

Scaffolding Strategy and Students Performance in Mathematics in Senior High School in Keta Municipality, Ghana

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Abstract

The aim of this study was to investigate the effect of scaffolding strategy on students' performance in Mathematics in Keta Municipality of Volta Region, Ghana. The study employed a quasi-experimental research design. The sample for the study consisted of one hundred and fifteen (115) Senior High School Two Mathematics students. The instrument used for data collection was a multiple type objectives test titled: Mathematics Performance Test (MPT). The instrument was validated by three experts and had a reliability index of 0.88 obtained through the use of Pearson moment correlation. Two research questions and two hypotheses were formulated to guide the study. The data collected were analyzed using adjusted mean and standard deviation to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the null hypothesis at alpha level of 0.05. The result of the study showed that students performed highly using scaffolding learning strategy than those students who were taught using the traditional method. The test of interaction showed that gender had no significant interaction with teaching approach on students mean performance. The study concluded that scaffolding strategy is a good teaching method for teaching elective mathematics. The study recommended that mathematics teachers should adopt scaffolding learning strategy in the teaching because it enhances the academic performance of students in Senior High Schools in Ghana. The study also recommended that workshops should be organized by educational bodies to emphasize and enlighten teachers and mathematics educators on the benefits of using scaffolding strategy in the learning and teaching in Senior High Schools in Ghana.

Keywords: Scaffolding strategy, Traditional method, Performance, Mathematics

Date of Submission: 12-08-2020

Date of Acceptance: 28-08-2020

I. Introduction

Improving the quality of learning mathematics from time to time has always received attention from various parties. The concern is inseparable from the awareness of the importance of mathematics itself. Mathematics has an important role both as a science that is in addition and a tool (Hudogo, 2003; Suherman, et al, 2003). As the science, mathematics can be viewed as knowledge acquired through reasoning that are hierarchical, deductive, axiomatic, accurate, formal and abstract. While as a tool, it can be viewed as the language of mathematics as well as a means to develop ways of thinking which is needed in everyday life to deal with and explain the phenomenon of mathematical science itself also the science outside of the area as well as in coping the progress of science of mathematic learning at every level of education requires attention in a comprehensive manner. The focus of attention would not be separated from the three inter-related aspects of the aspects: teachers, students and materials/content.

However, the review on student's achievement in mathematics in West African Senior Secondary School Certificate Examination (WASSSCE) showed that student's performance in mathematics was poor (16th July, 2018, Ghanaian times). This persistent failure was blamed on constant usage of traditional method by mathematics educators (Mezieobi, 2014). The limitation experienced with the traditional teacher-centered method led to the introduction of innovative strategies of teaching mathematics like scaffolding strategy.

Scaffolding instruction as a teaching strategy originates from Lee Vygosky's sociocultural theory and his concept of the *zone of proximal development (ZPD)*. "The zone of proximal development is the distance between what children can do by themselves and the next learning that they can be helped to achieve with competent assistance" (Raymond, 2011. p.176). The scaffolding teaching strategy provides individualized support based on the learner's ZPS (Chang, Sung & Chen, 2014). In scaffolding instruction, a more knowledgeable other provides scaffolds or supports to facilitate the learner's development. The scaffolds facilitate a student's ability to build on prior knowledge and internalize new information. The activities provided in scaffolding instruction are just beyond the level of what the learner can do alone (Olson & Pratt, 2019). The

more capable other provides the scaffolds so that the learner can accomplish the tasks that he or she could otherwise not complete, thus helping the learner through the ZPD (Bransford et al, 2006).

Vygotsky defined scaffolding instruction as the ‘‘role of teachers and others in supporting the learner’s development and providing support structures to get to that next stage or level’’ (Raymond, 2011, p.176). An important aspect of scaffolding instruction is that the scaffolds are temporary. As the learner’s abilities increase the scaffolding provided by the more knowledgeable other is progressively withdraw. Finally, the learner is able to complete the task or master the concepts independently (Chang et al, 2014, p.7). Therefore, the goal of the educator when using the scaffolding teaching strategy is for the student to become an independent and self-regulating learner and problem solver (Hartman,2017).

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. The test of interaction showed that gender had no significant interaction with teaching approach on students mean achievement. It was concluded that instructional scaffolding is a good teaching method for teaching financial accounting. Su and Klein (2010), in their study investigated the use of scaffolds in problem-based hypermedia. The study sampled out 320 undergraduate students enrolled in a computer literacy course worked in project team to use a problem-based hypermedia program focused on designing a personal computer. A 3*3 factorial research design was used in the study and a one – way (ANOVA) was used in the study analysis. The program included content scaffolds and metacognitive or no scaffolds. The results revealed that posttest scores for students who received content scaffolds were significantly higher than those who received metacognitive scaffolds or no scaffolds.

According to McKenzie (2002). Scaffolding provides clear direction and reduces students’ confusion, clarifies purpose by helping students’ understand why they are doing the work and why it is important. Also scaffolding reduces uncertainty, surprise, disappointment and eliminate difficulties so that learning is maximized.

Statement of the Problem

Mathematics as a subject affects all aspect of human life at difference levels. Mathematics is seen by society as the foundation of scientific technological knowledge that is vital in socio-economic development of a nation. Mathematics is a key requirement of gaining admission into any tertiary institution in the country. Mathematics is also a requirement for getting enlistments into security services in Ghana. For a Senior High School graduate to gain admission into any tertiary institution or get enlisted into any security service in Ghana, he or she must obtain a good grade (A1– C6) in mathematics.

However, there has been public outcry about the falling standard of mathematics education in Senior High Schools in Ghana. Many senior high school graduates drop out from school because of low grade in (WASSCE) mathematics. Whereas their home been several outcry of the low performance of students in Senior High Schools mathematics little study exist in support of these complain. This study therefore intends to find out whether or not scaffolding strategy can positively affect student’s performance in mathematics at Senior High Schools in Ghana.

Purpose of the Study

The purpose of the study is to find out whether or not scaffolding strategy can positively effect student’s academic performance in mathematics at Senior High Schools in Ghana.

Objectives

1. To find out if there is difference between the mean performance score of students taught with scaffolding strategy and those taught using traditional method at Senior High School in Ghana?
2. To find out if there is difference between the mean performance score of male and female students taught using scaffolding strategies at Senior High school in Ghana?

Research Hypotheses

To achieve the objective of the study, the following null hypothesis was test at a 5% level of significance.

Ho₁: There is no statistically significant difference between the mean performance score of student taught with scaffolding strategy and those taught using traditional method.

Ho₂: There is no statistically significant difference between the man performance scores of male and female students taught using scaffolding strategies.

II. Methodology

The design of the study is quasi-experimental group design. Specifically, the non-equivalent control group design. The design is considered appropriate because it establishes a cause effect relationship between the independent variable and the dependent variable. This design was adopted because it was possible to have a complete randomization of the subjects. Thus intact classes were used as experimental and control group, since it is not possible to disrupt existing classes in a school. The population of the study consists of all the 3632 Senior High School two (SHS2) mathematics students from eleven senior high schools in the Keta municipality of Volta Ghana. A total of 115 Senior high School two (SHS2) mathematics students from two schools consisting of 68 males and 47 female's students constituted the sample for the study through purposive sampling technique, because everyone can be selected for the study. This technique makes it possible to prove the validity of the information immediately because no one is left out from the sampling process. Data was collected through mathematics performance test, which consist of twenty (20) multiple choices objective question with options (A-D). The instrument was validated by three experts in mathematics department of Akatsi College of Education, Ghana. A reliability coefficient of 0.88 was obtained for the study using Pearson Product Moment Correlation. The treatment exercise lasted for six weeks before the post-test. Mean and standard deviation were used to answer the research questions, while the null hypotheses were tested with analysis of covariance (ANCOVA) of 0.05 level of significance.

III. Results

Objective One

To find out if there is difference between the mean performance score of students taught mathematics with scaffolding strategy and those taught using traditional method?

Table 1: Mean and standard deviation of pre-test and post-test scores of students taught with scaffolding strategy and those with traditional method.

Group	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Scaffolding Strategy	74	56.49	10.51	86.5	12.89
Traditional method	41	48.5	6.53	62.0	7.5

The results in table 1 show that the group taught mathematics using scaffolding strategy has a pretest mean of 56.49 with standard deviation of 10.51 and post-test mean of 86.50 with a standard deviation of 12.89. The difference between the pretest and posttest mean was 2.48. The group taught mathematics using traditional method had a pretest means of 48.5 with a standard deviation of 6.53 and a posttest means was 62.0 with a standard deviation of 7.5. The difference between the pretest and the posttest mean was 0.97. However, for each of the groups, the posttest means were greater than the pretest means with the group taught using scaffolding strategy having a higher mean gain of 2.42 while groups taught using traditional method have a mean gain of 0.97. This is an indication that scaffolding strategy has more positive effect on students' performance in mathematics than the traditional method.

Objective Two: To find out if there is difference between the mean performance score of male and female students taught mathematics using scaffolding strategy?

Table 2: Mean and standard deviation of pretest and post-test scores of male and female students taught using scaffolding strategy.

Gender	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Male	43	53.5	8.5	84.0	7.5
Female	31	58.0	8.0	89.0	9.0

The result in table 2 showed that the male students taught mathematics using scaffolding strategy has pretest mean of 53.5 with standard deviation of 8.5 and a post-test mean of 84.0 with a standard deviation of 7.5. The difference between the pretest and posttest means for the male group was 30.5. The female students taught mathematics using scaffolding strategy has a pretest mean of 58.0 with a standard deviation of 3.0 and a post-test mean of 89.0 with standard deviation of 9.0. The difference between the pretest and posttest means for female group was 31.0.

Ho₁: There is no significant difference between the mean performance score of students taught mathematics using scaffolding strategy and those taught using traditional method.

Table 3: Analysis of covariance (ANCOVA) of the significant difference in the mean performance scores of students taught mathematics using scaffolding strategy and those taught using traditional method.

Source	Type III sum of Square	DF	Mean Squares	F	P
Corrected					
Model	2047.559 ⁰	2	1023.780	83.787	0.000
Intercepts	2292.350	1	2292.350	187.607	0.000
Pretest	13.926	1	13.926	1.140	0.008
Groups	1984.099	1	1984.099	162.380	0.001
Error	1429.608	110	12.219		
Total	88278.000	115			
Corrected					
Total	3477.167	114			

The result in table 3 showed that significant difference in the mean performance score of students taught mathematics using scaffolding strategy and those taught using traditional method. An F-ratio of 162.380 was obtained with associated probability values of 0.01. Since the associated probability value of 0.001 was less than 0.05 set as level of significance, the null hypothesis (H_{01}) was failed to accept. This indicates a significant difference between students taught with scaffolding strategy and traditional method, in favour of scaffolding strategy.

Ho₂: There is no significant difference between the mean performance score of male and female students taught mathematics using scaffolding strategy.

Table 4: Analysis of covariance (ANCOVA) of the significant difference in the mean performance scores of male and female students taught mathematics using scaffolding strategy.

Source	Type III sum of Square	DF	Mean Squares	F	P
Corrected					
Model	8.044 ⁰	2	4.022	0.242	0.996
Intercept	1293.950	1	1293.950	77.920	0.063
Pretest	0.520	1	0.520	0.031	0.560
Gender	7.171	1	7.171	0.432	0.425
Error	946.556	69	16.606		
Total	57504.000	74			
Corrected					
Total	954.600	73			

The result in table 4 show the mean performance score of male and female students taught mathematics using scaffolding learning strategy. An F-ratio of 0.42 was obtained with associated probability value of 0.425. Since the associated probability value of 0.425 was greater than 0.05 set as level of significance, the null hypothesis (H_{02}) was accepted. This indicates that gender does not determine students' performance when taught using scaffolding learning strategy.

IV. Discussion of findings

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. This finding is in consonance with a study carried out by Su and Klein (2010), to investigate 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.

Table 2 revealed that the achievement mean score of the male and female students taught mathematics with scaffolding learning strategy were the same. Also the result in table 4 revealed that 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.

V. Conclusion

The results of the study indicated that students performed higher using scaffolding learning strategy irrespective of their ability level than those students taught using traditional method.

VI. Recommendations

In line with the finding of this study, the following recommendations are provided:

1. Mathematics teachers should adopt scaffolding learning strategy in the teaching because it enhances the academic performance of students in Senior High Schools in Ghana.
2. Workshops should be organized by educational bodies to emphasize and enlighten teachers and mathematics educators on the benefits of using scaffolding strategy in the learning and teaching in Senior High Schools in Ghana.

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Leonard Kwame Edekor. "Scaffolding Strategy and Students Performance in Mathematics in Senior High School in Keta Municipality, Ghana." *IOSR Journal of Research & Method in Education (IOSR-JRME)*, 10(4), (2020): pp. 18-22.