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Effects of think-pair-share on senior school students' performance in mathematics in Ilorin, Nigeria

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Abstract

The performance of Nigerian students in the Senior School Certificate Mathematics Examinations 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. Evidences abound in literature and WAEC Chief examiner's reports indicating that students performed poorly in set theory with Venn diagram. Therefore, this study examined the effects of think-pair-share on senior school students' performance in mathematics in Ilorin, Nigeria. The objectives of this study were to examine: (i) the performance of students' taught set theory using think-pair-share cooperative instructional strategy; (ii) the difference in the performance of students taught using think-pair-share instructional strategy based on gender and score level; (iii) the influence of think-pair-share instructional strategy on students' retention in set theory. The researcher employed a quasi-experimental design for the study. The sample consisted of 118 SS II students. The instruments used for the study was Mathematics Performance Test (MPT). The instruments yielded reliability values of 0.78 using Pearson Product Moment Correlation procedure. The data collected were analyzed using independent sample t-test, and Analysis of Covariance (ANCOVA). Findings of the study showed: (i) a statistically significant difference in the performance of students taught set theory using think-pair-share compared with their counterparts in the control group in favour of think-pair-share group, (ii) no statistically significant difference in the performance of male and female students taught set theory in Mathematics using think-pair-share; (iii) no statistically significant difference in the performance of students taught set theory in Mathematics using think-pair-share based on scoring levels; and (iv) a statistically significant difference in the knowledge retained by students taught set theory in Mathematics using think-pair-share compared with their counterparts in the control group in favour of think-pair-share group. The study concluded that, the use of think-pair-share improved students' performance in Mathematics, gender of a student does not affect his or her performance in Mathematics, and the use of think-pair-share improved the retention ability of the students. It was recommended among others that the use of think-pair-share be encouraged for teaching and learning of Mathematics at all levels of education.

Keywords: think pair share; cooperative teaching and learning; mathematics performance,

Introduction

Education is an effort to develop the ability of individuals to live optimally as individuals or members of the society (Siagian & Surya, 2017). According to Simbolon, et al (2017), the development of education in this era is inseparable from the desire of all stakeholders in education in order to improve the quality of teaching and learning in order to facilitate students' better academic performance. In Nigeria, Mathematics is one of the core subjects a student must passed at credit level before he/she can proceed to higher institutions of learning. According to the Risqi

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and Surya (2017), one of the purposes of mathematics learning in school is to train students in thinking and reasoning in reaching conclusions, develop the ability to solve problems, and develop the ability to provide information or communicate ideas through speech, writing, pictures, graphs, maps, diagrams, etc. Hasanah and Sun, (2017) was of the opinion that knowledge of mathematics should be provided to all learners, ranging from elementary schools to equip them with the ability to think logically, analytical, systematic, critical, creative, and cooperative.

Due to the importance of Mathematics to human and societal development, there is the need for effective teaching and learning strategies that would enhance students' better academic performance in Mathematics so that the youth can fully participate in science and technology, which are indicators of national development (Ayinla, 2015). It should be noted that learners are individuals with different learning needs. Therefore, there is need to seek for a teaching strategy that will address the individual learners' needs such as Think-pair-share strategy

Think-pair-share is a cooperative discussion strategy developed by Frank Lyman and his colleagues in Maryland. It gets its name from the three stages of student action, with emphasis on what students are to be doing at each of those stages. Think-pair-share (TPS) is a collaborative learning strategy where students work together to solve a problem or answer a question about an assigned reading. This strategy requires students to think individually about a topic or answer to a question; and share ideas with classmates. Discussing with a partner maximizes participation, focuses attention and engages students in comprehending the reading material.

TPS is a model of cooperative learning in pairs and give students more time to think, respond, and to help each other. As stated by Jumanta (2014), Think-Pair-Share is a simple technique with great advantages. Think-Pair-Share can improve students' ability to recall information and a student can also learn from other students and convey to each other ideas for discussion before being submitted to the class. Think-Pair-Share means giving time for students to think about answers to questions. Students help each other to resolve the issue with the capabilities of each. Sejani (2016) in a research carried out concluded that Think-Pair-Share enhance the problem solving and mathematics learning outcomes of students. Shadrina (2013) also concluded from a different research that an increase in student learning outcomes are taught by implementing cooperative learning model Think-Pair-Share with card use plus and minus in the matter of addition and subtraction. Think-pair-share creates an active learning environment for students and provides benefits to learning in the classroom. Think-pair-share according to Napitupulu and Surya (2017) is a cooperative learning model that is considered to arouse student interest in mathematics and make students more active and socialize, encourage cooperation among students in learning the material, so that it can improve student learning outcomes.

Procedures of using Think-Pair-Share Cooperative teaching and learning strategy

Think.

The teacher provokes students' thinking with a question or prompt or observation.

The students should take a few moments (probably not minutes) just to THINK about the question.

Pair.

Using designated partners, nearby neighbors, or a desk mate, students PAIR up to talk about the answer each came up with. They compare their mental or written notes and identify the answers they think are best, most convincing, or most unique.

Share.

After students talk in pairs for a few moments, the teacher calls for pairs to SHARE their thinking with the rest of the class. The teacher can do this by going around in round-robin fashion, calling on each pair; or take answers as they are called out (or as hands are raised). Often, the teacher or a designated helper will record these responses on the board or on the recording sheet

Example:

Learning Task:

The teacher will provide a worded problem involving vienn diagram in set theory.

Think:

The teacher will allow the students to individually solve the problem first.

Pair:

After 5 minutes, the teacher will ask the students to find a partner or the teacher will personally pair the students, and discuss their solutions to each other. They should come up with a single solution for the given problem. While partners are discussing their solutions, the teacher will roam around to see which partnered students were able to make it correctly and which are not.

Share:

The teacher will randomly select a partner to share their solutions to the class by explaining it in front and solving it using the blackboard.

Gender has considerable effect on students' academic achievements especially in science subjects. Adeniyi (2012) concluded in study on the influence the Personalized System of Instruction on students' academic performance in Mathematics in indices and logarithms based on gender that student gender has no influence on their performance. While Akanmu (2013) carried out a research on the influence of gender on senior school students' performance in Mathematics when taught using guided discovery method. The result revealed that there was no significant difference between the posttest means scores of both the male and female students.

Another important variable that may affect students' achievement in science is score level. The study carried out by Akanmu (2013) on the effects of guided discovery learning and cognitive styles on Senior School students' performance in Mathematics in Osun, Nigeria, revealed that all the three categories score levels students benefited from the study with the high scorers benefited most, followed by medium scorers and the low scorers benefited least without any significant difference. While the findings of Ayinla (2015) on the effects of Curriculum-Based Measurement (CBM) on senior secondary school mathematics in Kwara South, Nigeria corroborates Akanmu conclusion that the three categories score levels students benefited from the study without a statistically significant difference.

The main essence of teaching and learning should include the ability of students to remember what they have been taught overtime. Hence, the retention abilities of students cannot be overlooked. Ausubel, Novak and Henesiana as cited in Nneji (2011) described retention as the process of maintaining the availability of a replica of acquired piece of knowledge. Adeniyi (2012) examined the effect of personalized system of instruction (PSI) on senior secondary school students' performance in mathematics in Kwara south Nigeria. The results of the study revealed that PSI is more effective in enhancing students' retention ability in mathematics compare to those in the control group. Also, Ayinla (2015) examined the effects of Curriculum-Based Measurement

(CBM) on senior secondary school mathematics in Kwara South, Nigeria. The study concluded that the use of CBM in teaching of mathematics helps improve students' retention ability.

Purpose of the Study

The main purpose of this study was to investigate the effects of think-pair-share instructioal strategy on senior secondary school students' academic performance in Mathematics in Ilorin, Nigeria. Specifically, the study determines the difference in:

1. the performance of students' taught set theory using think-pair-share instructional strategy and those taught without think-pair-share instructional strategy;
2. the difference in the performance of male and female students when taught using think-pair-share instructional strategy;
3. the difference in the performance of high, medium and low scorer students in set theory when taught using think-pair-share instructional strategy;
4. the influence of think-pair-share instructional strategy on students' retention in set theory.

Research Questions

The following research questions were answered in the cause of this study:

1. What is the difference in the performance of students' taught set theory using think-pair-share instructional strategy and those taught without using think-pair-share instructional strategy?
2. Does the performance of male and female students differ when taught set theory using think-pair-share instructional strategy?
3. Does the performance of high, medium and low scorer students differ when taught set theory using think-pair-share instructional strategy?
4. What is the influence of think-pair-share instructional strategy on students' retention in set theory?

Research Hypotheses

The following research hypotheses were formulated and tested in this study at 0.05 Alpha level of significance.

HO_1: There is no significant difference in the academic performance of students' taught set theory using think-pair-share instructional strategy and those taught without.

HO_2: There is no significant difference in the academic performance of male and female students taught set theory using think-pair-share instructional strategy.

HO_3: There is no significant difference in the academic performance of low, medium and high scorer students' taught set theory using the think-pair-share.

HO_4: There is no influence of think-pair-share instructional strategy on students' retention in set theory.

Methodology

Research Design

The research design was a $2 \times 2 \times 3$ pretest, posttest, quasi experimental, non-equivalent and non-randomized control group design. The dependent variables for the study were the students'

performance in set theory of vienn diagram and the retention test which was administered to the students a month after the treatments. The independent variables were the instructional strategies (the think-pair-share and conventional instructional strategies), students' gender at two levels (male and female) and score levels at three levels (low, medium and high).

Population, Sample and Sampling Techniques

The populations for the study were SS II students in Ilorin, Kwara State, while One hundred and eighteen (118) students (56 in the control group and 62 in the experimental group) were sampled for the study. The choice of SS II students was appropriate because the topic of this research is in SS II syllabus. Besides, these students are not preparing for any external examination and have sufficient time for the pre-instruction required for the use of the metaphor instructional strategy.

Two government owned and co-educational secondary schools in Ilorin metropolis, Kwara State were selected for the study. One secondary school was used as the experimental group while the other secondary school was used as the control group. Intact classes were used in the study.

Research Instruments

The Mathematics Performance Test (MPT) containing 5 essay questions on set theory with Venn diagram developed by the researcher was used for the study. The questions in MPT were used as pre-test and later shuffle and use as post-test after the treatment. The posttest was re-administered as retention test a month after the treatment exercise. To ensure both face and content validity of the instrument, the research instrument was given to three Education experts in the Department of Science Education, University of Ilorin for proper scrutiny and necessary corrections. The reliability index of 0.78 was obtained using Pearson Product Moment Correlation procedure.

Procedure for Data Collection

The following procedures were followed while collecting data for this study. The experiment lasted for five weeks. The first day of the first week was devoted to pre-experimental preparations; the researcher met with the Principals of each of the selected secondary school for the study to seek for their permission, the researcher then meets with the mathematics teachers of the selected school who also serve as research assistant and inform them of their roles during the period of the experiment while the researcher also meet with the students who participated in the study and inform them about the research exercise. The researcher gave out informed consent forms to the students to sought for their consent to participate in the study.

The second day of the week the MPT on set theory was administered on all the subjects as the pre-test. The actual treatment commenced at the beginning of the second week. All the class lessons were held during the periods allotted for mathematics lessons.

Students in the control group were not exposed to think-pair-share instructional strategy treatment; the control group teacher was at liberty to use any other instructional strategy he/she feels is suitable for the teaching of set theory in mathematics while those in the experimental group were exposed to think-pair-share instructional strategy. In the third week, the MPT on the set theory were re-organized and administered on the entire subject as the post-test. All the pre-test and post-test scripts were marked by the researcher. Two weeks later, the retention test (re-organized post-test questions) were administered to the same subjects. The scripts were collected and marked by the researcher.

Data Analysis Techniques

The following statistical tools were used to analyze the data that were collected for the study: Hypotheses 1, 2 and 4 were tested using t-test, and hypothesis 3 was analyzed using Analysis of Covariance (ANCOVA). Data were coded and analyzed with the aid of statistical package for social science (SPSS) version 22.0. All hypotheses were tested at 0.05 level of significant.

Results

The data analysis of this study was done based on the results of 118 students who participated in the three tests (i.e. pretest, posttest and retention test respectively) conducted by the researcher. Although, the number of students who participated in the study were more than 118, only the results of 118 students who wrote all the three test conducted for the study were used in order to be able to get accurate result for the study and determine the effectiveness of the treatment on students' academic performance. Therefore, the data analyses are as follows:

Hypothesis One: There is no significant difference in the performance of students taught set theory using the think-pair-share and their counterpart in the control group.

Table 1: Independent Samples t-test of the students exposed to think-pair-share and those in the control group

		T	Df	Sig. (2-tailed)
Pretest	Equal variances assumed	-1.270	116	0.207
	Equal variances not assumed	-1.273	115.709	0.205
Posttest	Equal variances assumed	-3.315	116	0.001
	Equal variances not assumed	-3.298	111.512	0.001

For the posttest scores, t-test value is 3.315, degree of freedom is 116, and p-value is 0.001. Since the p-value is less than 0.05 level of significance, the mean posttest scores of experimental group (34.84) is significantly greater than the mean posttest scores of control group (28.39). Therefore, the null hypothesis one is rejected, it is thus claimed that a significant difference existed in the performance of senior school students taught set theory using the think-pair-share and their counterpart in the control group. This showed that the use of think-pair-share had significantly improved the performance of students in the experimental group.

Hypothesis Two: There is no significant difference in the performance of students taught set theory using think-pair-share based on gender.

Table 2: Independent Samples t-test of the students exposed to think-pair-share based on gender

		T	Df	Sig. (2-tailed)
Pretest	Equal variances assumed	-2.519	60	0.104
	Equal variances not assumed	-2.667	57.347	0.110
Posttest	Equal variances assumed	-0.937	60	0.352
	Equal variances not assumed	-0.873	38.189	0.388

For the posttest scores, Levene's test for equality of variance, *F* calculated value is 1.493 and p-value is 0.227. Since the p-value is not less than 0.05 level of significance, therefore, equality of variances can be assumed. The t-test that assumed equal variances is therefore employed. The t-test value is 0.937, degree of freedom is 60, mean difference is 2.456, standard error of mean difference is 2.620 and p-value is 0.352. Since the p-value is not less than 0.05 level of significance, there is no significant difference in the means of posttest scores of male and female students. Therefore, the null hypothesis two is not rejected. It is concluded that, there is no significant difference in the academic performance of students taught set theory in Mathematics using think-pair-share based on gender.

Hypothesis Three: There is no significant difference in the academic performance of low, average and high students scoring levels who are taught set theory using the think-pair-share.

Table 3: ANCOVA on Posttest scores of Students performance in Experimental groups based on scoring level

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1 362.820[a]	3	454.273	5.506	0.002
Intercept	824.421	1	824.421	9.992	0.002
Pretest	345.922	1	345.922	4.192	0.045
Score Level	2.948	2	1.474	0.018	0.982
Error	478 5.567	58	82.510		
Total	8140 0.000	62			
Corrected Total	614 8.387	61			

a. R Squared = .222 (Adjust e d R Squared = .181)

In Table 3 pretest is the covariate, scoring level is the factor considering and the dependent variable is posttest scores. Since the p-value is 0.982 is greater than 0.05 level of significance, scoring level is not a significant factor. Also, Table 3 shows the analysis of covariance table containing the source of variations, sum of squares, degree of freedom, mean squares, *F*-values and corresponding p-values. From the table $F(2, 58)$ is 0.018, p-value is 0.982, since the p-value is greater than 0.05 level of significance, the null hypothesis was not rejected. Therefore, there is no significant difference in the academic performance of low, average and high students scoring levels who were taught set theory using the think-pair-share. That means that the use of think-pair-share in teaching cell in Mathematics improved students' performance across the three categorized scoring levels.

Hypothesis Four: There is no significant difference in the retention knowledge of students taught set theory using the think-pair-share and their counterpart in the control group.

Table 4: Independent Samples t-test of the retention test of students exposed to think-pair-share and those in the control group

		T	Df	Sig. (2-tailed)
Posttest	Equal variances assumed	-3.315	116	0.001
	Equal variances not assumed	-3.298	111.512	0.001
Retention	Equal variances assumed	-10.229	116	0.000
	Equal variances not assumed	-10.091	102.446	0.000

For the retention test scores, t-test value is 10.229, degree of freedom is 116, and p-value is 0.000. Since the p-value is less than 0.05 level of significance, the mean of retention scores of experimental group is 11.21 is significantly greater than the mean of retention scores of control group is 3.84. Therefore, it is thus claimed that a significant difference existed in the retention ability of senior school students taught set theory in mathematics using the think-pair-share and their counterpart in the control group. This showed that the use of think-pair-share had significantly improved students' retention ability in mathematics.

Discussion

The findings of the study indicated that the use of think-pair-share improved students' performance in mathematics. This finding corresponds with the findings of Jumanta (2014), Sejani (2016) and Shadrina (2013) that had worked on the effect of the use of think-pair-share on students' academic performance in mathematics and found it to be effective at improving students' academic performance.

The result of the study revealed that both male and female students benefited from the use of think-pair-share as a teaching strategy. The post-test mean gain of the male students exposed to the strategy was 10.00 while that of female students was 5.39. This implies both male and female students benefitted from the study with no statistically significant difference in their posttest mean gain scores. The findings were in agreement with the findings of Adeniyi (2012), and Akanmu (2013) who reported in then various research works that there was no significant difference in the performance of male and female students when exposed to various instructional strategies. The researchers concluded that gender has nothing to do with students' academic performance.

The study also revealed that all the three categories of scoring level benefitted from the study with the low scoring students benefited most with 12.83 mean gain score, followed by the medium scoring students with 5.76 mean gain score and high scoring students with 4.17 mean gain score respectively. These conform to the findings of Akanmu (2013) and Ayinla (2015) who reported that the three categorized scoring level benefited from their various studies. This implies that the use of think-pair-share can be used to enhance students' better performance in Mathematics regardless of the students scoring level.

The result of this study shows that students taught set theory in Mathematics using think-pair-share were able to retain material learnt better than students in the control group. This was in agreement with Adeniyi (2012) and Ayinla (2015), who stated in their different research works that students who were exposed to the use of PSI and CBM respectively in the teaching and learning of Mathematics were able to retain the contents learnt after one month of the experiment better than their counterparts in the control group.

Conclusion

The findings of the study revealed that the use think-pair-share in the teaching and learning process enhance students' performance in Mathematics significantly. It can be concluded that think-pair-share improved students' performance in Mathematics.

Also, the findings from this study revealed that gender did not have any effect on the performance of students taught set theory in Mathematics using think-pair-share. That is to say that, gender of a student does not affect his or her performance in Mathematics.

It could also be concluded from the study that think-pair-share could be used to teach all the three categories of scoring level of students since the result of the study showed that all the three categories equally benefited significantly from the study.

The findings of this study also indicated that students taught set theory in Mathematics using think-pair-share were able to retain content learnt better and longer than those in the control group. This implies that the use of think-pair-share actually improved the retention ability of the students.

Recommendations

Based on the findings of this study, the following recommendations were considered appropriate:

1. The use of think-pair-share is an effective instructional strategy; therefore its use should be encouraged for teaching and learning of Mathematics at all levels.
2. It is observed that the academic performance of male and female students improved after the treatment. Also, the performance of the three categories of scoring level improved after the treatment. Therefore, teachers' emphasis should shift from teacher-centred approach of teaching to more activities-based learning strategies such as the use of think-pair-share.
3. The professional bodies like National Teacher's Institute (NTI), Science Teachers' Association of Nigeria (STAN), Mathematical Association of Nigeria (MAN) should organize seminars/workshops for teachers on how to use think-pair-share strategy for effective teaching and learning of Mathematics.

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