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EFFECTS OF REFLECTIVE LEARNING APPROACHES ON ELECTRICAL INSTALLATION AND MAINTENANCE WORK STUDENTS' COGNITIVE ACHIEVEMENT AND RETENTION IN TECHNICAL COLLEGES IN SOKOTO STATE

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***Abstract*:** *The study investigated the Effects of Reflective Learning Approaches on Electrical Installation and Maintenance Work (EIMW) Students Cognitive Achievement and Retention in Technical Colleges in Sokoto State. Two research questions and two null hypotheses guided the study. Relevant literature was reviewed in line with the objectives of the study. The study adopted a quasi-experimental research design. The population of the study covered 70 Technical College Year Two (TC II) students offering EIMW in four Technical Colleges in Sokoto State for the 2023/2024 academic session. Purposive sampling techniques were used to group the four technical colleges into experimental groups I and II for the study. The instrument used for data collection was the EIMW Cognitive Achievement Test (EIMWCAT). The instrument was validated by three research experts. To ascertain the internal consistencies of the instruments, Kuder Richardson 21 (KR 21) was used for EIMWCAT and a coefficient of 0.90 was obtained. The data for research questions were analyzed using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA) at $p < 0.05$ level of significance. The findings of the study revealed that action-reflection and critical-reflection instructional strategies significantly increased the students achievement, and retention in EIMW, but the group taught with critical-reflection instructional strategy had the highest mean gained in the cognitive achievements scores of (18.67 > 16.55) than group taught with action-reflection instructional strategy, but the group taught with action-reflection instructional strategy had the highest mean gained in the retention scores of (1.72 > 0.81) than group taught with critical-reflection instructional strategy. The result of the hypotheses tested at 0.05 level of significance, with a p-value of 0.097 on EIMW cognitive achievement mean score showed that there is no significant difference in the cognitive achievement mean score, also with a p-value of 0.02 on EIMW retention mean score shows that there is significant mean difference in the retention mean score. Based on the findings, of the study, therefore, it is recommended among others that more attention should be given to the inclusion of modern instructional strategies such as action-reflection and critical-reflection for teaching EIMW in Technical Colleges in Nigeria.*

Keywords: *Reflective learning approaches, electrical installation and maintenance work, cognitive achievement*

Introduction

Technical Colleges (TCs) are specialized institutions of learning where trades and modular courses are offered in addition to general education and science subjects. TCs play vital roles in Nigeria. TCs train and produce technicians for industry, and TCs impart vital technical skills to the youths, they help towards the goal of self-employment and job creation and in the struggle towards technological advancement and acquisition (Excellence and Education Network, 2021). According to Federal Republic of Nigeria (FRN) (2014), a technical college is a post-primary institution that imparts the necessary skills leading to the production of craftsmen and technicians who are enterprising and self-reliant. Hence, there are three major objectives the technical colleges in Nigeria were designed to achieve as stated in (FRN), the graduates would be able to (a) secure employment either at the end of the whole course or after completing one or more modules of employable skills; (b) set up their businesses and become self-employed and be able to employ others, and (c) pursue further education in advance craft/technical programmes or post-secondary (tertiary) technical institutions such as polytechnics or colleges of education (technical) and universities. The technical and vocational trades available in TCs include Automobile Trades, Building and Wood Work Trades, Business Trades, Computer Trades, Hospitality Trades, Mechanical Trades, Printing Trades, Textile Trades and Electrical/Electronic Trades (EETs)

(NBTE, 2017). Electrical/Electronic Trades, as offered in technical college, comprise Appliance Maintenance and Repairs, Instrument Mechanics, Radio and Television, Electronics Work, and Electrical Installation and Maintenance Work.

Electrical Installation and Maintenance Work (EIMW) is a trade subject offered in electrical and electronic programmes in technical colleges' that gives students the theoretical knowledge and practical skills they need to possess and to become competent and effective craftsmen in the area. These technicians are required for work in businesses like the Electricity Distribution Company (EDC), as well as in the manufacturing, mining, and oil and gas industries. Graduates of this programme are also required to acquire psychomotor abilities for installing, operating, maintaining, and repairing electrically powered systems in buildings, and machinery (Eze & Osuyi, 2018). Electrical installation and maintenance work provide technical training to meet the demands of electrical industry and the needs of the individual allowing the students to identify their career objectives (Ogwa, 2015). Additionally, it provides technical training to meet both the needs of the electrical industry and those of the individual students, enabling them to choose their career paths (Eze, 2015). In order to promotes students knowledge and practical skills effective instructional strategies are required.

Effective instructions have severally been linked to favourable outcome of students' learning. These strategies are determined partly based on subject matter to be taught and partly on the nature of the students. For a particular instructional technique to be appropriate and efficient, it has to be in relation with the characteristic of the students and the type of learning outcomes it is expected to bring about. However, many teaching strategies have been in use in the teaching of technical subjects such as discussion, demonstration, and lecture methods among others (Pilato & Ulrich, 2014). Effective instruction in EIMW is required since failure to do so could endanger the lives and property of electricity consumers and promote unemployment and poverty among the workforce (Ogbuanya & Akinduro, 2017). According to Raymond (2022); Johnson *et al.* (2014); Larmer *et al.* (2015), some of the effective instructional strategies that can be used to enhance students learning includes flipped classroom, project-based learning, gamification, problem-based learning, design thinking, thinking based learning, competency-based learning, inquiry-based learning, cooperative and collaborative learning, social and emotional learning, virtual reality-based teaching, 3D-based teaching, cloud computing-based teaching, differentiation teaching, blended learning, and reflective learning.

Reflective learning is a process by which learners engage in critical thinking about their own learning experiences, in order to gain a deeper understanding of what they have learned and how they have learned it. Reflective learning could be described as teaching and learning strategies which stimulate learners to utilize encounters to find learning themselves through reflection on past encounters (Oke, 2021). There are several types of reflective learning approaches that can be used to facilitate this process, they include: experiential reflection, dialogic reflection, creative reflection, reflexive journaling, collaborative reflection, critical reflection, and action reflection (Moon, 2013).

Action-reflection learning is a learning process that involves taking action, reflecting on the outcomes of that action, and using that reflection to guide further action (Brockbank & McGill 2012). Brockbank and McGill stated that, Action-reflection learning strategy involves two types of reflection: reflection-in-action, which occurs in the midst of an activity, and reflection-on-action, which occurs after the activity has been completed. Another type of reflective learning is critical-reflection instructional strategy. Critical reflection learning is a process of thinking deeply and critically about one's own experiences, beliefs, and assumptions in order to gain a deeper understanding and insight (Brookfield, 2017). Brookfield added that, it involves examining and questioning one's own thoughts, actions, and values, as well as considering alternative perspectives and potential biases. With the help of these strategies, all students can work together to encourage understanding and promote students' cognitive achievement, and retention in EIMW.

Cognitive achievement measures how well a student has achieved the learning outcomes in the intellectual area. According to yerima (2021), described that cognitive achievement is the measure of students' learning acquisition of certain skills at the end of teaching and learning activities. As observed by Devis and Mayuri (2013), cognitive achievement is excellence in all academic disciplines, in classes as well as in extracurricular activities. Sharma (2013) verified the link between educational achievement and retention of previous knowledge. Retention has to do with the ability to remember and apply previously learnt behavior. Adeyemi and Adeyemi (2014), defined retention as the tendency of a learner to respond favorably to specific features of their environment. It typically develops through and is linked to more fundamental motivations. Omoiya (2017) stated that long time retention of knowledge will be absorbed by the usage of appropriate teaching method. Therefore, the ability to retain learned skills for long period of time, this will enable a properly trained EIMW craftsman to remain relevant in today's world of work. Hence, the researcher sought to investigate the effects of Reflective Learning Approaches on Electrical Installation and Maintenance Work Students Cognitive Achievement and Retention in Technical Colleges in Sokoto State.

Statement of the Problem

Cognitive achievement development in different trades specifically in electrical installation and maintenance work, is critical for sustainable economic growth. The goal of electrical installation and maintenance work in technical colleges is to produce skilled craftsmen with good knowledge of working principle of domestic and industrial installation and safety practices involved in its maintenance (Ezenwafor *et al.*, 2020). Cognitive achievement, and retention in the study of EIMW among students in technical colleges have been declining over the years. Bello and Shuaibu (2013) reported that most of the products of vocational and technical education programmes in tertiary institutions in Nigeria are half-baked as they lack psychomotor skills and therefore are unable to function effectively in the world of work after schooling. This unpleasant trend could be attributed to type of instructional strategy used by teachers since the use of instructional strategies that match the programme objectives of technical education will increase students' interest in the study as well as quip and empower them with practical skills to fit into jobs in the society. This is why they are unable to exhibit the technical skills required to become self-dependent after their training especially as they lack clear understanding of the theories and principles of electrical installation and maintenance work (Ezenwafor *et al.*, 2020). Students' poor academic performance in EIMW has been observed from literature to be caused by many factors such as teacher's insensitivity to the nature of EIMW when planning instructional objectives in the classroom, inadequate infrastructural materials and poor or ineffective teaching methods (Ao *et al.*, 2020). The achievement of students in the EIMW trade in Sokoto State in particular has not been encouraging despite the substantial expenditures made by governments in programme for technical colleges intended to improve both the image and performance of technical college students. The average failure rate in the EIMW trade for the years 2018-2021 was 61.4%, 64.6%, 66.97%, and 80.8%, respectively (NABTEB Sokoto State, 2023). This problem statement sets the stage for the research by highlighting the existing knowledge gap and justifying the significance of investigating the specific effects of action-reflection and critical-reflection strategies on EIMW students' learning outcomes in technical colleges. Therefore, this research seeks to investigate the effects of action-reflection and critical-reflection instructional strategies on the learning outcomes of EIMW students in Sokoto State's technical colleges, aiming to discern the extent to which these strategies contribute to improved academic achievement, and problem-solving abilities in this specialized field.

Purpose of the study

1. Action-reflection and critical-reflection instructional strategies on Students cognitive achievement.
2. Action-reflection and critical-reflection instructional strategies on Students retention in EIMW.

Research Questions

1. What are the effects of action-reflection and critical-reflection instructional strategies on students' cognitive achievement in EIMW in Technical Colleges?
2. What is the effect of action-reflection and critical-reflection instructional strategies on students' retention in EIMW?

Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance guided the study.

H_{O1}: There is significant difference between the mean cognitive achievement scores of students taught EIMW with action-reflection instructional strategy and those taught using critical-reflection instructional strategy.

H_{O2}. There was no significant difference between the mean retention scores of students taught EIMW with action-reflection instructional strategy and those taught using critical-reflection instructional strategy.

Methodology

This study employs a quasi-experimental design involving intact classes to investigate the effects of two instructional strategies. Two intact classes were selected as separate experimental groups, with each group receiving a different form or intensity of the intervention. Random assignment is not feasible due to the use of intact classes (Nworgu, 2015). The study was carried out in Sokoto State of Nigeria. The population of this study comprised of all 70 students of EIMW trade of the four technical colleges in Sokoto State. Purposive sampling technique was used to group the four technical colleges into experimental group I and experimental group II for the study. The instrument used for data collection was tagged; "EIMW Cognitive Achievement Test" (EIMWCAT). The EIMWCAT consisted of questions adapted from WAEC and NABTEB past questions in EIMW trade based on TC II syllabus. The achievement test consisted of 50 multiple choice questions, which were given, scores. Data collected for this study were analyzed as follows: mean and standard deviation statistic was used to answer the two research questions, while the null hypotheses were tested using ANCOVA at 0.05 level of significance. To answer the research questions of the study, both pre-test and post-test mean scores of experimental groups I and II were compared for mean difference. Higher mean score showed better achievements. The decision for testing the two null hypotheses of the study was that; when the calculated f-value is less than the p-value, the null hypothesis is accepted, if otherwise, the null hypothesis is rejected.

Results

Table 1: Mean of Pre-test and Post-test Cognitive Achievement Scores of Students Taught Electrical Installation and Maintenance Work Using Action-reflection and Critical-reflection Instructional Strategies

		Pre-test		Post-test		
Groups	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean Gain**
Experimental Group I (Action-reflection strategy)	40	21.45	5.23	38.00	9.20	16.55
Experimental group II (Critical-reflection strategy)	30	37.43	7.88	56.10	15.42	18.67

Source: Adapted by the researcher

Table 1 shows that, the experimental group I taught with action-reflection instructional strategy had a pre-test mean cognitive achievement score of 21.45 with standard deviation of 5.23 and a post-test score of 38.00 with standard deviation of 9.20. The mean gain between the pre-test and post-test of the experimental group I was 16.55. The experimental group II taught with critical-reflection strategy had a pre-test mean cognitive achievement score of 37.43 with standard deviation of 7.88 and a post-test score of 56.10 with standard deviation of 15.42. The mean gain

between the pre-test and post-test of the experimental group II was 18.67. Therefore, experimental group II performed slightly higher than experimental group I. This indicated that students taught Electrical Installation and Maintenance Work using a critical-reflection instructional strategy had higher mean cognitive achievement scores than students taught using the action-reflection instructional strategy. The mean scores in the table 1 showed that, Critical-reflection instructional strategy is good at improving cognitive achievement scores, compared to the action-reflection instructional strategy.

Table 2: Mean of Post-test and Retention-test Scores of Students Taught Electrical Installation and Maintenance Work Using Action-reflection and Critical-reflection Instructional Strategies

		Post-test		Retention-test		
Groups	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean Gain**
Experimental Group I (Action-reflection strategy)	40	48.32	12.09	50.04	11.64	1.72
Experimental group II (Critical-reflection strategy)	30	39.67	8.87	40.48	9.24	0.81

Source: Adapted by the researcher

Table 2 shows that, the experimental group I taught with action-reflection instructional strategy had post-test mean score of 48.32 with standard deviation of 12.09 and retention-test score of 50.04 with standard deviation of 11.64. The mean gained between the post-test and retention-test of the experimental group I was 1.72. The experimental group II taught with critical-reflection instructional strategy had post-test mean score of 39.67 with standard deviation of 8.87 and retention-test score of 40.48 with standard deviation of 9.24. The mean gained between the post-test and retention-test of the experimental group II was 0.81. The experimental group I had slightly higher mean gained than experimental group II. This indicated that students taught EIMW using action-reflection instructional strategy had slightly higher mean retention scores than students taught using a critical-reflection instructional strategy. Action-reflection is good at Improving Students retention as Compared to Critical-reflection.

Table 3: Analysis of Covariance for the Test of Significant difference Between the Cognitive Achievement Scores of Students Taught EIMW Using Action-reflection Instructional Strategy and Those Taught Using Critical-reflection Instructional Strategy

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	293.741[a]	2	146.871	1.726	.186
Intercept	5315.076	1	5315.076	62.448	.000
Pre-Test	19.455	1	19.455	.229	.634
GROUP	241.801	1	241.801	2.841	.097
Error	5702.545	67	85.113		
Total	116402.000	70			
Corrected Total	5996.286	69			

R Squared = .049 (Adjusted R Squared = .021)

Table 3 shows the F-calculated value of 2.841 was obtained with an associated exact probability value of .097. Since the associated probability of .097 is greater than 0.05 set as a level of significance, the null hypothesis of no significant difference between the cognitive achievement scores of students taught electrical installation and maintenance work using action-reflection and critical-reflection instructional strategies is accepted. Hence, there is no significant difference between the cognitive achievement scores of students taught EIMW using action-reflection and critical-reflection instructional strategies**.**

Table 4: Analysis of Covariance for the Test of Significant difference between the Retention Scores of Students Taught EIMW Using Action-reflection Instructional Strategy and Those Taught using Critical-reflection Instructional Strategy.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3524.091[a]	2	1762.045	62.211	.000
Intercept	407.561	1	407.561	14.389	.000
Pre-Test	1959.255	1	1959.255	69.174	.000
GROUP	156.238	1	156.238	5.516	.022
Error	1897.681	67	28.324		
Total	153174.000	70			
Corrected Total	5421.771	69			

R Squared = .0650 (Adjusted R Squared = .640)

Table 4 shows the F-calculated value for testing the significant difference between the retention scores of students taught EIMW using action-reflection instructional strategy and those taught using critical-reflection instructional strategy. The F-calculated value of 5.512 was obtained with an associated exact probability value of 0.02. Since the associated probability of 0.02 was less than 0.05 set as level of significance, the null hypothesis of no significant difference between the retention scores of students taught EIMW using action-reflection instructional strategy and those taught using critical-reflection instructional strategy is rejected. Hence, there is significant difference between the retention scores of students taught EIMW using action-reflection and critical-reflection instructional strategies**.** However, Table 4 indicates that the action-reflection instructional strategy had a higher retention mean gain, indicating that the difference was pointed in the favour of experimental group I.

Conclusion and Recommendation

Based on the findings of the study, insights on the effects of reflective learning approaches on electrical installation and maintenance work students cognitive achievement and retention was provided. The study found out that, students taught Electrical Installation and Maintenance Work (EIMW) using: critical-reflection instructional strategy had positive effect on the cognitive achievement, and retention, of students in EIMW. The implication of the findings is that, the adoption of action-reflection and critical-reflection instructional strategies hold the potential to enhance students‟ cognitive achievement as well as stimulate retention in EIMW. Nevertheless, the findings are limited to the first term contents of EIMW at technical colleges of Sokoto state. Therefore, it is concluded that, action-reflection and critical-reflection instructional strategies had positive effects on students' cognitive achievements, and retention in EIMW.

Studying the effects of action-reflection and critical-reflection instructional strategies on Electrical Installation and Maintenance Work of students learning outcomes in technical colleges in Sokoto State presents an intriguing area for further research. Here are some suggestions for advancing research in this domain: Teacher Training and Implementation: Investigate the role of teacher training in effectively implementing these strategies. Understanding how instructors adapt and apply these techniques in the classroom setting is crucial, Student Engagement and Perception: Evaluate student engagement and perception towards these instructional methods. Assess how these strategies affect their motivation, interest, and overall learning experience, Practical Application and Skill Development: Assess not only theoretical knowledge but also practical skills gained through these strategies. Measure how well students apply their learning in real-world electrical installation and maintenance scenarios. Moreover, these findings could contribute significantly to enhancing instructional strategies and educational practices in technical colleges.

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