

EFFECTS OF TWO TEACHING STRATEGIES ON STUDENTS' ACADEMIC ACHIEVEMENT IN SCIENCE AND TECHNOLOGY EDUCATION IN KOGI STATE, NIGERIA

BY

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Abstract

This study examined the effects of two of teaching strategies on students' academic achievement in science and technology education in Kogi State. Two research questions and two null hypotheses guided the study. The study adopted quasi-experimental design of pre-test, post-test non randomized control group. The sample consisted of 149 (SS)II science and technology education students selected through multi-stage sampling technique. The instrument used for data collection was Science and Technology Education Achievement Test (STAT) validated by Three experts. The reliability coefficient obtained was 0.86 using Kuder Richardson20 (KR-20) formula. Data collected were analyzed using mean and standard deviation for research questions and analysis of covariance (ANCOVA) at 0.05 level of significance for the hypotheses. The results revealed that students taught science and technology education with Think-Pair-Share Teaching Strategy (TPSTS) and Scaffolding Teaching Strategy (STS) achieved significantly higher than those taught with Traditional Lecture Teaching Method (TLTM). Gender and achievement level do not significantly influence the mean achievement score of students taught Science and Technology Education using TPSTS and STS. The study recommended among others that curriculum planners should integrate TPSTS and STS in the teaching and learning of Science and Technology Education in secondary schools.

Keywords : Think-Pair-Share Teaching Strategy, Scaffolding Teaching Strategy, Traditional Lecture Teaching Method, Academic Achievement, Science and Technology Education

Introduction

Science and technology form the key player in the development of any nation. This is because nations that have control of science and technology have been able to cope with global issues such as conditions of poverty, poor sanitation, illiteracy, disease, rapid increase in population and malnutrition. Science is knowledge obtained through study or practice of the operation of general laws, especially as obtained and tested through scientific method and concerned with the physical world (Njoku, 2016). Science refers to a system of acquiring knowledge which uses observation and experimentation to describe and explain natural phenomena while technology is the application of scientific knowledge in solving human and societal problems (Achor, 2013). Science and Technology Education is the teaching and learning of science and technology. Achor opined that Science and technology has become an enterprise on which developing nations depend in order to be self-sufficient in the training of technological personnel and to sustain a viable economy and that Nigeria in the twenty first century continues to look forward to science and technology to bring about industrialization and physical transformation. Hence science and technology is therefore receiving an

increasing attention in educational sectors all over the world, Nigeria inclusive. Science and technology is the bedrock of human development. Many of the developed nations were able to achieve the status of development through science and technology. Therefore, there is need for adequate and equal participation of students to acquire the knowledge of science and technology through the use of efficient and quality instructional strategies.

Despite the important place of science and technology education in secondary school curriculum, academic achievement of secondary school students in science and technology subjects like physics, chemistry and Biology in west African senior school certificate examination (WASSCE) has remained consistently poor (Chief examiners Report, 2016-2021). This phenomenon has remained a source of concern to the researchers, parents/guidance, educational administrators and the nation at large. Achievement is the feeling of getting things done as we desired or getting things that we expected. Okafor (2018) described achievement as the act of accomplishing or finishing something well, something accomplished successfully especially by means of exertion, skill, practice or perseverance. Academic achievement is determined by the level of accomplishment of given task evaluated by the teachers through achievement Test, Assignment e.t.c. Okorochoa (2019) describes Academic achievement as the scholastic standing of students at a given moment which states individual's intellectual abilities. Achievements in science and technology education therefore identifies how well or bad students have accomplished a given task or test in science and technology subjects. Thus achievement in science and technology education may not necessarily take place unless teachers form solid foundation for solid instruction through effective use of teaching strategies that are students centered and activity oriented techniques. Science education researchers have come up with many strategies and methods for teaching science and science and technology education inclusive, namely; problem solving method, inquiring based teaching /learning approach, analogies as advance organizer, collaborative approach among others (Osomoye,2016). Despite all these efforts, the problem of poor achievement in science and technology education subjects (physics, chemistry and Biology) has continued to be noticed in the public examinations like WASSEC. Therefore, more efforts should be undertaken to improve the situation.

Teaching strategy is seen as the overall plan or large scale of pattern of activities geared towards achieving a goal and guarding the goal. A good strategy guarantees a positive change in behavior, which is evidence that meaningful learning has taken place. The learner is at the centre of the teaching and learning process. Hence, learner centered strategies are mostly needed in the teaching and learning of science and technology education. Learner-centered method is the type of teaching strategy that places the learner in the center of all teaching activities (Achor,2017). This method devotes more time to students' participation and recognizes the fact that no learning is effective unless the child is personally involved in the learning situation. The child must be constantly participating in order to help his or herself and the group activities, engage in the discussion, asking questions, seek solutions, and generally take part in the activities. This is possible only with instructional strategies that are student centered like think- pair-share and scaffolding techniques that will help students to explain and be actively involved in the teaching and learning process.

Think-pair-share teaching strategy (TPSTS)is a harmonious learning technique that entails presenting students with an assignment or task and granting them time to think individually, then in pairs, they present their findings, examine their thoughts and then refine their work if they see fit to come up with an agreement on the question or task. Then after pairs have had time to communicate, the class comes together and members of the different pairs share their

thought with the class .Think- pair –share teaching mode facilitate student participation in discussing the task and promotes students’ ability to form and critique assertions both in small and large groups. The use of TPSTS instructional strategy could help students to change their learning style from listening and talking notes given by a traditional” chalk and talk” teacher centered to activity based learning where students get more involved in their learning and to learn from other students (Okorochoa & Nwachukwu,2020). Think- pair- share is a cooperative learning mode that can promote and support higher level of thinking. Brown (2021) defined the TPSTS as a successful teaching mode in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. There are three components in this teaching strategy which includes; time for thinking, time for sharing with a partner and time to share among pairs to a larger group. - pair-share strategy has many advantages over the traditional questioning structure. The think time incorporates the important concept of “waittime” it allows all students to develop answers, and more elaborate answers can be given and answers will have reasons and justifications because they have been thought and discussed. The teacher asks students to think about a specific topic, pair with another student to discuss their thought and then share their ideas with the group. Students are willing to take risks and suggest ideas because they have already ‘tested them ’with their partners. This strategy differs from scaffolding in that it allows for interaction among the learners during the pairing and sharing stages.

Scaffolding on the other hand refers to the process by which a teacher, an instructor or a more knowledgeable peer assists a learner, altering the learning tasks so that the learner can solve problems or accomplish task that would ordinarily be impossible for him/her and to learn from the experience (Reiser,2018) .Scaffolding is a teaching strategy where the teacher or the gifted students lend academic support to the slow learners through discussion and interactions with the slow learners, it is a teaching learning process designed to promote a deeper level of learning as the teacher pair up gifted and knowledgeable students with the slow learners or students during classroom instruction or activities . Scaffolding is derived from mother –child observation and has been applied to many other contexts, such as computer education (Hadwin&Azeuedo,2016). The term is used to describe certain kinds of support which learners receive in their interaction with parents, teachers and other “mentors” as they learn more new skills, concepts or levels of understanding. It is a term which helps to portray the temporary but essential nature of the mentors as the learner advances in knowledge and understanding. In education, teachers are regarded as builders. They can use gifted and fast learners as scaffolds to build up slow learners. The gifted students therefore lend academic support to the slow learners through discussions and interactions with the slow learners on what the teacher taught previously in class. This is because students learn very fast and better with each other as the interaction stabilizes their emotional state.In applying this process of scaffolding as a strategy for teaching and learning of physics, the teacher should note the background knowledge of the child, breakdown the process into manageable bits, so that it will not be too tasking for the learner and assist the students in the acquisition of such skills. The use of scaffolding as a teaching strategy helps to boost the overall achievement of students in the class, it aids meaningful learning of science and technology education concepts and finally helps boost the average performance of students in the class.

Using these strategies of teaching Science and technology education that is think-pair share teaching strategy and scaffolding teaching strategies entails students ‘involvement in teaching and learning. By so doing, the students are not only observing but are directly involved in the process. The involvements in process bring about increase in academic achievement of

students, hand on practical in and intelligibility in concepts learning. Questions and answers are easily gotten or derived among the students as they pose difficult questions and abstract concepts in the subject matter to each other wherein teacher compliment their answers by giving them correct one. If the potentials of think-pair –share and scaffolding modes of teaching or instructional strategies are fully and carefully utilized as against traditional breeding patterns, the academic achievement of students in science and technology education could improve and discrepancy in gender bias in academic achievement in the discipline could be verified. Gender is the state of being male or female in relation to the social and cultural roles that are deemed ethical for men and women. The issue of gender will be considered in this study because achievement in science and technology education can be gender based. Sometimes, the subject a male child finds fascinating may not be fascinating to the female child. Also teaching and learning techniques which may enhance male child achievement in science and technology may seem too hard to the female. Oguniyi (2016) found a differential academic achievement as a result of gender. Mbellomize (2017) observed that male students out performed females in examination. Gender differences in achievement have been examined for some time resulting in a substantial body of literature. Mordi&Njoku (2017). Umeoduagu, (2018); Talabi, Emiolat and Ogunkola (2018), and Akinsola (2019) Pointed out that there is no significant difference in students' academic achievement in various subjects including science and technology subjects form an integral part. However Awotala and Akinsola (2019); Adeneye and Amosun (2021) in their study found significant difference in students' achievement with either, male or female girl child performing better. Hence this study is put forward to identify possible impacts of two teaching strategies on student's academic achievement in science and technology education in Kogi East Education Zone of Kogi State.

Statement of the Problem

It is worrisome to both scientist and educational researchers of the plight that bedevil the study of science and technology education in Nigeria which Kogi East education zone is inclusive, as declining trends of students' academic achievement is noted. This might be that students are not taught with teaching modes that were dialogically oriented and all inclusive to discover knowledge on their own and gain experience for themselves.

Effective teaching strategies that can enhance students' academic achievement in science and technology education requires active involvement of the parties involved. It is however believed that applying two teaching strategies specifically think-pair share- teaching strategy and scaffolding teaching strategy as an alternative instructional strategies could make teaching and learning active, interactive, attractive and usingful in achieving the desired output. Hence, the statement of the study put in question form is what are the impacts of two teaching strategies on students' academic achievement in science and technology education in Kogi East Education zone of Kogi State.

Research Questions

The following research questions guided the study:

1. What are the differences between the mean achievement scores of students taught Science and Technology Education with Think-Pair Share Teaching Strategy (TPSTS), Scaffolding Teaching Strategy (STS) and Traditional Teaching Method (TTM)?
2. What are the differences between the mean achievement scores of male and female student taught Science and Technology Education with think- pair – share teaching Strategy (TPSTS) and scaffolding Teaching Strategy (STS)?

Hypotheses

The following hypotheses were tested at 0.05 Alpha level of significance.

H₁ There is no significance difference between the mean achievement scores of students taught Science and Technology Education with Think-Pair-Share teaching Strategy (TPSTS), Scaffolding Teaching Strategy (STS) and Traditional Teaching Method (TTM).

H₂ There is no significant difference between the mean achievement scores of male and female students taught Science and Technology Education with think-pair share Teaching Strategy (TPSTS) and scaffolding Teaching Strategy (STS).

Methodology

A quasi experimental design adopted for this study was both a pretest and posttest nonrandomized control group. The area of the study is kogi East education zone of kogi state. The population comprised 2250 (1220 males and 1030 females) students in the 38 public secondary schools in kogi east education zone of kogi state .sample size was 149 Senior Secondary Two (SS2) students selected through multi-stage sampling technique. This is because it enable the researcher to sample the students in the nine local government areas in Kogi East Education Zone including co-educational schools with laboratory and qualified science and technology education teachers. The breakdown includes, random sampling technique was used in selecting three local government areas out of the nine LGA in kogi East Education zone, from this sampling technique Ankpa, Idahand Olamaboro local government areas were selected. Purposive sampling technique was employed in selecting six(6) schools (two each) out of the sampled local government areas in kogi East Education zone. Purposive sampling was used because the six schools enjoy common characteristics which are not in other schools. These characteristics are a well equipped laboratory ,experienced teachers in science and technology education subjects, available two intact classes made of male and female science and technology education students (co-educational school). Stratified random sampling technique was used to assign two schools each to each of the three groups or strata (experimental group1& 2 and the control group). One intact class in each of the six schools was used for the study. Therefore in this study random sampling, purposive sampling and stratified random sampling techniques were used in the sampling process.Mean and standard deviation were used to answer the research questions while the hypotheses were tested using analysis of covariance (ANCOVA). The null hypothesis (H⁰) is rejected at p value less than 0.05.

Results

Relevant findings in the this study were presented in tables according to the research questions and hypotheses

Research question one: What are the differences between the mean achievement scores of students taught Science and Technology Education with think-pair –share teaching strategy (TPSTS), scaffolding teaching Strategy (STS),and Traditional Teaching method (TTM)?

Table 1

Mean and Standard Deviation of Achievement Scores inPre-test and Post –test of the Treatment Groups

Groups	N	Mean pretest score	SD pretest score	Mean pottest score	SD pottest score	Mean pottest score	Gain Score
TPSTM	51	34.84	8.64	60 .91	10. 54	26.07	
STM	50	33.62	9.34	52.50	11.95	18.88	
TTM	48	32.49	7.86	48.40	8.14	15 .91	

Data in Table1 shows TPSTS has a mean gain score in achievement of 26.07 while STShas mean gain score of 18. 88 and TTM mean gain score is 15.91. This shows that the students in TPSTS groups achieved higher than those in STS and TTM group. Thus the three groups did not achieve equally. Also from Table1 STS groups has the highest standard deviation score of 9.34 in pretest and 11.95 in posttest showing that score from that groups is less homogenous when compared to the other two groups (TPSTS& TTM). In general, the table reveals that standard deviation score for each group is very high in both pretest and post test.

Research Question two: What are the differences between the mean achievement scores of male female students taught Science and Technology Education with Think-Pair Share Teaching StrategyTPSTS and Scaffolding Teaching Strategy(STS)?

Table2:

Mean Achievement Scores of Male and Female Students Taught with TPSTS and STS

Groups	N	Mean pretest score	SD	Mean pretest score	SD posttest socre	Mean posttest score	Difference
TPSTM							
Male	30	30.40	7.10	60.80	10.11		
Female	21	29.50	8.30	57.20	12.60	3.60	
STM							
Male	30	31.10	7.70	52.50	11.70		
Female	20	30.60	8.60	50.40	14.00	2.40	

Data in Table 2 indicates that the mean achievement score of male students (60.80) is higher than the mean achievement score of their female (57.20) counter parts taught Science and Technology education using TPSTS with mean difference of 3.60. Also, male students taught Science and Technology education using STS had mean achievement score of (52.50) while the female students had 50.40 given a mean difference of 2.10 in favor of the male students. Table2 further reveals that female students had higher standard deviation (SD) score before teaching than their male counterpart in the two strategies. In general male students achieved higher than their female counterparts when taught with TPSTS and STS

Hypothesis one:There is no significant different between the mean achievement scores of taught Science and Technology Education with TPSTS,STS and TTM

Table 3

ANCOVA Test of Significant Difference Between the Mean Achievement Scores of Students in the Treatment Groups

Source	Type III sum Of squares	df	Mean	F square	Sig	partial Eta square
Corrected model	16583.2960	17	975.488	37.374	.000	.850
Intercept	17164.068	1	17164.068	657.299	.000	.836
Pre-test	268.964	1	268.964	10.824	.001	.082
Method	846.276	2	423.138	16.687	.000	.216
Gender	121.122	1	121.122	4.032	.037	.037
Method *Gender	30.283	2	15.142	.612	.544	.010
Error	2995.673	121	24.758			
Total	413116.000	139				
Corrected Total	18599	138				

Tables3 reveals that significant difference exists between the achievement scores of students taught Science and Technology Education with Think-pairs share teaching Strategy (TPSTS,) Scaffolding teaching mode (STS) and Traditional teaching mode (TLTM). $F(2,121) = 16.687, 43$ $p = 0.000 < 0.05$. Thus there is a significant difference between the posttest mean achievement scores of students taught physics with TPSTS, STS and TLTM. To obtain the direction of the difference a post-hoc multiple comparisons was conducted and summarized in

Table 4

ANCOVA Test of Significant Difference Between the Mean Achievement Scores of Male and Female Students Taught With TPSTS and STS Source

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	13561.4530	12	1,130.12	42.671	.000	.836
Intercept	16777.367	1	16777.367	714.610	.000	.861
Pretest	124.577	1	124.577	5.611	.33	.046
Method	132.156	1	132.156	6.141	.026	.051
Gender	40.122	1	40.122	1.712	.215	.018
Method* gender	10.302	1	10.302	.376	.526	.004
Error	2414.328		9425.684			
Total	32986.000	107				
Corrected total	140974	106				

From the result of the ANCOVA test as shown in Table5, the statement of hypothesis is not rejected, implying that there is no significant difference in the mean achievement scores of male and female students taught physics using both TPSTS and STS($1,94) = 1.712, P=0.215>0.05$).

This shows that the achievement of students in relation to both TPSTS and STS is not influenced by gender of the students.

Discussion

The result of the study revealed that students taught Science and Technology Education with TPSTS and STS achieved more than those taught with TLTM showing that TPSTS and STS are very effective on students achievement in Science and Technology Education .That is to say that use of student centered approach in lesson delivery was very effective .It could also be seen that the group of teachers who cooperatively plan the lesson and incooperated the students into the teaching process really did a good work and the interaction between teacher –student and student - student was supper also students were not given the chances to be part of the lesson modification in TTM as seen in TPSTS and STS.The finding equally revealed that there is significant differences between the posttest mean achievement scores of students taught Science and Technology Education with TPSTS,STS and TLTM.The posthoe multiple comparism revealed that TPSTS is more effective than STS and TLTM , followed by STS .The findings of the study are in line with Okorochoa and Nwachukwu (2020) who reported that the TPSTS is more effective in enhancing students’ achievement in financial accounting when compared to STM and the conventional teaching method. The findings of the study concur with the findings of Adekule (2015) who found that students taught with Think-pair share and scaffoldingstrategies obtained significantly higher posttest mean scores than those taught using conventional strategy. Also the findings is in line with Uduafemhe, Numwo,Emmanuel and Owodunni(2018) finding that TPSTS and STS approach are effective

in improving students achievement in basic electronics, However, TPSTS approach is more effective than scaffolding instructional approach .The finding is also in agreement with Ahmed (2018) that there was significant influence in the Geometry achievement test of students exposed to think-pairs –share and scaffolding strategies in favour of the students taught with think-pair Share strategy.

This study further revealed that there is no significant difference in the mean achievement scores of male and female students taught Science and Technology Education using both think-pair –share Teaching Strategy and scaffolding teaching Strategy .That is to say that gender and achievement level do not significantly influence the mean achievement scores of students taught Science and Technology Education using the two Strategies think-pairs share and scaffolding teaching strategies .

Conclusion

Based on the findings, the researchers concluded that Both Think-pair –share Teaching Strategy (TPSTS) and Scaffolding Teaching Strategy (STS) are effective in enhancing students' achievement, however, Think-pair–share Teaching Strategy is more effective than Scaffolding Teaching Strategy. And that both strategies and techniques are gender friendly.

Recommendation

Based on the findings, the following recommendations were made:

1. Science and Technology Education teachers should adopt the use of TPSTS and STS in the teaching so as to allow the students participate in the activities of the classroom
2. Gender differences in Science and Technology Education classroom should be reduced using TPSTS and STS.

References

- Abuh , P.Y.(2021). Relative effects of cognitive conflict instruction and conceptual change pedagogy on students' academic performance in physics. *Journal of the International Centre for Science Humanities and Education Research*, 5 (1), 35-46.
- Achor, E.E. (2013). Teaching waves and radioactivity using innovative approaches, In R.M.O. Samba & J.O. Eriba (Eds) *innovative approaches to teaching difficult Concepts* (128-148). Makurdi: Destiny ventures
- Achor ,E.E. (2017) .Effects of learner centred and Peer Collaboration Strategies on Students academic achievement in Basics Science in Makurdi local government of Benue State. *Journal of Research in Curriculum and Teaching*, 10 (2), 126-132.
- Akinsola, M.K. (2019). Instructional methods employed by Mathematics teaching: A Managerial Approach. *African Journal of Educational planning and policy studies* 3(1), 25-32.
- Awofala, A; Adeneye ,O.p; & Amosun , O. (2012). Comparison of Private and Public Schools Products Performance in Mathematics and English Language from Educational Technology Perspective. *Ilorin Journal of Education*, 4(1), 39-47
- Adekunle , N.M .(2015). Effects of Two Modes of Computer Aided Instruction on Students Achievement and Interest in Strategies and Probability. *International Journal of Education and Research*, 3(1), 89-102.
- Adeneye, N. & Amosun, S .A (2021). Science education and national development being a paper presented at the ASUTIBS maiden National conference at college of Education kahtsina – Ala 6th -9th October 2021 from [http: humbolde](http://humbolde)
- Ahmad , M.O. (2018). The Role of Gender on Secondary School Students Academic Performance in Basic Science in Edo state, Nigeria. *African Journal of Education*, 24(1), 90-94.

- Brown, m .G .(2021) .Effect of Gender Related Differences in Academic achievement and retention of senior secondary school students taught geometry using problem solving approach. *InternationalConference on Education Mathematics Sciences and Technology*, 1,484-488.
- Hadwin, A.T. &Azeudo, O.A. (2016). Effects of thought –peer Review and peer investigation on students’ academic performance in biology in Asia State. *Journal of Science Education*, 14(2) 69-76.
- Jegede, O.J. &Iyana, N. (2010). Effects of meta cognitive strategies on students’ Anxiets and achievement in Biology.*Journal of Teacher Education*, 30(4), 18-28.
- Joda, A.I. (2019).Critical Pedagogy for Science Education: the role of teacher education *Journal of Industrial Teacher Education* 30(4), 7-18.
- Mbellomize, B. (2017) .teachers, perception of their students’ gender. Retired *December 14, 2021 from http://Humboldt*.
- Mordi, C.&Njoku, J.C. (2017).Sex differences in science Achievement. *Bensu Journal of Education*, 3(2), 1-11.
- Njoku, Z. C., (2016). Identification of difficult science process skills in physics practical activities Among advanced level physics students. *African Journal of Science, Technology and Mathematics Education (AJSTME)*.8(2),75-81.
- Osomoye, O.R. (2016). Nigeria science teaches perceptions of effective science teaching practice ang their classroom teaching practice in junior secondary school in lagos state.*Journal of Learning Sciences* 21(2), 241-250.
- Okafor, C.A. (2018). Influence of gender, school location and use of play simulation on school Achievement in chemistry. *JORIND*, 9(1),381387.Retrieved from www.ajol.info/journals/jorind.
- Okoronka, O.N. (2019). Effect of emotional pictures on students, concept attainment in primary Science. *Journal of Primary and Teachers’ Education Association of Nigeria*.9(2) 56-62.
- Okorocho, C.C.&Nwachuwukwu, .f.c (2020). Effect of think-pair-shsre instructional strategy on secondary school financial accounting inAbia State. *International ScholarsJournal of Arts and Social Science Reaesrch* ,3(1), 52-67.
- Oguniyi, P. I.(2016). Effects of peer tutoring strategy on Academic Achievement of Senior Secondary School Students in Technical Drawing in Nigeria.*British Journal of Educatiion, Soicety&Behavioural science*,19(1), 1-10.
- Okeke, F.A.C.(2011) . Gender science and *technology in Africa* .Achallenge to education *RammenetaAnnual public Lecture*, Cambridge USA: Riddle college.
- Osakwe, E.O. (2012). Effects of instructional modes on spatial conceptualization in social studies. *Unplishedph.D Thesis, University of Ibadan, Ibadan*.
- .Ogunkola, B.J. (2018). Instructor Expressiveness, students 40 cus of control and cognitive entry behavior as a measure of students achievement and attitude towards Biology .*Unpublished Ph.D Thesis University of Ibadan*.
- okorocho, C.C. (2019). effects of cooperative and individualized of instruction on the senior secondary school student s achievement in mathematics (*unpublished doctorate dissertation*) *NnamdiAzikwe university Awka*. retrieved from www.navlibrary.com
- oguyemi, T.H. (2018). Enhancing science performance through think pair-share strategies among college of education students in integrated science in Ekiti State Nigeria. *InternationalJournal of Education and Evaluation*, 4(4), 59-66