than the significant level (0.05). Consequently, there is significant difference in the mean practical skill acquisition scores of EIMW students taught Cable Jointing using project-based learning and those taught using the conventional method in favor of the experimental group (F -value = 28.11, $df = 1$, Sig-value = $0.000 < 0.05$). The partial eta squared value for group ($\eta^2 = 0.390$) indicates a large effect size, suggesting that the teaching method accounted for 39.0% of the variance in students' post-test scores after controlling for pre-test scores. This implies that project-based learning had a strong and meaningful impact on students' practical skills compared to the conventional method.

Research Question 2: What is the difference in the mean motivation level of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria?

Table 4: Mean and Standard Deviation of Pre-test and Post-test Motivation Scores of Experimental and Control Groups.

Groups	Pre-Test Scores		Post-test Scores		Mean Gain
	N	$\bar{X}$	S. D	$\bar{X}$	S. D
Project-Base Teaching	22	30.68	8.63	38.04	9.80
Conventional Teaching	25	36.68	5.12	42.24	5.11
Mean Difference		6.00		4.20	

The results in table 7 show that students in the project-based teaching had a pre-test mean score of 30.68 with a standard deviation of 8.63, while those in the conventional (control) group recorded a higher pre-test mean score of 36.68 and a standard deviation of 5.12. After the treatment, the experimental group obtained a post-test mean score of 38.04 with a standard deviation of 9.80, whereas, the control group recorded a post-test mean score of 42.24 and a standard deviation of 5.11. When the mean gains were computed, the project-based teaching (experimental) group showed an improvement of 7.36 points, compared to 5.56 points improvement recorded by the conventional (control) group. This indicates that while conventional teaching (control) group scored slightly higher in post-test, the PjBL (experimental) group experienced greater improvement, suggesting that project-based teaching was more effective in enhancing students' Motivation in cable Jointing. The higher standard deviation observed in the post-test scores of the project-based teaching group indicates students responded differently to the instructional approach, with some demonstrating a substantial increase in motivation. This suggests that PjBL may be particularly effective in stimulating motivation among students who were initially less motivated. In contrast, the relatively lower standard deviation recorded by the conventional group at both pre-test and post-test stages indicate more homogeneous motivation levels among the students.

Ho2: There is no significant difference in the mean motivation scores of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method in technical colleges of Katsina State, Nigeria.

Table 5: Summary of Mann-Whitney U-test for Students' Mean Rank Motivation Level for experimental and Control Groups

Group	N	Mean Rank	Sum of Ranks	U	Z	P (2tailed)	Decision
PjBL	22	20.30	446.50	193.50	-1.740	.082	Accept HO ₃



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Conventional	25	27.26	681.50
Total	47		

The results in table 8 shows the experimental group had a mean rank of 20.30 (sum of ranks = 446.50) while the control group recorded a higher mean rank of 27.26 (sum of ranks = 681.50). Although a numerical difference exists between the groups, the Mann-Whitney U statistic produced a value of $U = 193.500$, with a corresponding $Z = -1.740$ and an Asymp. Sig. (2-tailed) value of 0.082. Since the p-value (0.082) is greater than the 0.05 level of significance, the difference between the groups is not statistically significant. This indicates that the project-based learning method significantly improved students' motivation equally compared to the conventional method. Consequently, the null hypothesis is retained. Therefore, there is no significant difference in the mean motivation scores of EIMW students taught Cable Jointing using Project-Based Learning and those taught using the Conventional method.

Discussion of Findings

The findings of this study, as revealed in Table 2, showed that Electrical Installation and Maintenance Work (EIMW) students taught cable jointing using Project-Based Learning (PjBL) acquired practical skills significantly better than those taught using the conventional teaching method. The experimental group recorded higher post-test mean scores and mean gain (45.32; 10.96) than the control group (34.48; 4.16). This indicates that students exposed to PjBL experienced greater improvement in practical skill acquisition in cable jointing.

Ho₁: The ANCOVA result presented in Table 3 ($F(1,44) = 28.11$, $p < .05$, $\eta^2 = .390$) confirmed that the difference between the two groups was statistically significant, leading to the rejection of the null hypothesis. The eta squared value of .390 indicates a large effect size, suggesting that approximately 39% of the variance in students' practical skill acquisition was attributable to the instructional method used. This implies that Project-Based Learning had not only a statistically significant effect but also a substantial educational impact on students' acquisition of cable jointing skills. In educational research, such a magnitude reflects a strong instructional influence, demonstrating that PjBL meaningfully enhances students' hands-on competence beyond chance or minor instructional differences. This finding is consistent with earlier studies by Afolabi and Adesanya (2021), Yusuf and Soyemi (2022), and Akpan and Emmanuel (2016), which reported that learner-centered, activity-based instructional strategies significantly improve students' practical skill acquisition in technical and vocational subjects. Similarly, Okoro (2013) reported that Project-Based Learning significantly enhanced students' practical achievement, attributing this improvement to sustained engagement in hands-on tasks, self-regulated learning, and authentic project execution. The agreement between the present study and previous studies may be attributed to the practical, learner-centered, and activity-oriented nature of Project-Based Learning. Through PjBL, students in the present study actively participated in real-life cable jointing projects that required the appropriate selection and use of tools, materials, and procedures. This learning-by-doing approach enabled students to develop procedural accuracy, improve skill mastery, and enhance retention. In addition, the collaborative learning embedded in PjBL allowed students to exchange ideas, learn from peers, and correct errors, thereby further strengthening their practical competence. However, this finding contradicts some studies such as Owolabi (2019), which reported no significant difference between project-based and conventional teaching methods in skill acquisition. Mettas and Constantinou (2007) similarly observed that although PjBL improved students' attitudes and conceptual understanding, significant improvement in practical skills was not immediate due to insufficient practice time. Likewise, Al-Bahadli *et al.*, (2023) reported minimal skill gains where PjBL was implemented without adequate instructional scaffolding or sufficient technical resources. These discrepancies may be attributed to differences in instructional context, teacher competence, availability of instructional materials, and duration of treatment. In contrast, the present study ensured adequate resources, structured project tasks, close supervision, and sufficient time for project execution, which may have enhanced the effectiveness of PjBL and accounted for the significant results obtained. Findings presented in Table 4 revealed that both PjBL and the conventional teaching methods improved students' motivation toward cable jointing, although no statistically significant difference was observed between the two groups. While the experimental group recorded a higher mean gain (7.36) compared to the control group (5.56),

HO₂: The Mann-Whitney U-test result in Table 5 ($U = 193.50$, $p > .05$) indicated that the difference was not statistically significant, leading to the retention of the null hypothesis. This finding is consistent with studies such as Adebayo and Olatoye (2016), who observed that students' motivation did not differ significantly across instructional strategies when external factors such as examination pressure, employability prospects, and teachers' personality influenced learners'



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engagement. Adeyomo (2010) similarly argued that motivation in technical disciplines is often more closely related to learners' prior vocational interests and career aspirations than to instructional strategies alone. Additionally, Hmelo-Silver (2004) and Savery (2015) reported that both learner-centered and traditional instructional approaches can enhance students' motivation when lessons are well structured and engaging. The agreement may also be attributed to the inherently practical nature of cable jointing, which naturally captures students' attention regardless of the teaching method employed. However, this finding contradicts studies such as Adeyemi (2017) and Ahmed (2021), which reported significant improvement in students' motivation when taught using project-based and collaborative instructional strategies. Similarly, Adebayo and Sulaiman (2017) found that interactive learning strategies significantly enhanced students' self-efficacy and willingness to engage in practical tasks. These differences may be due to individual learner characteristics, prior learning experiences, or the duration of exposure to project-based instruction. It is also possible that motivational outcomes require prolonged and sustained implementation of PjBL to yield statistically significant differences.

Conclusion

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

1. Project-Based Learning enhances the practical Skill acquisition of EIMW students in Cable Jointing.
2. Project-Based Learning increases the Motivation level of EIMW students toward Cable jointing.

Recommendation

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

1. The PjBL should be adopted as a primary teaching method for Cable Jointing since students taught with PjBL acquired practical skills significantly better than those taught with conventional method.
2. The study also recommended that, EIMW stakeholders combine PjBL with other motivational strategies such as adequate tools, feedback and industry linkages since students taught with PjBL showed higher motivation than those taught with conventional method, although the difference was not statistically significant.

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