Kontagora International Journal of Educational Research (KIJER) ISSN: 3027-0618
Volume 2, Issue 1, January 2025
https://fuekjournals.org/index.php/kijer

Effect of Think-Pair-Share Learning on Students' Emotional Intelligence and Retention in Electrical Machines in Technical Colleges, Kano-Nigeria

[1]Dr. Hassan Yunusa Jamilu, [2]Sule Hussaini Jido

Corresponding author: **sulehussainijido@gmail.com** 08038451031

[1]Science and Technology Education Department Bayero University Kano, Kano State, Nigeria

[2]Nigerian Building and Road Research Institute (NBRRI), Federal Ministry of Science, Technology and Innovation, Kano-zonal Office

To cite:
Jamilu, H. Y., & Jido, S. H. (2025). Effect of think-pair-share learning on students' emotional intelligence and retention in electrical machines in technical colleges, Kano-Nigeria. *Kontagora International Journal of Educational Research, 2*(1), 393–408.

DOI: https://doi.org/10.5281/zenodo.14797066

Abstract

This study examined the effect of think-pair-share learning on student's emotional intelligence and retention in electrical machines in technical colleges, Kano-Nigeria. Two research questions and two hypotheses guided the study. The population of the study consisted of all 1756 Technical College NTC II students offering electrical installation and maintenance work trade in Kano State. The sample of the study comprised of 114 students of two intact classes selected from two technical colleges using simple random sampling technique. Quasi experimental design was adapted involving pre-test, post-test and post post-test non-equivalent control groups. The instruments used for data collection were Electrical Machine Cognitive Achievement test (EMCAT) and Electrical Machine Emotional Intelligence Questionnaire (EMEIQ). The reliability of EMCAT and EMEIQ was calculated using PPMC and cronbach alpha yielded an index of 0.84 and 0.72 respectively. Mean and standard deviation were used to answer the research questions while Analysis of Covariance was used to test the null hypotheses at 0.05 level of significant. The result of the study revealed that think-pair-share learning was more effective in enhancing students' emotional intelligence and retention and there is a statistically significant difference in the emotional intelligence and retention ability of students taught electrical machine using Think-Pair-Share and traditional teaching methods. The study recommends that, Think-Pair-Share method should be incorporated into the teaching and learning of electrical machine, Governments and other educational stakeholders should organize workshops to train electrical installation and maintenance work teachers so as to be well equipped with the require acquaintance on the use of Think-Pair-Share to teach electrical machine in Technical colleges.

Keywords: Think-Pair-Share learning, Electrical Machine, Emotional Intelligence, Retention, and Technical College

Introduction

The educational landscape right from technical colleges is undergoing continuous transformation propelled by the unremitting progress of technology and the dynamic requirements of the workforce. This evolution is particularly evident in technical education, specifically within the areas of electrical machine, where there is need for competent people that could install, test, maintain and repairs electrical machines (Olelewe, Doherty, Orji & Aneyo, 2021). In today's cut throat competition, producing the brightest expert in technical education is not enough. Technical colleges should also focus on developing the entire personality of the students which includes intellectual, emotional and social skills which will help students in their future endeavors (Ezeugwu, Nathaniel, Zaku & Pulife, 2020). Technology development in the field of electrical machine and reshaping the landscape requires teachers to adjust their instructional methods to align with the evolving needs of both students and employers of labors.

Nowadays employers of labors prefers graduates' that possess new sets of skills such as team work, cognitive and psychomotor skills and emotional intelligence which technical education graduates needs to acquire before they can be employed in modern days world of works (Igrubia, Shetima & Paul, 2021). Many electrical installation and maintenance work students in technical colleges find it difficult to operate simple electrical machines independently. This scenario has become a serious concern to stakeholders and everyone is searching for the possible cause of this challenge.

Electrical machine converts electrical energy into mechanical energy or mechanical energy into electrical energy. The machine which takes in-put as electrical energy and gives out mechanical energy as output is known as motor while the machine which converts mechanical energy in to electrical energy is called generator. The output of the machine is obtained due to the interaction between magnetic field and winding currents (Muktar, 2022). The applications of electrical machine were varied and utilized in many human activities which range from domestic to industrial applications. Electrical machines are used in industries and home as machine tools, power tools, conveyors, electric fan, vacuum cleaner, the washing and drying machines. According to National Board for Technical Education (NBTE, 2019) the goal of electrical machine module is to provide the trainee with knowledge and skills in installation, testing, maintenance and repairs of electrical machine. In order to realize these goals, electrical machine teachers, apart from being versed in the

subject, need to adopt right teaching approach such as think-pair-share learning in teaching electrical machine (Odika & Tom, 2020).

Think-Pair-Share learning refers to as cooperative learning approach which gives student opportunity to think and respond to the problems or questions presented by the teacher and then pair up with each other to brainstorm on possible solutions (Akanmu, 2019). The approach firstly, gives the students enough time to think about the subject matter independently. This thinking may be useful in the learning of electrical machines as it will help students to develop cognitive and creative thinking skills towards solving complex problems. Secondly the approach permits learners to pair the content of what they have learned about the concept of electrical machine with a desk mate within 2-5 minutes and thirdly to allow the paired learners to share the ideas and thinking on what they have learned about the subject matter with the whole class in about 3-10 minutes (Hassan, Raymond, Usman & Usman, 2020). This strategy may enhance student's emotional intelligence and retention when compared with traditional teaching method. Traditional teaching method simply means a teaching approach in which the teacher dominates the class in the delivery of concept and syllabus (Yang, Yingxiao & Swang, 2018) This approach disseminate huge amount of information in a short period of time, covering too much content in a single class period, and it merely develops only learners listening and communication skills (Nwalo & Eze, 2021). The persistent use of traditional teaching method such as demonstration and lecture method in teaching electrical machine reduces student's ability to effectively grasp relevant concepts especially the practical aspects (Eze & Osuyi, 2018). The approaches seem to be insufficient to prepare students with skills such as problem-solving skills and higher order thinking skills for self-reliance. The approach also causes dissatisfaction, inadequate knowledge development and high dependency of students on teachers. Thus, this could be partly responsible for students' poor emotional intelligence skills and retention ability.

Emotional intelligence refers to capacity to recognize, perceive, understand, regulate, assimilate and manage one's own feelings and that of others, and use them to achieve success and joy in life (Kumar, 2020). Students emotional Intelligence in electrical machine is the combination of intelligence and emotion which can be understood based on personal, technical and social competences (Veljkovi´c, et al, 2020). Emotional intelligence could also help students to recognize and manage their emotions and intellect, acquire problem solving skills and effectively use the skills in designing, operating,

installing, testing, coiling, and re-coiling, maintenance and repairs of electrical machines (Bako & Yusof, 2022). Using think-pair-share learning in teaching electrical machine in technical colleges may improves students emotional intelligence, retention ability, reduce their academic pressure and becoming a better practically oriented decision maker. Retention simply refers to student ability to remember and recall what has been taught after an interval of time without practice (Apriant & Ayu, 2020). Retention in electrical machine could be seen as a repetitive performance of skills and knowledge earlier obtained by a learner after an interval of time (Ugwuanyi, Nduji, Elejere & Omeke, 2020). Retention in electrical machine is very crucial in practical skills acquisition because it ensures that the learned skills are not only grasped temporarily but is embedded in long-term memory (Lekan & Emmanuel, 2020). Poor student's retention ability can lead to students inefficiency in applying learned skills in technical colleges and hinder their performance in both internal and external examinations, which leads to inadequate cognitive and psychomotor skills for self-employment.

Ogbu, Obiageri and Happiness, (2021) investigated the effect of Blended Smartphone Think-pair-share teaching strategy onYear2 Students' Emotional Intelligence and Academic Achievement in Ed221(Curriculum Theory) in AlvanIkoku Federal College of Education, Owerri, Imo State. The findings of the study revealed that students taught using Blended Smartphone Jigsaw teaching strategy had a higher academic achievement gain score than those taught using traditional teaching method. Also students taught using Blended Smartphone Think-pair-share teaching strategy had higher mean responses scores at the post-test than at the pretest. He recommended that teaching with blended smart-phone teaching strategy is different from that of ordinary traditional (Lecture) teaching. As a result of this, teacher educators should engage in self-training in the area of blending mobile technology with pedagogy delivery. Based on the fact that this strategy enhances students' academic achievement and also sharpens students' emotional intelligence which helps individuals with social emotional skills that help in curbing strives and encourages social tolerance. Ochigbudu, Comfort and Tofi (2023) conducted a research on Model-aided and think-pair-share: comparing effectiveness of modes of collaborative strategies on students' emotional intelligence in Biology in Makurdi, Nigeria. The findings revealed that, firstly, no significant difference was found between the mean emotional intelligence scores of students taught Biology using model-aided collaborative instructional strategy and those taught using Think-pair-share collaborative instructional strategy. Secondly, there is a significant difference exists in the mean emotional intelligence ratings scores of

students taught Biology using model-aided collaborative instructional strategy and those taught using conventional instruction strategy. Finally, it was found that a significant difference exists in the mean emotional intelligence ratings of students taught Biology using think-pair-share collaborative instructional strategy and those taught using conventional instructional strategy. It was recommended among others that both model-aided and think-pair-share collaborative instructional strategies should be used by Biology teachers to improve students' emotional intelligence. Redondo-Rodriguz, Alberto, Gil-Fernandez and Jos (2023) carried-out a research on Influence of gamification and cooperative work in peer, mixed and interdisciplinary teams on emotional intelligence, learning strategies and life goals that motivate university students to study in Extremadura University. The results of the study showed an increase in learning strategies and life goals that motivated university students to study, as well as increase in emotional clarity and significantly in emotional repair. It was concluded that gamification is a positive tool for its ability to increase emotional intelligence, life goals, and learning strategies in university student's motivation to learn compared with cooperative work in peers, mixed and interdisciplinary teams.

Theoretical Framework

The theoretical framework for this research work was based on the theory of Mayer and Salovey Theory of Emotional Intelligence. Mayer & Salovey (1990) developed the theory of emotional intelligence on the perception of personal and social intelligence. The personal intelligence comprise of two factors which are intra- and interpersonal intelligence. Mayer & Salovey refer the emotional intelligence as a type of social intelligence that entail the ability of the learner to monitor own and others emotions and feeling, differentiate among them, and to use this information to guide ones action and thinking. It is also the ability to use this information to guide your behavior and thoughts. Thus, emotionally intelligence individuals pay attention to, use, manage and understand their emotion. Mayer & Salovey coined five main domains of emotional intelligence namely Self awareness; Self regulation; Self motivation; Empathy; and Social skills.

1) Self-awareness

Self-awareness refers to the capacity to recognize and understand emotions and to have a sense of how ones action, moods and emotions of others take effect. It involves keeping track of emotions and noticing different emotional reactions, as well as being able to identify the emotions correctly. Self-

awareness is associated with being open to different experiences and new ideas and learning from social interaction.

2) Self-regulation

This aspect of emotional intelligence involves the appropriate expressions of emotion. Self-regulation includes being flexible, coping with change, and managing conflict. It also refers to diffusing difficult or tense situations and being aware of how ones action affects others and take ownership of these actions.

3) Self-motivation

Self-motivation, when considered as component of emotional intelligence, refers to intrinsic motivation. Intrinsic motivation refers to the internal drive or personal satisfaction to engage in an activity, pursue a goal, or meet their own needs, without relying on external rewards or incentives. People who are intrinsically motivated also experience of "Flow", by being immersed in an activity. They are more likely to be action-oriented, and set goals. Such individuals have a need for achievement and search for ways to improve.

4) Empathy

Empathy refers to being able to understand how other people are feeling. It involves the ability to recognize and understand other people's emotions, as well as the ability to share in and respond to those feeling in a sensitive and appropriate manner.

5) Social skills

This component of emotional intelligence refers to interacting well with other people. It involves applying an understanding of the emotions of ourselves and others to communicate and interact with others on a day-to-day basis. Examples of social skills include- active listening, eye or face contact, verbal communication skills, non- verbal communication skills, leadership, and developing rapport. The implication of the Mayer & Salovey theory of emotional intelligence to this study is that think-pair-share learning allows students to think and brainstorm on what they were taught, share the ideas with peers through social interaction while working on assignments, projects, and various types of problems related to subject matter. This will better improve the student's ability to recognize and understand their own emotions and that of others, leading to increased emotional awareness. In

addition, learning electrical machines using think-pair-share learning approach will allow students to display their emotion and appropriately share it with others; improve their internal drive or personal satisfaction to pursue a goal. This will also give the students ability to understand how other people are feeling and improve their social skills such as active listening, verbal communication skills, non-verbal communication skills, leadership, and developing rapport with others. Think-pair-share learning as a cooperative teaching approach will also allow students to share their skills and build their emotion and improve that of the others. Subsequently, the approach will improve learner's ability to monitor their own emotions and feeling and that of others, differentiate among them. Hence, the study needs to consider emotional intelligence theory.

Research Questions

1. What is the difference in the mean emotional intelligence scores of students taught electrical machine using think-pair-share learning and those taught using traditional teaching method, in technical colleges in Kano state, Nigeria?

2. What is the difference in the mean retention scores of students taught electrical machine using think-pair-share learning and those taught using traditional teaching method, in technical colleges in Kano state, Nigeria?

Research Hypotheses

HO_1**:** There is no significant difference in the mean emotional intelligence scores of students taught electrical machine using think-pair-share learning and those taught using traditional teaching method, in technical colleges in Kano state, Nigeria.

HO_2**:** There is no significant difference in the mean retention scores of students taught electrical machine using think-pair-share learning and those taught using traditional teaching method, in technical colleges in Kano state, Nigeria.

Methodology

This study adopted quasi experimental design involving the pre-test, post-test and post post-test non-equivalent control group design. The design is considered suitable for the study because there was no room for randomization (Eze, Ezenwafor & Onwusa, 2020). The study involved two selected technical colleges under Kano State Science and Technical School Board. Intact classes were used to

avoid disruption of normal class lessons. The population of the study consisted of all 1756 Technical College NTC II students in twenty six (26) technical colleges in Kano State offering electrical installation and maintenance work trade (Planning Research and Statistics Department, Science and Technical School Board, Kano State, 2023). The sample size of the study consisted of 56 students in one intact class selected as an experimental group and 58 students in another intact class selected as a control group.

Random sampling technique was used to select two technical colleges among government technical colleges offering electrical installation and maintenance work trade in Kano state science and technical schools board. Tossing was used to assign one intact class to experimental group (TPS) and the other to control group (TTM). The electrical machine cognitive achievement test (EMCAT) was adapted from past questions of National Examination Council (NECO) and National Business and Technical Examination Board (NABTEB) Electrical Installation and Maintenance Work Trade from (2019-2023) in electrical machine module. While the electrical machine emotional intelligence questionnaire (EMEIQ) was adapted from Mayer & Salovey theory of emotional intelligence to measure students' emotional intelligence based on five main domains of emotional intelligence. The instruments were subjected to content and face validation to ensure are suitable in terms of syllabus coverage, course content, language expression, and appropriateness to student's ability. The instruments were validated by three experts. One is an experienced electrical installation and maintenance work trade teacher with at least ten (10) and above years of teaching experience. The remaining two were senior lecturer in the relevant field of the study in the Department of Science and Technology Education, Bayero, University and Federal College of Education (T) Bichi, Kano-Nigeria. The reliability of the instruments were determined by administering them on 40 NTC II students of Electrical Installation and Maintenance Work in other Technical College in Kano State who are not part of the population of the study. The reliability of EMCAT was determined using split-halves method and correlated using PPMC formula yielded reliability index of 0.84. The reliability of EMEIQ was used to determine Cronbach Alpha method yielded reliability index .72. The two groups were taught the module by the researcher using think-pair-share learning and traditional teaching method respectively. The module was taught for six weeks, after which the post-test was administered. Subsequently, after two weeks of no activity a post-post test was administered to determine student's retention ability. Mean and standard deviation were used for answering the

research questions. Analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. Data were analyzed using Statistical Packages for Social Sciences (SPSS) version 27.

Results

Research Question 1: What is the difference in mean emotional intelligence scores of students taught electrical machine using think-pair-share learning and those taught using demonstration teaching method, in technical colleges of Kano state, Nigeria?

Table 1: Pre-test and Post-test Mean Scores for Student emotional intelligence Taught Electrical Machine Using TPS Leaning and Demonstration Method

Groups	N	Pre-test		Post test		Mean gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental Group	56	78.96	4.99	108.29	4.66	29.33
Control Group	58	76.90	7.29	87.41	3.62	10.51
Mean gain difference						18.82

Result presented in Table 1 show that the experimental group that were taught electrical machine with Think-Pair-Share learning had a mean score of 78.96 and SD of 4.99 in the pre-test and a mean score of 108.29 and SD of 4.66 in the post-test making a pre-test, post-test mean gain in this experiment group to be 29.33. The control group that were taught with Demonstration Teaching Method had a mean score of 76.90 and SD of 7.29 in the pre-test and a post-test mean score of 87.41 and SD of 3.62 yielding a pre-test, post-test mean gain of 10.51. With these results, both teaching methods are effective in enhancing student's emotional intelligence in Electrical Machine, but the effect of Think-Pair-Share learning on enhancing students emotional intelligence in Electrical is higher than the effect of Demonstration Teaching Method.

Hypothesis 1: There is no significant difference in mean emotional intelligence scores of students taught electrical machine using think-pair-share learning and those taught using demonstration teaching method in technical colleges in Kano State, Nigeria.

Table 2: Analysis of Covariance (ANCOVA) for Test of Significance Difference of Students Emotional Intelligence When Taught Electrical Machine Using Think-Pair-Share Learning and Those Taught Using Demonstration Teaching Method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12420.593[a]	2	6210.297	361.465	.000	.868
Intercept	5866.358	1	5866.358	341.446	.000	.756
Pre-test	40.509	1	40.509	2.358	.128	.021
Group	11835.365	1	11835.365	688.866	.000	.862
Error	1889.902	110	17.181			
Total	1093495.000	113				
Corrected Total	14310.496	112				

a. R Squared = .868 (Adjusted R Squared = .866)

The result presented in Table 2 shows that the F-calculated value is 688.86 with a significance of F at .0001 which is less than 0.05. This result shows that there is a significant difference between the effects of treatments on students' emotional intelligence in Electrical Machine. The null-hypothesis is therefore rejected at 0.05 level of significance. Hence, there is significant difference in the mean scores of students emotional intelligence taught electrical machine using Think-Pair-Share Learning and Demonstration Teaching Method.

Research Question 2: What is the difference in mean retention scores of students taught electrical machine using think-pair-share learning and those taught using demonstration teaching method, in technical colleges of Kano state, Nigeria?

Table 3: Pre-test and Post-test Mean Scores for Student retention ability Taught Electrical Machine Using TPS Leaning and Demonstration Method

Groups	N	Pre-test		Post test		Mean gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental Group	56	15.05	3.77	18.02	3.73	2.97
Control Group	58	11.88	2.96	14.07	3.56	2.19
Mean gain difference						0.78

Result presented in Table 3 show that the experimental group that were taught electrical machine with Think-Pair-Share learning had a mean score of 15.05 and SD of 3.77 in the pre-test and a mean score of 18.02 and SD of 3.73 in the post-test making a pre-test, post-test mean gain to be 2.97. The control group that were taught with Traditional Teaching Method had a mean score of 11.88 and SD of 2.96 in the pre-test and a post-test mean score of 14.07 and SD of 3.56 yielding a pre-test, post-test mean gain of 2.19. With these results, both teaching methods are effective in enhancing students retention ability in Electrical Machine, but the effect of Think-Pair-Share learning on enhancing students retention ability in Electrical is higher than the effect of Demonstration Teaching Method.

Hypothesis 2: There is no significant difference in mean retention scores of students taught electrical machine using think-pair-share learning and those taught using demonstration teaching method, in technical colleges of Kano state, Nigeria.

Table 4: Analysis of Covariance (ANCOVA) for Test of Significance Difference of Students Retention Ability Taught Electrical Machine Using Think-Pair-Share Learning and Those Taught Using Demonstration Teaching Method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	766.588[a]	2	383.294	36.413	.000	.396
Intercept	529.144	1	529.144	50.269	.000	.312
Post-test	322.303	1	322.303	30.619	.000	.216
Group	109.007	1	109.007	10.356	.002	.085
Error	1168.403	111	10.526			
Total	31151.000	114				
Corrected Total	1934.991	113				

a. R Squared = .396 (Adjusted R Squared = .385)

The result presented in Table 4 shows that the F-calculated value is 10.356with a significance of F at .0001 which is less than 0.05. This result shows that there is a significant difference between the effects of treatments on students' retention ability in Electrical Machine. The null-hypothesis is therefore rejected at 0.05 level of significance. Hence, there is significant difference in the mean

scores of students retention ability taught electrical machine using Think-Pair-Share Learning and Demonstration Teaching Method.

Discussions

The findings of research question one and hypothesis one revealed that students taught electrical machine using think-pair-share learning achieved higher emotional intelligence and there is a significant difference between the mean scores of students taught electrical machine using think-pair-share learning and demonstration teaching method. This finding is in agreement with the findings Ogbu, Obiageri & Happiness (2021) which found that students taught using Blended Smartphone Think-pair-share teaching strategy had higher mean responses of emotional intelligence mean scores at the post-test than at the pre-test. The findings of this study are also in line with Ochigbudu, Comfort and Tofi (2023) who revealed that there significant difference exists in the mean emotional intelligence ratings of students taught using think-pair-share collaborative instructional strategy and those taught using conventional instructional strategy. This could be as a result of the fact that the use of think-pare-share strategy may have increased students' active participation and enabled them to formulate their thoughts, skills and knowledge in electrical machine from others. However finding contradicts with the finding of Redondo-Rodriguz, Alberto, Gil-Fernandez and Jos (2023) who discovered that gamification is a positive tool for increasing emotional intelligence, life goals, and learning strategies in university student's motivation to learn compared with cooperative work in peers, mixed and interdisciplinary teams. The result of research question two and hypothesis two revealed that students taught electrical machine using think-pair-share learning retained better and there is significant difference between the retention mean scores of students taught electrical machine with think-pair-share learning and demonstration teaching method. This result confirms the finding of Brain, friday and Emem, (2023) and Maryjane and Ebele (2021) whose found that there was a significant difference between the mean retention scores of students taught in the class using think pair strategy and those taught using lecture method. The finding of this study is also in line with Boluwatife (2023) who revealed that there is a statistically significant difference in the retention ability of students taught using think-pair-share strategy and those taught using lecture method. This could be as a result of the fact that Think-Pair-Share learning is a cooperative learning approach which gives student opportunity to think and respond to the problems or questions presented by the teacher and then pair up with each other to brainstorm on possible solutions. This finding is in

contrary to Ugwuanyi, Nduji, Elejere and Omeke, (2020), Chika and Josephine (2021), Daiko, Achor and Jack, (2023) who their findings showed that retention of students is more highly enhanced using flipped classroom and jigsaw teaching methods.

Conclusion

Think-pair-share instructional strategy improved students emotional intelligence in electrical machine and there is significant difference between students' emotional intelligence mean scores of students taught electrical machine taught using think-pair-share learning and those taught using traditional teaching method. Think-pair-share learning enhanced students' retention in electrical machine and there is significant difference between students' retention mean scores of students taught electrical machine taught using think-pair-share learning and traditional teaching method.

Recommendations

1. Teachers and school managers should promote and incorporate the use of Think- Pair-Share learning into the teaching and learning of electrical machine at the technical college level so as to encourage students to work together thereby enhancing emotional intelligence in electrical machine.

2. Curriculum planners, school managers and ministry of education at both state and federal level should incorporate and support the use of Think-Pair-Share learning in teaching electrical machine in technical colleges to enhance students' retention in electrical machine.

References

Akanmu, M. A. (2019). Effects of think-pair-share on senior school students' performance in mathematics in Ilorin, Nigeria. *African Journal of Educational Studies in Mathematics and Sciences, 15 (2),* 16-21.

Bako, H. & Yusof, Y. B. (2022). Promoting of emotional intelligence in enhancing employability skills for 21st Century among Nigerian technical education graduates. Proceedings of the international conference on industrial engineering and operations management Nsukka, Nigeria, 1258- 12675.

Boluwatife, S. S. (2023). Efficacy of think-pair-share in improving the retention ability of secondary school students in Biology. A project report presented to the department of science and technology

education, Faculty of Education, Lagos State University. In partial fulfillment of the requirements for the award of Bachelor Degree B.Sc.(Ed) in Science Education(Biology).

Brain, E. S, Friday, J. N. & Emem, A. F. (2023). Influence of think pair share instructional strategy on senior secondary school students' academic performance and retention in science subject in Akwa Ibom North East senatorial district, Nigeria. *International Journal of Advancement in Education, Management, Science and Technology, 6(2),* 68-108.

Chika, E. G. & Josephine, O. N. (2021). Effect of flip classroom and think-pair-share instructional strategies on students' retention in Biology in Enugu Education zone**.** *International Journal of Education and Evaluation, 7(3),* 70-79.

Daiko, C. Achor, E. E. & Jack, G. U. (2023). Jigsaw, think-pair-share and coop-coop cooperative instructional strategies and retention of students' knowledge in carbohydrate. *Journal of Research in Science and Mathematics Education (J-RSME), 2(3),* 117-135.

Eze, A. N. Ezenwafor, J. I. & Onwusa, S. C. (2020). Effect of computer-based instruction on students' achievement and retention of high and low achieving auto-mechanics technology in technical colleges. *International Journal of Scientific & Engineering Research, 11(8),* 1631-1645.

Eze, T. I. & Osuyi, S. O. (2018). Effect of problem-based teaching method on students' academic performance in electrical installation and maintenance works in technical colleges in Edo state. *International Journal of Development and Sustainability, 7(2),* 666-678.

Ezeugwu, J. O, Nathaniel, I. E, Zaku, V. N, & Pulife, M. C. (2020). TVET Policies and implementation in higher institution in Enugu State Nigeria. *Vocational And Technical Education Journal (VOTEJ), 2(2),* 123-133.

Hassan, J. Y. Raymond, E. Usman, G. A. & Usman, U. A. (2020). Development of intelligent tutor for enhancing think-pair-share in learning of light emitting diode television troubleshooting. *Journal of Science Technology and Education, 8(1),* 82-99.

Igrubia, V. Shetima, A. & Paul, T. M. (2021). Comparative effects of self-concept and self-belief teaching techniques in electrical installation and maintenance work students' psychomotor

achievement in technical colleges, in Nigeria. *Quest Journal of Software Engineering and Simulation, 7(20),* 01-08.

Kumar, A. (2020). Study of emotional intelligence among university students: technical competence. *International Journal of Creative Research Thought, 8(9),* 2320-2882.

Lekan, A. L. & Emmanuel, J. (2020). Effects of cooperative and individualized learning strategies on student's academic retention in mathematics in Minna metropolis, Niger state. *Global Scientific Journal, 8(8),* 2836-2850.

Maryjane, N. U. & Ebele, O. C. (2021). Effect of jigsaw teaching strategy on academic achievement and retention of Anambra State Secondary School students in Chemistry. *Unizik Journal of Educational Research and Policy Studies, 7,* 375-386.

Mukhtar, N. (2020). Masters in Technology education Electrical machine lecture note. Department of science and technology education, Bayero University, Kano, Nigeria.

National Board for Technical Education (NBTE, 2019). *Curriculum for Technical colleges (Revised).* Kaduna: NBTE Press.

Nwalo, C. N. & Eze T. I. (2021). Comparative effectiveness of project and demonstration teaching methods in improving students' retention ability in basic electricity in technical colleges. *International Journal of. Educational Policy Research and Review, 8(1),* 1-7.

Odika, E. M. & Tom, C. C. (2020). Electrical installation and maintenance works skills for sustainability amongst graduate of technical colleges in Rives State. *International Journal of Innovative Education Research, 8(1),* 1-10.

Ogbu, E. E., Obiageri, U. I. & Happiness, E. O. (2021). Effect of blending smartphone think-pair-share teaching strategy on year 2 students' emotional intelligence and academic achievement in Ed221 (Curriculum Theory and Practice). A paper presented at science education of Nigreia (SEAN), Held at Avan Ikoku Federal College of Education, Owerri, Imo State.

Olelewe, C. J. Doherty, F. V. Orji, C. T. & Aneyo, I. (2021). Effects of innovative pedagogy integration in electrical installation and maintenance works in Enugu and Lagos states technical colleges. *The International Journal of Electrical Engineering & Education, 3(3),* 55 – 66.

Redondo-Rodriguz, C. Alberto, J. B. Gil-Fernandez, & Jos, F. R. (2023). Influence of gamification and cooperative work in peer, mixed and interdisciplinary teams on emotional intelligence, learning strategies and life goals that motivate university students to study. *International Journal of Environ Research in public Health, 20(1),* 4-12.

Ugwuanyi, C. S. Nduji, C. C. Elejere, U. C. Omeke, N. E. (2020). Effect of flipped classroom and think-pair-share strategy on achievement and retention among senior secondary school physics students. *International Journal of Sciences: Basic and Applied Research, 2(4),* 136-148.

Veljkovi´c, Neši´c , Dudi´c , Gregus, Deli´c &S Maja Meško, (2020). Emotional intelligence of engineering students as basis for more successful learning process for industry, Www.Mdpi.Com/Journal/Mathematics.

Yang, G. Yingxiao, & SWang, Y. (2018). Electrical machine course teaching reform in the background of new engineering construction. *Libro de actas, 6(2),* 556-560.