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EFFECT OF THINK-PAIR-SHARE INSTRUCTIONAL STRATEGY ON INTEREST AND ACHIEVEMENT IN SET THEORY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN GARKI, ABUJA, NIGERIA

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Abstract

This study determined effect of think-pair-share instructional strategy on interest and achievement in set theory among senior secondary school students in Garki, Abuja-Nigeria. Quasi-experimental research design was adopted for this study. Four research questions and four null hypotheses guided the study. The population of the study comprises of 966 students in four government owned senior secondary school-SS1 in Garki, Abuja –Nigeria for 2024/2025 academic session and two out of three co-educational schools were used. Simple random sampling technique was used to select sample of 103 students who were grouped into experimental and control groups, having the sample of 63 and 40 students. Two instruments namely; set theory interest scale (STIS) and set theory achievement test (STAT) were employed for data collection. Cronbach Alpha's formula was used to determine the reliability of STIS yielding 0.79 as coefficient and Kuder-Richardson formula 21 (K-R_{21}) reliability was used to determine the internal consistency of STAT which yielded coefficient of 0.78. Descriptive statistics of mean and standard deviation were used to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses. The hypotheses were tested at 0.05 level of significance. Findings from this research revealed that; both students taught using the TPS instructional strategy and those taught using the conventional method have shown similar influence on students interest in set theory; students who were exposed to both TPS instructional strategy and the conventional method show similar levels of understanding in set theory; The study concluded that both TPS instructional strategy and the conventional method have shown similar effect on students' interest and improving academic achievement, highlighting the benefits of interactive, hands- on learning experiences in mathematics education. The study recommended that since the two strategies are effective, mathematics teachers should utilize their applications into mathematics classroom; government should organize regular capacity building programme to teachers such as workshop, conference, seminar, symposium and exhibition on both think-pair-share and conventional instructional strategies in secondary schools.

Keywords: Mathematics, Set Theory, Think-Pair-Share, Interest, Achievement, Senior Secondary School, Garki, Abuja, Nigeria.

Introduction

Mathematics is an essential tool needed for the successful development of any nation. In Nigeria, high expectation is placed on the teaching and learning of mathematics in schools that is why mathematics is a compulsory subject at primary, junior and senior secondary school levels. Due to the relevance and importance of mathematics in developing and building individual skills, the Federal Republic of Nigeria (FRN, 2014) has identified mathematics as a core subject in Nigerian secondary schools. According to Obarakpo (2015), mathematics is used either directly or indirectly in providing solutions to daily basic human problems for example, in the aspect of building, quantity of materials required can be calculated, a housewife can do her calculations on what to buy at the store. Also, mathematics is a useful tool in the hands of professionals like engineers, doctors, pharmacists among others. In other words, mathematics can be applied in all aspects of human endeavours. According to Timayi, Ibrahim and Sirajo (2016), mathematics is a logical language for expressing ideas, shapes, quantities, size, order, change and dynamism of single and complex system. Nkwocha (2016) defined mathematics as a science of numbers and systematic reasoning for resolving problems. The researcher further explains that, mathematics is a science of numbers and shapes which include arithmetic, algebra, geometry, statistics and calculus.

It is the relationship that revolves around the practice of counting, measurement, collection of well-defined objects and well describing shapes and spaces. According to Newman (2017), mathematics is the science of quantitative study of reasoning and their relations, spatial forms in the real world, being inseparably connected with the needs of technology and natural sciences. Thus, mathematics is a field of symbolic representation of ideas and relations.

Prerequisite for the progress in educational system, mathematics is not only a tool but it is a tool for educating the mind; it is a tool of subject and language; it is used for thinking about and facilitation of the learning of all other subjects especially sciences because not only is it needed for the sciences, but it also provides access to undergraduate courses (Norris, 2015). Learning mathematics as well as another science subject therefore is becoming more essential not only for the well-being of an individual but the society in general.

Acknowledging the importance of mathematics, Life (2017) viewed mathematics as king of arts and queen of sciences. Attributing to the importance and value of mathematics to human life in general, Emma (2015) maintained that using practical examples may promote interest in the arts of taking measurement at home (use of bathroom scale, people on medical in need to understand different dosages), distance-time

relationship in travelling, buying and selling at the store, averaging and statistics for sports all require the use of mathematics. Considering the importance and relevance of mathematics to an individual and the nation at large, Nigerian students' performance in the subject at both internal and external examination has been below expectation. Examination like Senior School Certificate Examination (SSCE) conducted by both the West African Examination Council (WAEC) and the National Examination Council (NECO) have not been satisfactory in Nigeria (Ashmore, Fratter and Casey, 2015). They observed that there is decline in students' achievement in subjects particularly mathematics which may not be unrelated to the perception of difficulties in comprehending certain areas in mathematics especially the areas that are regarded as complex and abstract like Venn diagram in set theory. As a result, students tend to dislike this topic in mathematics hence the tendency to avoid this area during examination.

This decline in students' achievement has been a huge concern to mathematics educators and education planners. Attesting to low achievement in mathematics, Zalmon and Wonu (2017) posited that, parents and government are in total agreement that their investing in education is not yielding the desired dividend. The West African Examination Council's chief examiner's report indicates that general performance of the candidates in mathematics for the May/June (WAEC 2015-2025) examinations did not differ significantly from those of the previous years. Attributing to the percentage credit pass of students in May/June WAEC between 2015-2025 is a concern. Though, there was no steady lift in the percentage of students with credit pass, the summary drawn from students' achievement in mathematics between 2015, 2016, 2021 and 2022 is that, more than 50% of students enrolled achieved below credit pass that is A1-C6 as compared to the students' achievement in 2017, 2019, 2024 and 2025. Can students' achievement in 2017, 2019, 2024 and 2025 be sustained or improve better? This is a source of worry to researchers. Poor academic performance could be attributed to many factors among teachers' approach itself may seem as an important factor. One of the areas of mathematics that contributes hugely to the poor achievement of students is set theory. The WAEC chief examiner further observed some of the challenges noticed in the students' performance include, inability of the students to handle the problem on set theory, the students seem not to understand the questions and do not answer them correctly except for few candidates. All of these led to the researcher's attention to set theory.

Set theory is an important topic in mathematics, where problem of teaching and learning occurs

most, students misunderstand the concepts of set theory in general (Sambo, 2015). All this difficulty of teaching or learning of set theory directly or indirectly is associated with the method of teaching used by mathematics teachers as mentioned in the WAEC chief examiner's report. Set theory are mathematics contents to be taught at senior secondary school (SSS) level as stated by Federal Ministry of Education (FME, 2015). Going by the place occupied by set theory in mathematics and science, if students are well taught using appropriate approach, it will go a long way in enhancing their achievement in the subject.

According to Nwoke (2015), significant efforts have been made by stakeholders in mathematics education which are aimed at identifying major problems associated with the teaching and learning of mathematics as regards the concepts of set theory as a topic in secondary schools in Nigeria, one of which is the method of instruction. Nwoke (2015) further opined that some teachers do not want to change their method of instruction; they are convinced that conventional approaches are better than newer ones when dealing with large classes in Nigerian secondary schools. This draws the researcher's attention to a method of teaching called "the conventional method." Conventional method is a traditional method of teaching that is common in most Nigerian classrooms today. According to Li (2016), conventional or traditional teaching method refers to a teaching method involving instructors and the students interacting in a face-to-face manner in the classroom. These instructors initiate discussions in the classroom and focus exclusively on knowing the content in textbooks and notes. Students receive the information passively. The conventional teacher sees that it is the teacher that causes learning to take place. This method of teaching practiced in mathematics classroom is yet to produce a significant result rather than promoting rote learning for many years back where students memorized facts, formulae, rules and procedures.

Due to the demerits of conventional method and its weak effect on students' achievement in mathematics, effort has been made by education planners and mathematics educators to promote mathematics teaching to a greater height. One way to address this situation may be to give trial to think-pair-share strategy (Sejani, 2016). Lyman created "think-pair-share" as a strategy for group discussions in the classroom that benefits students' achievement and is learner-centered. Found as a cooperative learning strategy, think-pair-share gives students activities that demand accountability and promote interaction (Hernando et al., 2023). Moreover, think-pair-share instructional strategy requires the active engagement of both the learners as well as the instructor who serves as the facilitator of the learning process. It is

intended to be an active, dynamic alternative to traditional classroom instruction that should be interactive and collaborative for those involved in this investigation and as well other learners. So, think-pair-share learning instructional strategy is a process of learning instruction that allows learners to think, pair themselves and then share ideas of the topic presented to them, that is, allow the pair to do and say and to have things happen to them in the realm of mathematics in order to make the learners active participants in the process of learning mathematics. By increasing physical activity level when learning a concept, learners will internalize the information and be more supported in the concepts. The more they can "do" while learning, the better (Airth, 2016). More so, Dange (2015) reported that students remember only 20% of what they hear, 30% of what they see, but up to 90% of what they hear, see, and practice cooperatively. This high level of retention can be achieved through the effective use of the think-pair-share learning strategy. Therefore, adopting the think-pair-share strategy in mathematics instruction might provide an interactive, collaborative, and learner-centered approach that enhances understanding, promotes active participation, and significantly improves students' achievement compared to conventional methods.

Objectives of the Study

The general objective of this study was to determine the effects of think-pair-share (TPS) instructional strategy on students' interest and achievements in set theory among the senior secondary schools in Garki, area of the federal capital territory (FCT), Abuja, Nigeria. Thus, the specific objectives of this research work was to determine the;

1. effect of think-pair-share (TPS) on students' interest in set theory among the senior secondary schools in Garki, Abuja, Nigeria.
2. effect of think-pair-share (TPS) on students' achievements in set theory among the senior secondary schools in Garki, Abuja, Nigeria.

Research Questions

The following research questions guided the study.

1. What are the mean interest ratings of students in set theory taught using think-pair-share (TPS) and conventional method?
2. What are the mean achievement scores of students in set theory who were taught using think-pair-share (TPS) and conventional method?

Null Hypotheses

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

H_{01}: There is no significant difference in the mean interest ratings of students taught set theory using think-pair-share (TPS) instructional strategy and those taught using the conventional teaching approach.

H_{02}: There is no significant difference in the mean achievement scores of students taught set theory using think-pair-share (TPS) instructional strategy and those taught using the conventional teaching approach.

Literature Review

a. Set Theory in Mathematics

The performance of Nigerian students in the Senior School Certificate Mathematics Examination over the years has not been encouraging. Studies have indicated that this is partly due to students' lack of in-depth knowledge of some selected topics in mathematics. Evidence abounds in literature and WAEC chief examiner's reports indicating that students performed poorly in set theory with Venn diagram. Venn diagrams are usually shown by a rectangle or a circle or both; they show relationships between the sets under discussion. And that problem involving two or three problems can be solved by using Venn diagrams. Although, an oversight in this research work is the fact that set theory is one area students mostly do not answer questions on problem related involving Venn diagram of a set theory both in internal and external examination and that prompt the researcher attention to ensure focus on this study work specifically among the Senior Secondary School students in Garki area of the Federal Capital Territory, Abuja, Nigeria.

b. Think-pair-share (TPS)

The TPS strategy developed by Lyman (1981), is an active learning technique designed to increase student engagement and facilitate. Research has shown that TPS encourages active learning, thinking, enhances student interaction, and improves understanding of complex concepts. Studies across various subjects, such as mathematics, science, and language arts, have demonstrated that TPS increases both student interest and achievement. For instance, in a study by Sejani (2016) in Nigerian secondary schools, TPS was found to enhance problem solving and mathematical learning outcomes of students compared to conventional (traditional) methods.

c. Students' Interest in Mathematics

Students' interest in the teaching and learning activities, scholars, researchers, has been of concern to students, parents, educators, government and other stakeholders in the education sector. One of the attributes of a professional mathematics educator is ability to

motivate and arouse the interest of students. Mcgrew (2018) conceptualized interest as a relatively stable or lasting predisposition, positive affective orientation and tendency to persist when performing certain specific academic task. Unlike achievement which is of cognitive domain, interest is an educational concept that determines some aspects of students' affective domain which is very important in the teaching and learning process. In education, interest is characterized by increased attention and concentration in classroom and academic activities. It is a motivational variable and emotionally oriented trait which determines the vigor of the learner in tackling educational activities (Okoro, 2017). Interest reflects a central feature in the knowledge value system of a learner, meaning that learners' interests are influenced by the value they have for an activity or knowledge. Interest guides and encourages students to think critically and to keep trying until success is achieved. Interest and achievement co-relate in teaching and learning process and have intra influence on each other. High interest improves students' achievement while high achievement promotes interest. On the other hand, low interest retards learning and results to poor achievement in education.

d. Students' Achievement in Mathematics

According to Ricarda, Anja, Anne and Linda (2017), achievement in mathematics and set theory in particular represents performance outcomes that indicate the extent to which a learner has accomplished specific goals across multiple subject areas (e.g. thinking) or included in the acquisition of knowledge and understanding within a specific intellectual domain that indicates academic achievement procedure and dependable knowledge acquired, the cumulative indicators of academic achievement such as educational degree and certificate. Students are expected to be high achievers in mathematics because of its importance. The researcher therefore seeks to determine understanding of complex concepts, studies across various subjects, such as mathematics, science, and language arts, have demonstrated that TPS increases both student interest and achievement. For instance, in a study by Sejani (2016) in Nigerian secondary schools, TPS was found to enhance problem solving and mathematical learning outcomes of students compared to conventional (traditional) methods.

Methodology

This study employed a quasi-experimental design with a pretest–posttest non-equivalent control group. Two out of three co-educational,

government-owned senior secondary schools in Garki, Abuja, were purposively selected. One school was designated as the experimental group (taught using the Interest-Based Pedagogical Strategy, TPS), while the other served as the control group (taught using the conventional method). The sample comprised 103 Senior Secondary One (SS1) students. Of these, 63 students were assigned to the experimental group and 40 students to the control group. The participants were selected through purposive sampling, and intact classes were used to avoid disruption of normal school settings. Two instruments were employed for data collection: A 20-item Likert-type questionnaire developed to measure students' interest in set theory. The scale included items assessing enjoyment, perceived importance, and willingness to engage with set theory tasks.

A 30-item multiple-choice test covering key concepts in set theory. These included the definition and introduction to set theory, types of sets, set operations, number of elements in a set, set values, and Venn diagrams with problem-solving applications. Both the experimental and control groups took the STIS and STAT before instruction to determine their baseline levels of interest and achievement in set theory. Students were taught set theory using the TPS strategy. A trained research assistant introduced the topic, after which students worked in pairs to discuss and solve set theory problems. Each pair shared their solutions with the class, and the research assistant facilitated class-wide discussions. Students were taught set theory using the conventional (traditional) method. Here, the instructor provided direct teaching of set theory concepts, followed by individual practice exercises. After four weeks of instruction, both groups were re-administering the STIS and STAT to measure changes in interest and achievement.

Data Analysis and Results

Research Question 1.: What are the mean interest ratings of students in set theory who were taught using think -pair-share (TPS) instructional Strategy and conventional method?

Table 1: Mean Interest Ratings and Standard Deviation in Set Theory of Students in Experimental and Control Groups

GROUP	N	Pre-Interest		Post-Interest	
		$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2
Experimental	63	49.67	4.012	49.67	5.048
Control	40	49.63	8.085	49.47	7.653

Table 1 shows the mean interest ratings and standard deviations of students in the experimental and control groups, as measured by the STIS. The results revealed that students taught using the Think-Pair-Share (TPS) instructional strategy had mean pre-interest ratings and post-interest rating of 49.67 in both the pre-treatment and post-treatment, with standard deviations of 4.012 and 5.048, respectively. Students taught using the conventional method had mean pre-interest ratings of 49.63 and mean post interest rating of 49.47 in the pre-treatment and post-treatment phases, respectively, with corresponding standard deviations of 8.085 and 7.653. The data were further analyzed using ANCOVA

Null Hypothesis 1: There is no significant difference in the mean interest ratings of students taught set theory using think-pair-share (TPS) instructional strategy and those taught using the conventional teaching method.

The testing was carried out using ANCOVA as shown in the table 1.

Table 1: ANCOVA Result of Students' Mean Interest Ratings in Set Theory Who Were Taught Using TPS Instructional Strategy and Conventional Method

Source of Squares	Type 111 Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Corrected model	0.946[a]	2	0.473	0.012	0.988	0.000
Intercept	3510.790	1	3510.790	90.861	0.000	0.476
Pre-interest	0.047	1	0.047	0.001	0.972	0.000
Methods	**0.900**	**1**	**0.900**	**0.023**	**0.879**	**0.000**
Error	3863.928	100	38.639			
Total	257182.000	103				
Corrected total	3864.874	102				

a.R squared =.000 (Adjusted R squared = -.020)

The null hypothesis (H_{O1}) determined the difference in mean interest ratings between students taught using Think-Pair-Share (TPS) and conventional methods. Results in table 4.2, revealed that the noted differences between mean interest rating of student taught using TPs instructional strategy and those taught with conventional method is not significant at 0.05 alpha level. This is from the fact that $F_{(1,100)} = 0.023$ and $p = 0.879 > 0.05$, which is greater than the significance level $\alpha = 0.05$. Since the p-value exceeds α, the null hypothesis is not rejected. This indicates that there is no significant difference in the influence of TPS and conventional methods on students' interest in set theory.

Research Question 2: What are the mean achievement scores of students in set theory who were taught using think-pair-share (TPS) and conventional method?

Table 2: Mean and Standard Deviation of Achievement Scores of Experimental and Control Groups

Group	N	Pre-test		Post-test	
		$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2
Experimental	63	16.84	3.642	20.52	4.052
Control	40	15.10	3.901	19.07	5.590

Table 2 presents the mean scores and standard deviations of students' achievement in set theory. Students taught using the Think-Pair-Share (TPS) method had mean scores of 16.84 and 20.52 in the pretest and posttest, respectively, with standard deviations of 3.642 and 4.052 respectively. Students taught using the conventional method had mean scores of 15.10 and 19.07 in the pretest and posttest, respectively, with standard deviations of 3.901 and 5.590, respectively. The data were further analyzed using ANCOVA.

Null hypothesis 2: There is no significant difference in the mean achievement score of students taught set theory using think-pair share (TPS) instructional strategy and those taught using the conventional approach.

Table 2: Results of One-way ANCOVA of Students' Mean Achievement Scores in the Post-test When Taught Using TPS and Conventional Method

Source of squares	Type 111 Sum of Squares	df	Mean Square	F	Sig	Partial Eta Square
Corrected model	132. 006[a]	2	66.003	3.062	0.051	0.058
Intercept	1342.902	1	1342.902	62.291	0.000	0.384
Pre-test	80.681	1	80.651	3.741	0.056	0.036
Methods	**24.820**	**1**	**24.820**	**1.151**	**0.286**	**0.011**
Error	2155.839	100	21.558			
Total	43328.000	103				
Corrected total	2287.845	102				

a.R Squared =.058 (adjusted R squared) =.039

The results of the one-way ANCOVA analysis, presented in Table 2, indicate that there is no significant difference in the mean achievement scores of students taught set theory using Think-Pair-Share (TPS) and those taught using the conventional method. With $F_{(1,100)} = 1.151$ and $p = 0.286 > 0.05$, which exceeds the significance level $\alpha = 0.05$, the null hypothesis was not rejected. This implies that both instructional strategies yielded similar outcomes in terms of student achievement in set theory.

Discussion of Findings

The findings of this study provide compelling evidence that both students taught using the Think-Pair-Share (TPS) instructional strategy and those taught using the conventional method showed similar levels of interest and achievement in set theory. The non-rejection of the null hypotheses indicates that TPS did not significantly influence students' interest or understanding compared to the conventional approach. Both male and female students exposed to TPS demonstrated similar levels of interest and achievement in set theory.

This result contradicts the findings of Syafii (2018), who reported that TPS significantly increased students' active involvement and improved their ability to learn set theory as compared to conventional methods. Similarly, Olusegun (2022) found that TPS improved students' achievement and attitudes toward chemistry, and other studies have also reported

favorable outcomes of TPS in enhancing student performance and engagement. However, the present study indicates no significant differences between the experimental and control groups in students' interest and achievement in set theory. This study suggests that while TPS can enhance students' engagement, its effect on students' interest and achievement in set theory may not always differ significantly from conventional teaching methods.

Conclusion

The study concluded that both TPS instructional strategy and the conventional method have shown similar influence on students' interest in set theory. Also, students who were exposed to both TPS instructional strategy and those of conventional method have shown similar levels of understanding in set theory.

Recommendations

From the discussion of the results, the following recommendations were made:

1. Since the two strategies are effective, mathematics teachers should utilize their applications into mathematics classroom.
2. Curriculum planners should integrate both strategies into mathematics classroom instruction to enhance student learning outcomes.
3. Future research should explore the long-term effects of TPS and Conventional Methods or strategies on Mathematics interest and Achievement as well as the application of both TPS and Conventional Methods to other Mathematical topics
4. Government should organize regular capacity building programme for teachers, such as workshop, conference, seminar, symposium and exhibition on both think-pair-share and conventional instructional strategies.

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