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EFFECT OF MAPPING AS INSTRUCTIONAL SCAFFOLDING AS A PANACEA FOR STUDENTS' PERFORMANCE IN MATHEMATICS AMONG SECONDARY SCHOOLS IN ONDO STATE, NIGERIA

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Abstract

This study investigated the Effect of Mapping as Instructional Scaffolding as a panacea for Students' Performance in Mathematics among secondary schools in Ondo State, Nigeria. The study adopted quasi-experimental of pre-test, post-test, control group design. The population comprised all Senior Secondary Schools II (SSS II) students in public Senior Secondary Schools in Ondo State. The sample was made up of 160 Mathematics students in their intact classes in four selected secondary schools in four local governments' area. Simple random sampling was used to select the four schools; the students were selected using random sampling technique. Mathematics Achievement Test (MAT) was used to generate data for the study. The face and content validity of the instrument was ensured by experienced secondary school Mathematics teachers, experts in the Department of Test and Measurement. The reliability of the instrument was determined through a test- retest method which yielded reliability co-efficient of 0.78. Data were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The findings indicated that concept mapping used as scaffolds was more effective than the one without scaffold in enhancing student's performance in Mathematics. The finding equally indicated that there was significant interaction effect of gender and strategies on students' performance in Mathematics. Also, the study indicated that there was significant interaction effect of location and strategies on students' performance in Mathematics.

Keywords*: Concept mapping, Scaffolding, mathematics, performance*

INTRODUCTION

It is very difficult to visualize the subject of study where Mathematics is not involved. Slow or steady, the study of Mathematics has attained greater distinction of involvement of subject of Science, Management, Commerce and Economics. So, Mathematics therefore, mothers all science subjects, in which the role of Mathematics Education in our society has been of importance for many years. For Nigeria to develop economically, socially, politically and technologically, she must be able to train large number of much-needed human resources. If a sound technological society must be created, there should be a thorough understanding of scientific studies among our youths. And to develop such sound basis for modern technology, the acquisition of Mathematical abilities, which facilitates the appropriate technological orientation, must be provided for successful generations (NCTM, 2013).

Mathematics Education is needed to expedite technological advancement. (Kolawole and Olofin 2017) submitted that, Mathematics is the heart of a nation and as a devise that facilitate the learning of all subjects. There is absolute confidence that Mathematics performs effective function in the efficient improvement in students learning. In the school curriculum, Mathematics is

normally identified as the foundation of many topics. Mathematics is a specialized language wherein facts of the bodily worldwide has been recorded; a language wherein idea originating within aspect of the minds of scientists can be encoded and transmitted scheme through specific strategies with lesser miscalculation. Mathematics plays keys role in education. It is cultural, utilitarian and interdisciplinary principles that make the topic special to learners. Mathematics aids in the acceleration of every society's social, economic, and technical advancement, and its comprehension is dependent on successful educating and instructing in schools. Mathematics is important in the humanities because it provides a solid foundation for providing effective solutions to problems. Mathematics knowledge has an effect on students' success in other school subjects such as physics, chemistry, accounting, and economics, as well as all facets of human life. This creates an important work for any area of academic endeavor and human growth in order to meet life's challenges.

Mathematics is one of the science subjects taught at the senior secondary school levels in all Nigerian secondary schools today which attracts the greatest patronage of both science oriented and arts-based students (Nwachukwu & Nwosu, 2007). For this reason, the teachers should be a guide for students in order to put themselves into discipline, to achieve self-control and have self-motivation (Anderson, 2004). The importance of Mathematics to human development attracted different comments, for instance, Cangiano (2009) described it as the queen of science and the language of nature and argued that its importance should be clear to any reasonable person. Agbajor (2013) posited that mathematics education is the bedrock of science and technology. Anaduaka and Okafor (2013) in support of the importance of Mathematics posited that Mathematics is also a body of knowledge essential for the achievement of a scientific/technological nation. Olaogun (2011) also stated that Mathematics is a language of orderliness and a strong tool of language in science and technology.
Despite the importance of mathematics as a school subject available statistics from the West African Examinations Council (WAEC, 2010-2018) revealed that candidates scored below credit level or failed to obtain the grades A1-C6. By implication, most students cannot gain admission into institutions of higher learning to study mathematics or its related disciplines. This leaves one in doubt about the effectiveness of instructional approaches employed by the mathematics teachers for the teaching and learning of mathematics. Researchers have shown that mathematics teachers do not always employ effective instructional approaches in teaching the subject (Nwagbo, 2012, Nwosu, 2007). This has led to situations where students cannot apply the knowledge of mathematics in real life situations. Agama (2009) posited that in most secondary schools, teaching methods are mainly based on inappropriate instructional approach, which requires teachers to give explanation or demonstration while students usually focus on textbook reading, note taking and memorization of facts. Some researchers have indicated that underachievement in science subjects such as mathematics is linked to inappropriate strategies of teaching in senior secondary schools (Okoye & Okeke 2007, Nwagbo, 2009). For instance, Classroom observations in many Nigerian secondary schools during teacher supervisions showed that the majority of the teachers do not apply appropriate science strategies as identified and recommended to be effective for science instruction (Norom, 2009). Scholars are creating a paradigm shift from what normally believed to be a traditional approach of teaching to completely special and technique this is actively primarily based totally and interactive.

The ability of a learner to learn well depends in his/her ability to connect or integrate previous

knowledge with new ones and also apply it to real life situations. Such learning is described as meaningful learning. So for meaningful learning to take place, the concept presented to the learner should be potentially meaningful and hence provide opportunity for the learner to form meaningful task. The learner should manifest the meaningful desire or tendency to make connections among concepts. Concept mapping originates from concept maps. Rao (2015) refers to concept maps as diagrammatic representations. It is not necessarily another learning strategy but a process designed to help students learn how to learn scientific concept which show meaningful relationships between concepts in the form of propositions which are linked together by words, circles and cross links.

Concept mapping seems to be a promising strategy for meaningful learning since its enables the learners to consciously connect new knowledge with relevant concepts already known. In concept mapping new knowledge is integrated into existing structures in order to enhance understanding (Stoica, Moranu & Miron, 2011). In the teaching and learning of mathematics (or any science subject), concepts do not exist in isolation. Each concept depends on its relationships to many others for meaning and in attempting to identify the key and associated concept of a particular topic or sub-topic, one will usually acquire a deeper understanding of the topic and clarification of any prior misconceptions. Concept mapping is an instructional scaffold for it provides support through diagrammatical representation and orderly presentation of the relationship between concepts or components of a concept using link s, lines, and nodes for meaningful learning.

Scaffolding from the researchers' view is a learning process designed to promote a deeper level of learning. Scaffolding is the support given during the learning process which is tailored to the needs of the students with the intention of helping the student achieve his/her learning goals. Scaffolding is a teaching technique whereby the teacher models the desired learning strategy/task, then gradually shifts responsibility to the students. In literal terms, scaffolding refers to poles and wooden boards that are joined together to make a structure for workers to stand on when they are working. It is used when building high structures such as storey building. Scaffolds are pillars for support to both the building and the builders. Scaffolding as an educational concept is the assistance (parameters, rules, or suggestions) a teacher gives to a student in learning situation to achieve learning. Also, scaffolding instruction is the "role of teacher and others in supporting the learners development and providing support structures to get to the next stage or level". Su and Klein (2010), investigated the use of scaffolds in problem-based hypermedia, results revealed that posttest scores for students who received content scaffolds were significantly higher than who received traditional method.

As a learner gains control of these new learning, the teacher withdraws the support gradually as the learner becomes increasingly able to complete the task alone. The teacher then plans and provides further support on new learning. Such support structures could be helping the learner to complete a task by using concept mapping as Scaffolding Strategy. In using scaffolding, the teacher's job is to help bridge the gap between what a student already knows and what he will learn next. A "Scaffold" ensures that children are not left to their own devices to understand something. The support is removed when the student is ready, like the scaffolding that supports workers who have been constructing or repairing a building. The scaffolds provides the workers with both a place to work

and the means to reach work areas that they could not access on their own which is removed when construction is complete (Olota, 2015). Scaffolding can be used at any level of education and in any discipline including mathematics, but it requires detailed planning on the part of the teacher. In using Scaffolds, the teacher helps in breaking down complex tasks into manageable bits, motivates learners, brings clear direction and reduces student's confusion. The teacher also clarifies expectation and incorporates assessment and feedback, and students understand why they are doing the work and why it is important.

There is need therefore to teach mathematics in an inspiring manner in order to achieve meaningful learning. Therefore, teachers should adopt instructional strategies to enhance better performance in the subject. Hence, the need to investigate if the use of concept mapping as scaffolding strategy could affect any changes in students' performance in mathematics. Since the use of concept mapping as instructional strategies engages both male and female students actively at the same time and the teaching taking place in particular location either urban or rural, there is need to investigate if the method could help to streamline gender and location differences in science.

According to Enki (2014), genders are the socially constructed roles and relation between men and women, while sex is biological characteristics which define humans as male and female. Results of findings on gender and students' achievement in Mathematics abound that revealed that boys perform better in Mathematics than girls. Leder (2000) concluded with the results of their findings that boys perform better in Mathematics. The revelation of gender difference in Mathematics performance became a vital point to be reviewed since it has been a point of concern for scientists to have a good number of female scientists getting to the top in sciences (Aiken, 2009). Researchers have done a lot of finding on what would have been the reasons for such pronounced difference in the ratio of boys and girls performance in Mathematics. Shaibu (2007) opined that the intellectual curiosity in boys is higher than that of the girls as a result of their persistency and eagerness to achieve their goals in life. This quality is highly demanded in Mathematics. Gender is not a significant factor in determining students' performance in Mathematics using scaffolding learning strategy. This finding harmonizes with a study carried out by Nonye and Nwosu (2011), to investigate the effects of instructional scaffolding method in improving the achievement of male and female students in social studies. The test of interaction showed that gender had no significant interaction with teaching approach on students mean achievements.

Therefore, the issue of gender and students' academic achievement has been inconclusive. While there are some views that male students perform better than females, others disagree with this view, arguing that achievement is a factor dependent on several factors such as socio- economic background, cognitive ability, type of exposure and appropriate teaching strategies among others. Therefore, one sees that the issue of gender has not yet been resolved particularly in relation to student's achievement in mathematics, hence the need for further study on that regard, especially when trying out new teaching strategy like concept mapping as instructional scaffolding. Nonye and Nwosu (2011), carried out a study to investigate the effects of instructional scaffolding on the achievement of male and female students in financial accounting in secondary schools, the results revealed that instructional scaffolding method was more superior than that of conventional method in improving the achievement of male and

female students in financial accounting.

STATEMENT OF THE PROBLEM

Considerable attempts have been made at reaching on some variables that causes poor performance in Mathematics but none has focus on the effects of concept mapping as instructional scaffolding on students' performance in mathematics. Despite the important position of Mathematics in the development of science and technology, it has been observed that the effective learning and teaching of Mathematics has been stalled by many factors such as inability of the learners to link theoretical knowledge with real life situation, the use of appropriate method or strategies in teaching Mathematics. The poor performance may due to poor instructional strategies employed by the teachers. There is need for effective strategies that would enhance performance in Mathematics so that youths can fully participate in science and technology which is an indicator of national development.

PURPOSE OF THE STUDY

The purpose of the study was to:

- ✓ evaluate the effect of Concept mapping as instructional Scaffolding on students' performance in mathematics
- ✓ examined the difference in academic performance of students taught with concept mapping as instructional scaffolding in Mathematics

RESEARCH HYPOTHESES

These hypotheses were generated to guide the study:

1. There is no significant difference in the mean performance score of students taught mathematics using concept mapping Instructional scaffold and those taught using conventional method.
2. There is no significant interaction effect of gender based performance of students taught Mathematics when exposed to Concept mapping as instructional Scaffolding strategy
3. There is no significant interaction effect of location based performance of students taught Mathematics when exposed to Concept mapping as instructional Scaffolding strategy

METHODOLOGY

This study adopted the quasi-experimental of pre-test, post-test, control group design. The targeted population for this study consisted of all the Senior Secondary Schools two (S.S.S.II) students in public schools in Ondo State. The sample for the study was made up of 160. Simple random sampling was used in the selection of four local government areas. The second stage entailed the use of stratified random sampling technique to select one school from each of the local government selected. While the third stage involved students in their intact classes in four selected secondary schools in Ondo State Research instrument used for this study was Mathematics Performance Test (MPT). The face and content validity of the instruments was done by the experts in Mathematics departments and it was also presented to Test Measurement and Evaluation experts. While the reliability was determined by using test re-test method and analyzed by using Pearson's Product Moment Correlation Analysis, which yielded 0.80 reliability coefficients. The research assistants were employed to administer the instrument and collected.

The data collected was analysed inferentially using analysis of covariance (ANCOVA) all at 0.05 level of significance.

RESULTS

Hypothesis 1: There is no significant difference in the performance of students taught mathematics using concept mapping Instructional scaffold and those taught using conventional method.

Table 1: Analysis of Covariance (ANCOVA) of the Effect of Concept Mapping as Instructional Scaffolding and conventional method on Students' performance in Mathematics

Source	SS	df	MS	F_{cal}	P	F_{table}
Corrected Model	9449.979	2	4724.989	12.762	0.000	3.00
Covariate (Pretest)	1213.079	1	1213.079	3,276	0.072	3.84
Group	7347.683	1	7347.683	19.845	0.00	3.84
Error	58128.796	157	370.247			
Corrected total	67578.775	159				
Total	1606964.000	160				

*P<0.05

Table 1 show that F_{cal} (19.845) is greater than F_{tab} (3.84) at 0.05 level of significance. The null hypothesis is rejected, indicating that there was significant difference in the performance score of students taught mathematics using concept mapping as instructional scaffolding.
In order to determine the effect of treatment on students towards mathematics, Multiple Classification Analysis (MCA) was used. The result is presented in table 2.

Table 2: Multiple Classification Analysis of students' performance exposed to Concept Mapping strategy.

Grand Mean = 98.09					
Variable + Category	**N**	**Unadjusted Devn**	**Eta**	**Adjusted for Independent + Covariate**	**Beta**
Concept mapping	80	7.17	30	6.72	.18
Conventional	80	-7.17		-6.73	
Multiple R^2					.031
Multiple R					.176

Table 2 shows that students in the concept mapping group had higher adjusted mean score of 104.81 998.09 + 6.72) than those not exposed to treatment 91.36 (98.09 + (-6.73)). This implies that the concept mapping as instructional scaffolding constitute veritable instructional strategy for enhancing students' academic performance in mathematics.

HO2: There is no significant interaction effect of gender based performance of students taught Mathematics when exposed to Concept mapping as instructional Scaffolding strategy

Table 3: Analysis of Covariance (ANCOVA) of gender and strategies on the performance scores of students in Mathematics in gender

Source	SS	Df	MS	F_{cal}	P	F_{table}

Corrected Model	11883.058	4	2970.765	114.657	0.000	2.37
Covariate (Pretest)	4.408	1	4.408	.170	0.681	3.84
Gender	3.775	1	3.775	.146	0.703	3.84
Group	11758.193	1	11758.193	453.810	.000	3.84
Gender + Group	41.202	1	41.202	1. 590	.209	3.84
Error	4016.042	155	25.910			
Corrected TOTAL	15899.100	159				
Total	98164.000	160				

P>0.05

The result in that F_{cal}(1.590) is less than F_{tab} (3.84) at 0.05 level of significance. Therefore, the null hypothesis is not rejected. This implies that there is no significant difference between the performance score of male and female students exposed to concept mapping strategy.

HO3: There is no significant interaction effect of location based performance of students taught Mathematics when exposed to Concept mapping as instructional Scaffolding strategy

Table 4: Analysis of Covariance (ANCOVA) of location and strategies on the performance scores of students in Mathematics in location

Source	**SS**	**Df**	**MS**	**F_{cal}**	**P**	**F_{table}**
Corrected Model	5685.419	4	1421.355	5.603	0.000	2.37
Covariate (Pretest)	1669.769	1	1669.769	6.583	0.011	3.84
Location	617.031	1	617.031	2.432	0.121	3.84
Group	3096.928	1	3096.928	12.209	0.001	3.84
Location + Group	171.276	1	171.276	.675	0.413	3.84
Error	39318.481	155	253.668			
Corrected Total	45003.900	159				
Total	147376.000	160				

P>0.05

Table 4: shows that F_{cal} (0.675) is less than F_{tab} (3.84) at 0.05 level of significance. The null hypothesis not rejected. This implies that there is no significant difference between the performances of students in location exposed to concept mapping strategy.

DISCUSSION

The finding of the study revealed that students in the experimental group that is those students taught selected Mathematics topics using concept mapping as scaffolding performed better than those taught using conventional method. The active involvement of students in the construction of the concept mapping may have helped in enhancing and facilitating students' performance in Mathematics than the conventional method. The students were always active trying to identify the key concepts and to link the various concepts together to arrive at a meaningful learning. The teacher was also able to use concept mapping to identify the fast and slow learners, he used their anchoring ideas as a scaffold to help the slow learners learn meaningfully an equally be active participants in the teaching- learning process. The ability of a learner to learn well depends on his /her ability to connect or integrate previous knowledge with the new ones and apply it to real life situations. Teaching with concept mapping therefore enabled them to be at their best, leading to better performance. The results of this study were in line with the views of Su and Klein (2010), which was of the opinion that the use of scaffolds in problem-based hypermedia. Results revealed that posttest scores for students who received content scaffolds were significantly higher than

those who received metacognitive scaffolds or no scaffolds. Results in table 1 showed that higher performance mean scores of students taught mathematics using scaffolding learning strategy compared with their counterparts in traditional method. The result in table 3 also show that a significant difference in the mean performance scores of students taught mathematics using scaffolding learning strategy and those taught using traditional method.

CONCLUSION

Based on the findings it was concluded that, Concept mapping makes learning to be easier, helps in the retention of knowledge, leads to academic performance and above all involves hands-on and minds-on activity. The teacher should then plan classroom activities properly using concept mapping to make learning more meaningful.

RECOMMENDATIONS

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

1. Mathematics teacher should be made to recognize the potentials of concept mapping as instructional scaffolding and utilize it for better performance of students in Mathematics.
2. The Ministry of Education should through seminars, workshops, and conferences equip serving Mathematics teachers with requisite knowledge, skills, and competences on the use of concept mapping as instructional scaffolding strategies for teaching and learning.

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