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EFFECT OF REFLECTIVE INQUIRY INSTRUCTIONAL STRATEGY ON STUDENTS' PRACTICAL SKILLS IN ELECTRICAL INSTALLATION AND MAINTENANCE WORKS IN TECHNICAL COLLEGES, DELTA STATE

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Abstract
Technical colleges in Nigeria were established to train skilled craftsmen, technicians, and personnel who will be innovative, inventive, and self-reliant. This study investigated the effect of reflective inquiry instructional strategy on students' practical skills in electrical installation and maintenance works in technical colleges in Delta State, Nigeria. The study was quasi-experimental and used a pre-test, post-test, non-randomized group design. Two research questions guided the study, while two null hypotheses were tested at 0.5 level of significance. The population of the study consisted of 138 Vocation 2 students, while the sample size was 93 Vocation 2 students drawn through multiple random sampling techniques. A validated Electrical Installation and Maintenance Works Test (EIMWT) of surface house wiring, conduit house wiring, and trunking systems with a rating scale containing 25 items was used for data collection. The reliability of the instrument was determined by administering it to a group of 20 students who were not part of the study sample. The scores of the different ratters were correlated using the Kendell coefficient of concordance with the help of the Statistical Package for Social Sciences (SPSS). A reliability coefficient of 0.9 was obtained. The arithmetic mean was used to analyse the data with respect to the research questions, while ANCOVA was used to test the hypotheses. Findings indicated that students taught with RIIS obtained a higher mean than those in the control group, and female students taught with RIIS performed better than male students; therefore, the use of RIIS in teaching electrical installation and maintenance works is significant. The implication is that reflective inquiry instructional strategies improve students' achievement in electrical installation and maintenance work. Consequently, it was recommended that technical teachers in technical colleges adopt reflective inquiry instructional strategies to improve students' academic achievement in practical skills in electrical installation and maintenance work.
Key Words. Electrical installation, instructional strategy, reflective inquiry, practical skills,

Introduction

Nigeria's Technical Colleges offer the Electrical Installation and Maintenance Works (EIMW) Trade course, preparing students with skills in diagnosing, testing, and fixing electrical issues. The National Board of Technical Education emphasizes the aim of training beneficiaries with the necessary skills to create competent craftsmen, specialists, and self-reliant individuals. The electrical installation and maintenance work curriculum is designed to prepare students to acquire entry-level knowledge and manipulative practical skills for employment in the electrical industry (NBTE 2018). Students who undergo training in electrical installation and maintenance work are expected to acquire skills for the installation of electrical machines and equipment, the winding of electrical machines, the testing and inspection of electrical installations, the repair of electrical machines, and others. To achieve these, the strategy for instruction is vital.

The predominant use of conventional methods such as lecture methods, demonstration methods, and teacher-based learning strategies could be one of the reasons for the low achievement of the students in practical skills in electrical installation and maintenance work. This is because these strategies generally encourage passivity in learning and do not allow learners the opportunity to actively participate in classroom activities (Markley, 2012). In view of this, there is therefore a need for a more practical and innovative approach to teaching that can allow learners the opportunity to participate actively in classroom activities. According to Owodunni (2020), reflective inquiry instructional strategy is one of such recommended teaching strategies.

The reflective instructional inquiry strategy encourages active student participation, challenges presumptions, and presents diverse perspectives on various topics. It involves diligent research, questioning, and data evaluation, promoting concepts, principles, self-direction, responsibility, and social communication. Despite its complexity, it is uncommon in vocational teaching in technical colleges. Studies show students excel in practical exams by understanding facts and developing their own strategies. The reflective instructional inquiry strategy encourages active student participation, challenges presumptions, and presents diverse perspectives on various topics. It involves diligent research, questioning, and data evaluation, promoting concepts, principles, self-direction, responsibility, and social communication. Despite its complexity, it is uncommon in vocational teaching in technical colleges. Studies show students excel in practical examinations by understanding facts and developing their own strategies. The reflective instructional inquiry approach encourages proactive knowledge acquisition and problem-solving, which aids students in understanding their interests and the learning process. In small groups, it promotes discussion, critical thinking, and information exchange. By combining idea mapping, scaffold learning, critical thinking, questioning, discussion, and collaborative learning, this approach enables students to autonomously develop their own knowledge.

With a focus on examining real-world experiences, reflective inquiry allows educators to improve and refine the teaching process. Students can discover, recognize, and comprehend new material when questions are used in conjunction with an approach that encourages active participation. Reflective inquiry is often prioritized in classrooms because it fosters student engagement and conversation. Using this technique demonstrates to students how skilfully a teacher may challenge presumptions, values, and beliefs in order to promote cooperative learning, instruction-focused attention, and reflective inquiry. Using a reflective instructional inquiry approach, students can expand their body of knowledge and practice cognitive control throughout class activities. It is an integral part of the learning process and entails critical analysis of performance as well as self-evaluation. Reflection lends meaning to experiences. Reflective inquiry as an educational strategy considerably raises students' academic achievement, according to Ogbuanya and Owodunni's (2013). The researcher examines the impact of various teaching methods on the academic performance of technical college students in Nigeria. Despite six years of study, some students still struggle with practical skills in electrical installation and maintenance work. The researchers suggest using student-centered teaching methods but question their results. They aim to understand the changes and improvements in reflective instructional inquiry strategies.

Reflective inquiry is a teaching strategy that focuses on exploring life events and enhancing the educational process. It encourages active engagement, collaboration, and dialogue among students. This approach fosters cooperative learning, instruction-focused attention, and cognitive control. Reflective inquiry helps students develop their knowledge, evaluate their

performance, and prepare for further instruction. Reflective inquiry significantly enhances students' academic progress, but it struggles with practical skills in electrical installation and maintenance tasks. Despite various instructional techniques, students struggle to acquire these skills. Researchers aim to address this gap using reflective methodologies. Technical institutes in Nigeria struggle to develop students' practical abilities, and while student-centered teaching methods are suggested, their results are questionable.

Statement of the Problem

The Technical and Vocational Education (TVE) curriculum is meant to equip students with practical skills sufficient for the world of work and other human endeavors, as well as smooth transmission from school to the work environment. TVE graduates in electrical installation and maintenance work are expected to possess practical skills, work competencies, and adequate skills that will enable them to acquire higher vocational qualifications in their field for effective work performance.

Despite these expectations, school records are replete with evidence of poor academic achievement and poor performance in the practical skills in electrical installation work in technical colleges (NABTEB, 2016). The National Business and Technical Education Board (2016) reported that the disparity in practical skills achievement could be a result of the methods used.

The problem of this study, therefore, is the unsatisfactory performance of electrical installation and maintenance work. Students' practical skills despite the efforts of the teachers, which is negatively affecting their employment and work performance irrespective of gender. Hence, there is a need to investigate the effect of a reflective inquiry instructional strategy on students' practical skills in electrical installation and maintenance work.

Purpose of the Study

The main purpose of the study is to determine the effect of reflective inquiry instructional strategy on students' practical skills in electrical installation and maintenance works in technical colleges in Delta State.

Specifically, the study will determine the;

1. Difference between the mean achievement scores of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy and those taught in the control group using lecture method.
2. Difference between the mean achievement scores of male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy.

Research Questions

The following research questions will guide the study.

1 What is the difference between the mean achievement scores of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy and those taught with conventional instructional strategy?

2 What is the difference between the mean achievement scores of male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy?

Hypotheses

The following null hypotheses guided the study and was tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy and those taught with conventional instructional strategy.
2. There is no significant difference between the mean achievement scores of male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy.

Method

The design of this study was quasi-experimental, which used a pre-test and post-test non-randomized group design. A quasi-experimental design is used when participants are not randomly assigned to treatments as they are in experimental research. Two groups were used for the study: the experimental (treatment) group and the control group. The population of the study consisted of 138 (119 males and 19 females) Vocational 2 (VOC 2) students offering EIMW in six technical colleges in the area of the study, with a sample size of 93 (79 males and 14 females) VOC 2 students. A multisampling technique was adopted in selecting four schools. Simple random sampling was used in assigning the four schools to the experimental group (E) and the control group (C), respectively. The control group had 45 students (39 males and 6 females), while the experimental group had 48 students (40 males and 8 females).

The instrument used in this study was the Electrical Installation and Maintenance Works Test (EIMWT). The instrument covered surface house wiring, conduit wiring, and trunking in electrical installation and maintenance works, with a 25-item rating scale. The EIMWT instrument was used for both the pre-test and post-test. The instrument was validated by experts to ensure its suitability for the study. The reliability of the instrument was determined by administering it to a group of 20 students who were not part of the study sample. The scores obtained were correlated using the Kendell coefficient of concordance with the help of the Statistical Package for Social Sciences (SPSS). A reliability coefficient of 0.9 was obtained, which is considered high enough to regard the instrument as reliable for the study. The pre-test was administered and rated; after the 6-week experiment, the post-test was administered and the scores were also rated. The collected data were analysed using mean gain and standard deviation to answer the research question. ANCOVA was used to analyse the hypothesis with a P-value < or = 0.5 level of significance.

Presentation of Results

Research Question 1: What is the difference between the mean achievement scores of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy and those taught with conventional instructional strategy?

Table 1.

Mean Achievement scores of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy and those taught with the conventional instructional strategy

		Pretest		Posttest		
Groups	N	Mean	SD	Mean	SD	Gain in Mean
RIIS	48	84.46	2.49	94.40	2.72	11.94
CIS	45	69.04	1.70	76.80	1.51	7.76

Mean Difference	15.42	17.60	4.18

Table 1 shows the various means and standard deviation scores on achievement of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy (experimental group) and those taught in the control group. From table 1 above, Experimental group had the mean achievement scores of 84.46 and 94.40 in the pretest and posttest respectively while their counterparts taught with CIS had achievement mean scores of 69.04 in the pretest and 76.80 in the posttest. The mean difference of the gains in mean for RIIS and CIS, revealed that the experimental group achieved higher than the control group with a mean difference of 4.18. The result indicated that teaching practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy more than CIS.

Research Question 2. What is the difference between the mean achievement scores of male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy?

Table 2.
Mean Achievement and Standard Deviation scores of male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy

		Pretest		Posttest		
Gender	N	Mean	SD	Mean	SD	Gain in Mean
Male	40	83.55	2.85	94.35	3.05	10.80
Female	8	81.00	2.39	97.13	5.43	16.13
Mean Difference		2.55		2.78		5.33

Table 2 above shows that for the experimental group, the male students had a mean achievement score of 83.55 and 94.35 in their pretest and posttest respectively while their female counterparts had 81.00 in their pretest and 97.13 in their posttest. The mean difference in the gains in mean for the male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy is 5.33. From the gains in means, it means that female students achieved higher than the male students when taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy, showing that RIIS favored the female students better than the male students.

Hypothesis 1: There is no significant difference between the mean achievement scores of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy and those taught with conventional instructional strategy.

Table 3.
ANCOVA test of mean achievement scores of students taught practical skills in electrical installation and maintenance works using RIIS and CIS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	11419.451[a]	2	5709.725	37.236	.000	
Intercept	2809.276	1	2809.276	18.321	.000	

POSTTEST	5901.278	1	5901.278	38.485	.000	
METHOD	653.325	1	653.325	4.261	.042	Sig.
Error	13800.549	90	153.339			
Total	576617.000	93				
Corrected Total	25220.000	92				

a. R Squared = .453 (Adjusted R Squared = .441)

The result of the ANCOVA test from table 6 shows that the F-value is 4.261 and P-value is 0.042. Since the P-value is less than 0.05 level of significance at df 1 and 90, the null hypothesis is rejected. This shows that there is a significant difference between the mean achievement scores of students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy and those taught in the CIS (control group) in favour of those in the experimental group. Thus, indicating that the use of RISS in teaching electrical installation and maintenance works is a significant factor in academic achievement of students in the experimental group.

Hypotheses 2: There is no significant difference between the mean achievement scores of male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy.

Table 4.
ANCOVA Test of Mean achievement Scores of male and female students Taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	4206.677[a]	2	2103.338	10.685	.000	
Intercept	1869.417	1	1869.417	9.496	.004	
POSTTEST	4163.327	1	4163.327	21.149	.000	
GENDER	104.190	1	104.190	.529	.471	Not Sig.
Error	8858.573	45	196.857			
Total	344734.000	48				
Corrected Total	13065.250	47				

a. R Squared = .322 (Adjusted R Squared = .292)

ANCOVA test from table 7 shows that at F-value of 0.529, P-value is 0.471. Since the P-value is greater than 0.05 level of significance at df 1 and 45, the null hypothesis is not rejected. This shows that there is no significant difference between the mean achievement scores of male and female students taught practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy.

Discussion of Findings

The reflective instructional inquiry approach encourages proactive knowledge acquisition and problem-solving, which aids students in understanding their interests and the learning process. In small groups, it promotes discussion, critical thinking, and information exchange. By combining idea mapping, scaffolded learning, critical thinking, questioning, discussion, and collaborative learning, this approach enables students to autonomously develop their own knowledge.

Reflective inquiry, a critical thinking approach, enhances achievement by encouraging students to engage in their learning experiences. This deepens understanding, promotes thoughtful problem-solving, and enhances practical skills. Active participation in learning enhances retention as it connects theoretical knowledge with real-world applications. This reflective strategy contributes to long-term knowledge retention.

The study found that female students achieved higher academically in practical skills in electrical installation and maintenance works using reflective inquiry instructional strategy. This suggests that RIIS favored female students better than male students. The difference in achievement could be attributed to female students' higher motivation and interest in the subject, as well as individual differences within each gender group, as diverse backgrounds, experiences, and learning preferences can influence performance.

The study found that female students outperformed male students in practical skills in electrical installation and maintenance works using conventional instructional strategies. This suggests that teaching methods may favor male students' learning styles, potentially leading to a performance gap due to unintentional use of male-focused examples or language.

Implications of the Study

The finding that reflective inquiry instructional strategies significantly improved students' achievement scores in practical skills in electrical installation and maintenance work compared to conventional instructional strategies has several educational implications: By implication, therefore, reflective inquiry instructional strategies, if employed by teachers in teaching practical skills in electrical installation and maintenance in technical colleges, will create a learning environment for students to properly understand the taught concepts (as they are actively involved in the teaching and learning process) and hence improve their achievement. This also implies that if this learning approach is employed, there might be a consistent improvement in the performance of students in WASSCE and other external examinations.

The study further revealed that gender significantly influenced students' achievement in practical skills in electrical installation and maintenance work. The implication of this is that educators should consider designing instructional strategies that are inclusive of diverse learning styles and preferences. If there are gender-based differences in achievement, it's important to explore ways to make instructional methods more accessible to all students. Also, teachers who adopt reflective inquiry instructional strategies must ensure that all students, irrespective of their gender, actively engage in the learning process.

Conclusion

The study established that reflective inquiry instructional strategy significantly improved students' achievement scores for students taught practical skills in electrical installation and maintenance work, as the experimental group taught with RIIS had a higher mean achievement score in practical skills in electrical installation and maintenance work than their counterparts taught with the conventional instructional strategy (CIS). The study also revealed a significant influence of teaching methods and gender on students' achievement scores for students taught practical skills in electrical installation and maintenance work.

Recommendations

In the light of the findings of the study, the following recommendations were made:

1. Technical teachers in secondary schools should adopt the use of reflective inquiry instructional strategies to improve students' academic achievement in practical skills in electrical installation and maintenance work

2. Seminars, symposia, workshops, and conferences should be organized for technical teachers by the government, education stakeholders and professional bodies to familiarize teachers with innovative instructional approaches such as Reflective Inquiry Instructional Strategies.

References

Abrahams, I. and Reiss, M. J. (2015). The assessment of practical skills. *School Science Review*, 96(357), 40-44

Agbele, (2020). *African Journal of Education and Practice* ISSN 2519-0296 (online) Vol.7, Issue 2. No.1. pp 1 - 17, 202

Agboola, O. S. and Oloyede, E. O. (2013). Effects of project, inquiry and lecture –demonstration teaching methods on senior secondary students' achievement in separation of mixtures practical test. Retrieved June 20, 2013 from: http://www.academicjournals.org/ERR.

Akinlaye, F. A. (2002). *Social Studies Methods for Teachers*. Lagos: Pumark Nigeria Ltd.

Ajai J. T, Imoko B. I (2015). Gender differences in mathematics achievement and retention Scores: A case of problem-based learning method. *International Journals of science; 1(1);45-50*

Alokan, F.B., Arijesuyo, A.E.(2013): Rural and urban differential in students' academic performance among secondary school students in Ondo state, Nigeria. *Journal of Educational and Social Research* 3(3), 213

Anyima, F.F. (2011). Effect of reflective inquiry instructional technique on students' achievement in Government senior secondary schools Unpublished Master's T thesis Nsukka. University of Nigeria

Bosede AF, Emiloju AA. Rural and urban differential in students' academic performance among secondary school students in Ondo state, Nigeria. *JESR* 2013; 3(3): 213-217.

Cañas, A. J., Novak, J. D., and Reiska, P. (2012). Freedom vs. restriction of content and structure during concept mapping—possibilities and limitations for construction and assessment. In A. J. Cañas, J. D. [accessed Jun 13 2018].

Chen, S., and Kompf, M. (2012). Chinese scholars on Western ideas about thinking, leadership, reform and development in education. Rotterdam: Sense Publishers. https://doi.org/10.1016/j.system.2010.03.003

Chen, S.-M., and Sue, P.-J. (2013). Constructing Concept Maps for Adaptive Learning Systems based on Data Mining Techniques. *Expert Systems with Applications*, 40(7), 2746-2755.

Dixit, M.N. (2017). Reflective Teaching of Secondary Teachers in relation with their Attitude towards Action Research and Some Other Variable Educational Quest: *An Int. J. of Education and Applied Social Science:* Vol. 8(3), pp. 1-8.

Dorothy Uchenna Akubuilo, Anthonia Chinwe Ugo, Donald Chukwuma Ugo, Jane Ijeoma Ugochukwu, Michael Ejime Ikehi (2019)

Edinyand, S. D andUbi, I. E. (2012). Relative effectiveness of inquiry and expository method of teaching social studies on academic performance of secondary students in Akwa Ibom State, Nigeria. Retrieved June 20, 2013, from: www.connectionebscohostcomy/articles.

Essays, U.K. 2018. The Myers Briggs Type Indicator Education Essay. Retrieved from https://www.ukessays.com/essays/education/the-myers-briggs-type-indicator educationessay.php?vref=1 (NF EN 13306 X 60-319 standard, June 2010). From Wikipedia, the free encyclopedia.

Gibbons, P. (2015). Scaffolding language, scaffolding learning: Teaching English language learners in the mains tream classroom. Portsmouth, NH: Heinemann.

Gningue, S. M., Schroder, B., & Peach, R. (2014). Reshaping the "glass slipper": The development of reflective practice by mathematics teachers through action research. *American Secondary Education,* 42(3), 18–29.

Hu, M. L. M., and Wu, M. H. (2012). The Effect of Concept Mapping on Students' Cognitive Load. World transaction on engineering and technology education, 10 (27) 134-137

Ige T.A and Olayode A.J (2012).Effects of two modes of reflective teaching on Students' Academic Achievement in Basic Science Fines, B.G. 2014. Assessing Reflection. Retrieved from: http://law2.umkc.edu/faculty/profiles/glesnerfines/REFLECTION.pdf

Lyons, N., Halton, C., and Freidus, H. (2013). Reflective inquiry as transformative self-study for professional education and learning. *Studying Teacher Education*, 9(2), 163–174. doi:10.1080/17425964.2013.808057

Markley (2012). *International Journal of Education*, Learning and Development Vol. 8, No.9, pp.40 49, December 2020 Published by ECRTD-UK Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

M. Pedaste *et al.* Phases of inquiry-based learning: Definitions and the inquiry cycle Educational Research Review (2015)

MTH Chi, R Wylie - 2014. The ICAP framework; linking cognitive engagement to active learning and outcomes. Educational psychologist, 49:219-243

NABTEB, (2016) (2017) *Journal of Research in Humanities and Social Science* Volume 9 ~ Issue 4 (2021) pp: 13-23ISSN (Online):2321-9467 www.questjournals.org

National Board for Technical Education (2018). FCE Approves six-level NVOF for Country NBTE Blweekly Bulletin, April-May -1

Olibie, E. I. and Ezeoba, K. O. (2013). Effects of guided inquiry method on secondary students' performance in social studies curriculum in Anambra State, Nigeria. Retrieved June 6, 20

Okwelle and Ojotule (2018). *British Journal of Education* 8(4), 46-56.

Owodunni, (2020) *In International Journal of Social Sciences & Educational Studies* 7, No.3

S.Dogan *et al.* Effect of professional learning communities on teachers and students: Reporting updated results and raising questions about research design School Effectiveness and School Improvement (2018).

Shanmugavelu, G., Parasuraman, B., Arokiasamy, R., Kannan, B, and Vadivelu, M. (2020).

The Role of Teachers in Reflective Teaching in the Classroom. Shanlax *International Journal of Education*, 8(3), 30-33

Tienken, C. H., Goldberg, S., and Dirocco, D. (2010). Questioning the questions. Education Digest: Essential Readings Condensed for Quick Review, 75(9), 28–32.

Ugo, Ugo, Ugochukwu and Ikehi, (2019), *International Journal of Education, Learning and Development* Vol. 8, No.9, pp.40 49, December 2020 Published by ECRTD-UK Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online) *Journal of Research in Education and Society*, 5(3), 2141-6753

Umar I, Abdullahi Z, Hassan H. (2015). Effects of cooperative learning on secondary school students' achievement in financial accounting. Paper presented at the international conference on accounting studies. Johor, Malaysia;Available:http://www.icas.my

Vishnu, C. R. and Regikumar, V. (2016). Reliability Based Maintenance Strategy Selection in Process Plants: *A Case Study. Procedia Technology*,. 1080-1087. doi: 10.1016/j.protcy.2016.08.211.

World Transactions on Engineering and Technology Education, 10(2), 134-137. (Furtak, Seidel, Iverson, Briggs, in Marcia C. Linn, Kevin W. McElhaney, Libby Gerard, & Camillia Matuk, 2018). *Inquiry Learning and Opportunities for Technology* ISSN- 2349-7076

Zainuddin, Z., and Halili, S. (2016). Flipped classroom research and trends from different fields of study. *The international review of research in open and distributed learning, 17*(3). doi:10.19173/irrodl.v17i3.2274.