EFFECTS OF THE THINK-PAIR-SHARE INSTRUCTIONAL STRATEGY ON STUDENTS' LEARNING ACHIEVEMENTS IN SECONDARY SCHOOL MATHEMATICS

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Abstract
This study investigated the effects of think-pair-share instructional strategy on students' learning achievement in secondary school mathematics. It used quasi-experimental research design of a pre-test and a post-test control group 2x3x2 factorial. The instrument used was Mathematics Achievement Test (MAT) which was subjected to face and content validity with with the help of some colleagues and an expert in the field of research study. Kuder- Richardson formula 21 (K-R, 21) method was used to determine the reliability of the instrument and the process returns reliability coefficients of 0.85. The study samples involve two SS2 students of public schools in the Badagry Local Government Area. In analysing the data, Inferential statistics (ANCOVA) for testing the hypotheses at the 0.05 alpha level of significance. The findings of the pretest value [F(1,113)=11.426; p<0.05] and the posttest value [F(1,113)=16.332; p<0.05] are significant at 0.001 of hypothesis one i.e. H_{01} is rejected; hypotheses two, three, four, five and six of the gender value [F(1,113)=0.557; p>0.05], the interaction effect of the gender and ability level value [F(2,113)=0.655; p>0.05], the interaction effect of the group and ability level value [F(2,113)=0.704; p>0.05], the interaction effect of the gender and group value [F(1,113)=3.411; p>0.05] and the interaction effect of the gender, ability level and group value [F(2,113)=0.564; p>0.05] are all not significant at 0.457, 0.521, 0.497, 0.068 and 0.571 respectively. i.e. H_{02}, H_{03}, H_{04}, H_{05} and H_{06} were not rejected. It was concluded that the learning achievements of the think-pair-share classroom are better than those of the conventional classroom. It was however recommended that the use of the think-pair-share strategy should be known by all the school teachers.

Keywords: *Think-Pair-Share strategy, learning achievement, Mathematics education.*

1. Introduction

The usefulness of Mathematics education had been seen as adding value to development of a nation and contribute immensely to her growth. Mes'ed (2004) indicated that "Mathematics is one of the basic educational materials that can effectively contribute to the development of the students' mathematical aspects, with the use of math language, symbols, words, forms and relationships to express and understand mathematical ideas" In buttressing this usefulness of Mathematics, Alabi (2020) noted that Mathematics "…occupies a conspicuous position among the branches of knowledge in any educational institution" (p. 86). No wonder Nebesniak (2012) identified that "the teacher determines what a student learns in a maths class and how well the student understands the Mathematics" (p. 1). In other words, what a student learns depends on whom the student has as a teacher in his or her classroom activities (Colvin & Johnson, 2007).

This suggests that there is no amount of knowledge acquired by the students, it would be tailored to their teacher's competence.

Specifically, a teacher's instructional techniques were recognised as the major contributing factor with regard to aftermath in a Mathematics student's success or failure (Yeulet, 2010). As the teacher uses a specific way of presenting lesson in the Mathematics classroom, there were as many other methods of teaching Mathematics as possible but there was no one best or most effective method in teaching Mathematics. The pattern of delivery of lessons by a teacher in the Mathematics classroom and the depth of content in the lessons were aspects that directly affect Mathematics learning and teaching (Martinez & Martinez, 2003). When teachers use unproductive instructional strategies, their students' performance can fall behind academically (Scarpello, 2007). It is in this regard Taylor (2006) argued that the use of more hands on materials and increased awareness of role multiple representations are among the shifts in instructional deviations that play in the students' learning and an emphasis on the role of the students as active learners in the Mathematics classroom to create the environment where the students are less apprehensive about Mathematics.

The illustration above indicated that effective teaching requires continuing efforts to learn and improve on the mathematical concepts and the teacher's ability to engage the students in a task. According to Sanni (2008), "there is a need for teachers to consider the affordances of different tasks before they are taken to class for use in instruction" (p.25). It is, therefore, necessary for every teacher to see more importance to Sanni's remark on how to cultivate effective Mathematics instruction while teaching and learning are taking place in the classroom. In another view of the research work conducted by Obanya (2004), the concept of Mathematics was referred to the knowledge required to show resourcefulness and flexibility not simply the ability to store and produce facts and figures. Research over the years has shown that teachers only adapt to solving Mathematics problems with very few examples when teaching in the Mathematics classroom and this is an implication for the students' achievements. Jonah-Eteli (2010) stated that if the teachers were aware that the examples, they use are just only tools for developing concepts and not the trend, it will be part of their instructional strategy to solve more examples until the students have a grasp of the idea, meaning and diversified knowledge of the concept.

Meanwhile, Ogunkunle (2007) revealed that secondary school teachers use conventional methods in teaching Mathematics concept and that this method does not impact positively on the academic achievement of the students. This is in line with Jonah-Eteli's (2010) recommendation that the teachers should be trained on the teaching strategies that would emphasise conceptual understanding rather than rote mathematical concepts and the teachers' pedagogical change from the conventional approach appears difficult. Thus, the teachers need to know an appropriate strategy for solving particular problems and also understand that such a strategy might not help in solving other problems based on concepts. Taylor (2017) opined that instructional best practices involve a process enabling class structured reservation and simple routine of reviewing the previous lesson, guiding the students through a new lesson and finishing with independent practice through innovation of games to help the students to understand more efficiently.

Furthermore, the study of Taylor further explained that the teacher being the focus of the lesson in using the teaching approach of instructing, interactive and individualised methods of instruction takes a more student-centred approach to the teaching of Mathematics. However, the interactive approach of instruction with the use of the think-pair-share strategy would not only

assist the students' learning but also help to increase their level of understanding concepts in the Mathematics classroom. Moreover, Anthony and Walshaw (2007) enumerated ten principles of effective teaching of Mathematics to include: An ethic of care; Arranging for learning; Building on students' thinking; Worthwhile mathematical tasks; Making connections; Assessment for learning; Mathematical communication; Mathematical language; Tools and representations and Teacher knowledge. Indeed, there are various strategies at every teacher's disposal in the teaching and learning environment that can contribute meaningfully to the students' learning achievements. Among the teaching strategies, co-operative learning is one of the active learning strategies with the process of learning as a replacement for the traditional system of learning. Co-operative learning is a systematic and team learning organised to be socially structured in order to facilitate exchange of information, ideas and knowledge among learners who are individually held accountable for their learning (Kirby, 2008).

It is on this note that Accelerating Learning in Mathematics (ALIM, 2012) identified some strategies to help the students to listen and contribute in the Mathematics classroom. The strategies are characterised as Revoice; Increase wait time; Use partner talk; Think, Pair, Share; Use question cards and Create a framework for the interaction. It is an evidence that Think-Pair-Share and Create a framework for the interaction among the strategies aforementioned have the potential for exploring classroom conversation and its implication on learning achievement. Thus, the think-pair-share strategy as a form of co-operative learning is one of the group discussion strategies falling within curved structure and it is a method of diverse methods of learning collaboration. This process under the treatment group is referred to as student-student centred method of teaching and learning. Figure 1 below is the steps illustration of the Think-Pair-Share strategy in Mathematics classroom.

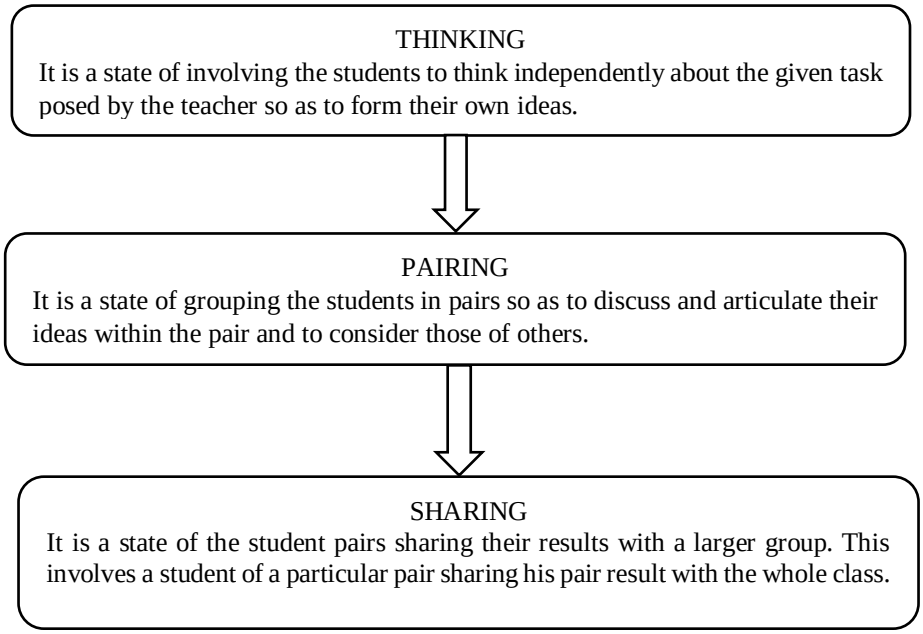

Figure 1: Steps illustration of the Think-Pair-Share strategy

2. Statement of the Problem

Although there were different strategies for the teaching of Mathematics and their implication for the students' learning, researchers over the years have realised and reported that the think-pair-share strategy is an adequately effective technique in classroom conversation (Bataineh, 2015; Hamdan, 2017; Sampsel, 2013; and Al-Sultani, 2015). This effectiveness of the think-pair-share strategy had been supported with similar or different subject contents research studies. In similar subject content, the study of Althelab and Omar (2013) aimed at knowing the impact of the think-pair-share strategy on the achievement of the second-grade intermediate female students in Mathematics and their reasoning thinking while in different subject content, the study of Khaji (2010) aimed to investigate the effectiveness of the think-pair-share strategy to acquire Physics concepts and the development trend towards solving Physics issues among the students in the first grade. All these aforementioned research works had been carried out on the students' achievements in the classroom in the think-pair-share. Despite the use of the think-pair-share instructional strategy by various researchers, the students' learning achievement still face various challenges in the Mathematics discourse. The implication here is that the use of the think-pair-share has not been used effectively. It is against this background that the researcher explores the effects of the think-pair-share classroom on learning achievements in secondary school Mathematics.

3. Purpose of the Study

The researcher explored the effects of the think-pair-share instructional strategy on students' learning achievements in secondary school Mathematics. It is the belief of the researcher that the strategy has the potentials of providing a panacea for students' learning difficulties in Mathematics. Thus, the study explored the:

i. students' learning achievements in think-pair-share Mathematics classroom and those in the conventional classroom.
ii. gender difference of the students' learning achievements in think-pair-share Mathematics classroom.
iii. interaction effects of the gender and ability levels of the students' learning achievements in the Mathematics classroom
iv. interaction effects of the ability levels and teaching strategies in the Mathematics classroom.
v. interaction effects of the gender and teaching strategies in the Mathematics classroom.
vi. interaction effects of the gender, ability levels and teaching strategies in the Mathematics classroom.

4. Research Questions

The research was guided by the underlisted research questions in the course of the study.

i. Is there any difference in the students' learning achievements in the think-pair-share Mathematics classroom and those in the conventional classroom?
ii. Is there any significant gender difference in the students' learning achievements in the think-pair-share Mathematics classroom and those in the conventional classroom?
iii. Is there any significant interaction effect of the gender and ability levels of the students' learning achievements in the Mathematics classroom?
iv. Is there any significant interaction effect of the ability levels and teaching strategies in the Mathematics classroom?

v. Is there any significant interaction effect of the gender and teaching strategies in the Mathematics classroom?
vi. Is there any significant interaction effect of the gender, ability levels and teaching strategies in the Mathematics classroom?

5 Hypotheses

The formulated hypotheses were in associated with all research questions stated above and were tested at 0.05 significance level.

H_{01}: There is no significant difference in the students' learning achievements in the think-pair-share Mathematics classroom and those in the conventional classroom.
H_{02}: There is no significant gender difference in the students' learning achievements in the think-pair-share Mathematics classroom and those in the conventional classroom.
H_{03}: There is no significant interaction effect of the gender and ability levels of the students' learning achievement in the Mathematics classroom.
H_{04}: There is no significant interaction effect of the ability levels and teaching strategies in the Mathematics classroom.
H_{05}: There is no significant interaction effect of the gender and teaching strategies in the Mathematics classroom.
H_{06}: There is no significant interaction effect of the gender, ability levels and teaching strategies in the Mathematics classroom.

6. Research Method

The researcher employed a quantitative approach in the conduct of the study which was the quasi-experimental research design that focused on the effects between the think-pair-share classroom and the students' learning achievements. This design was in accordance with Martins-Umeh (2009), who observed that "quasi-experimental design permits deliberate control and manipulation of the learning conditions to some extent" (p.391). It is the non-equivalent control group design involving two intact groups of one being the treatment group and the other being the control group. A pre-test, post-test control group 2x3x2 factorial design was employed. The factorial design is in a form of true experiment where multiple factors were manipulated or allowed to vary and effects of the independent variables simultaneously.

The instrument used for this study was Mathematics Achievement Test (MAT) which was validated by face and content validity with the help of some colleagues and an expert in the field of research study who patiently goes through it and makes some structural corrections, adjustment and suggestions to enhance the instrument before it is eventually finalised for administration. The data was collected during the study and being integrated into the interpretation of the overall results. Indeed, this research design of two teaching strategies (think-pair-share strategy and conventional teaching method) is traversed with students' ability levels (high, average and low) in the Mathematics and students' gender (male and female). A non-randomised pre-test and post-test on Sequence and Series (Arithmetic and Geometric progression) of the Number and Numeration concepts in Mathematics was administered before and at the end of the treatment lasting for six weeks.

The target population for the study consists of 229,980 Senior Secondary Two (SS2) students in the public secondary schools in Lagos State according to the 2018 annual public school census. The choice of SS2 as population for the study was because the selected concept for students was on SS2 scheme of work. The study sample involves two non-equivalent (intact) classes of the

Senior Secondary Two (SS2) students designated as the treatment and control groups of public schools in the Badagry Local Government Area, Agboju District V in Lagos State. Both classes are mixed with male and female students and comparable numbers of students (60 in the treatment group and 54 in the control group) selected from from the population.

7. Results

To consider these research questions and test their associated hypotheses, the data on the learning achievements in the think-pair-share classroom and in the conventional classroom were collated and analysed using the Analysis of Covariance (ANCOVA) as presented in the table below. These hypotheses were tested at 0.05 significance level.

Table 1: The ANCOVA of the students' achievements in the treatment and control groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	5607.903[a]	12	467.325	12.680	.000
Intercept	601.921	1	601.921	16.332	.000
Pretest	421.090	1	421.090	11.426	.001
Gender	20.536	1	20.536	.557	.457
Group	458.987	1	458.987	12.454	.001
Ability level	152.276	2	76.138	2.066	.132
Gender * Group	125.720	1	125.720	3.411	.068
Gender * Ability level	48.307	2	24.153	.655	.521
Group * Ability level	51.879	2	25.939	.704	.497
Gender * Group * Ability level	41.553	2	20.777	.564	.571
Error	3722.351	101	36.855		
Total	66325.000	114			
Corrected Total	9330.254	113			

R Squared = .601 (Adjusted R Squared = .554)

Hypothesis One: There is no significant difference in the students' learning achievements in the think-pair-share Mathematics classroom and those in the conventional classroom.

In consideration of this ANOVA table where the F-value of [$F(1,113)=11.426$; $p<0.05$] is significant at 0.001 and this indicates that there is a significant difference in the students' learning achievements in the think-pair-share classroom and those in the conventional classroom before being subjected to treatments. Meanwhile, the F-value [$F(1,113)=16.332$; $p<0.05$] is also significant at 0.001. Therefore, the hypothesis one that says there is no significant difference between the students' learning achievements in the think-pair-share Mathematics classroom and those in the conventional classroom is thereby rejected, that is, H_{01} is rejected.

Hypothesis Two: There is no significant gender difference in the students' learning achievements in the think-pair-share Mathematics classroom and those in the conventional classroom.

Considering the ANOVA table where the gender value of [$F(1,113)=0.557$; $p>0.05$] is not significant at 0.457. Therefore, the hypothesis that says there is no significant gender difference between the students' learning achievement in the think-pair-share Mathematics classroom and those in the conventional classroom is thereby not rejected, that is, H_{02} is not rejected.

Hypothesis Three: There is no significant interaction effect of the gender and ability levels of the students' learning achievement in the Mathematics classroom.
Considering the ANOVA table where the gender and ability level value of [F(2,113)=0.655; p>0.05] is not significant at 0.521. Therefore, the hypothesis that says there is no significant interaction effect of the gender and ability levels of the students' learning achievement in the Mathematics classroom is thereby not rejected, that is, H_{03} is not rejected.

Hypothesis Four: There is no significant interaction effect of the ability levels and teaching strategies in the Mathematics classroom.
Considering the ANOVA table where the group and ability level value of [F(2,113)=0.704; p>0.05] is not significant at 0.497. Therefore, the hypothesis that says there is no significant interaction effect of the ability levels and teaching strategies in the Mathematics classroom is thereby not rejected, that is, H_{04} is not rejected.

Hypothesis Five: There is no significant interaction effect of the gender and teaching strategies in the Mathematics classroom.
Considering the ANOVA table where the gender and group value of [F(1,113)=3.411; p>0.05] is not significant at 0.068. Therefore, the hypothesis that say there is no significant interaction effect of the gender and teaching strategies in the Mathematics classroom is thereby not rejected, that is, H_{05} is not rejected.

Hypothesis Six: There is no significant interaction effect of the gender, ability levels and teaching strategies in the Mathematics classroom.
Considering the ANOVA table where the gender, ability level and group value of [F(2,113)=0.564; p>0.05] is not significant at 0.571. Therefore, the hypothesis that says there is no significant interaction effect of the gender, ability levels and teaching strategies in the Mathematics classroom is thereby not rejected, that is, H_{06} is not rejected.

8. Discussion of Findings

From the findings of this study, it was an indication that there is a significant improvement of the achievement level of the students in the think-pair-share-classroom over the conventional classroom in terms of the teaching strategy used in delivering the course contents. The think-pair-share strategy affords the students the opportunity to express themselves without fear when in the classroom and being reported by several researchers as more significant on the learning achievements in the think-pair-share classroom than in the conventional classroom (Farrajallah, 2017; Hamdan, 2017; Al-Sultani, 2015; Chianson, O'kwu & Kurumeh, 2015; Bataineh, 2015; Althelab & Omar, 2013). It is in this vein of the effectiveness of the think-pair-share strategy for improving learning achievements as Hamdan (2017) opines that the think-pair-share strategy is one of the active group conversation strategies used as a method of learning collaborative and falling within the curved structure. In another context, Farrajallah (2017) concluded that using the think-pair-share strategy "turns the classroom into a scientific and cultural and entertainment field endeared to the students' souls by which the information is passed to the students in an interesting and attractive image" (p. 1627).

The study revealed that the gender difference of the students' learning achievements is not significantly better in the think-pair-share classroom than that in the conventional classroom. This implies that there is no statistically significant gender difference of the students' learning

achievements between the think-pair-share classroom and the conventional classroom. In supporting this finding with the literature, Lowe (2015) had a similar result of the insignificant gender difference but attributes it to uneven numbers of the male and female students involved in the research study. On the contrary, Hamdan (2017) reported a significant gender difference in the learning achievements of the think-pair-share classroom in favour of the female students in the Mathematics classroom. This also shows that there is no interaction effect of the gender and ability levels of the students' learning achievements in the think-pair-share classroom and in the conventional classroom as revealed in the analysis of covariance of the table above. This is consistent with Bamiro and Ajayi (n.d.) who reported no interaction effect between gender and the students' ability levels in the Mathematics achievements. It, therefore, appears that regardless of any classroom interaction on the gender and ability levels, the learning achievements of the students remain intact. In the next section, the interaction effects of the ability levels and teaching strategies are discussed.

This study showed that there is no interaction effect between the ability levels and teaching strategies in the Mathematics classroom of both the treatment and control groups as this is in line with Afthina, Mardiyana & Pramudya (2017) that reported no interaction effect between the teaching strategies and ability levels of the students' cognition towards their Mathematics achievements. It, therefore, appears that regardless of any classroom interaction on the ability levels and teaching strategies, the learning achievement of the students remain intact. It further shows that there is no interaction effect between the gender and teaching strategies in the think-pair-share classroom and in the conventional classroom as this finding is in line with Igboanugo (2011) that sees no interaction effect between the teaching strategies and gender for the treatment and control groups. It, therefore, appeared that regardless of any classroom interaction on the ability levels and teaching strategies, the learning achievements of the students remained intact. The interaction effects of the gender, ability levels and teaching strategies of the students' learning achievements were not significant in the Mathematics classroom.

It is, however, noteworthy that the gender, ability levels and teaching strategies are not significant and they were capable of bringing about the required positive change in the learning environment regardless of the gender and students' ability levels. This result is contrary to Bamiro & Ajayi's (n.d.) research study that reported the significant interaction effects of the gender, ability levels and teaching strategies. It, therefore appeared that regardless of any classroom interaction on the gender, ability levels and teaching strategies, the learning achievements of the students remain intact.

9. Conclusion

The study explored the effects of the think-pair-share classroom on the students' learning achievements in secondary school Mathematics. From the findings of this study, it was concluded that:

- the learning achievements of the think-pair-share classroom are better than those of the conventional classroom as a result of the strategy used that allows the absolute students classroom interaction to take place. It is also noted that the students relate to each other without any bias or fear.
- regardless of the gender involved in the learning activities in the Mathematics classroom, the learning achievement of any gender is not tied to whatever the gender possesses. It is, however, noteworthy that the think-pair-share strategy is not subjective

but significant and it is capable of bringing about the required positive change in the learning environment.

- regardless of the gender involved in the learning activities in the Mathematics classroom, the ability level of any gender is not tied to whatever the gender possesses.
- regardless of the strategy used in the learning activities in the Mathematics classroom, the ability level of any group is not tied to whatever group they might belong to.
- regardless of the gender involved in the learning activities in the Mathematics classroom, the teaching strategy used to disseminate in the classroom is not tied to whatever the gender possesses.
- the gender, ability levels and teaching strategies are not significant and the students' learning achievements in the classroom are not tied to any of the aforementioned variables.

10. Recommendations

In consideration of the findings of this study, the following recommendations towards improvement were made:

i. Education districts, schools, teachers and future researchers could benefit from this study and continue building on this research.
ii. The use of the think-pair-share strategy should be known by all the secondary school teachers at all levels as a mode of instruction since it has been largely reported to be effective in improving the meaningful learning.
iii. There is need to often organise seminars or workshops in training the teachers on the contemporary concepts in teaching and learning Mathematics.
iv. Professional associations like the Mathematical Association of Nigeria (MAN) should popularise the use of think-pair-share strategy.

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