

**EFFECT OF GREPSOM AND MEPSOM PROBLEM-SOLVING MODELS
ON SENIOR SECONDARY SCHOOLS STUDENTS' ACHIEVEMENT IN
SCIENCE TECHNOLOGY AND MATHEMATICS(STEM) IN ABUJA.**

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Abstract

This study investigated the effects of GrepSom and MepSom problem-solving models on senior secondary school students' achievement in STEM in Abuja. Quasi-experimental, pre-test, posttest, non-randomized control group design was adopted for the study. The population consists of 2,178 senior secondary two (SS2) students. The sample was 241 students which were purposively selected to participate in the study. Two research questions and corresponding hypotheses guided the study. STEM Problem-solving Achievement Test (STEMPAT) was the instrument used to collect data for the study. The STEMMPAT was validated and have a reliability index of 0.83 using the test-retest technique and Kuder-Rickardson formula 20(K-R20). The collected data was analysed using mean and standard deviation for the research questions and T-test for the research hypotheses at 0.05 level of significance. The findings of the study show that GrepSom and MepSom problem-solving models enhance students' achievement in STEM significantly without any bias on gender. Hence it was recommended that mathematics teachers should use GrepSom and MepSom problem-solving models in teaching mathematics for ensuring global security and sustainable development in Nigeria.

Keywords: GrepSom, MepSom, Achievement, Problem-solving, STEM

Introduction.

STEM is the study of quantity, structure, space and change. It is the basic tool in the development of any nation. The applications of STEM is found in every rating

in the military which begins from simple skills to complex computing and engineering (Ejakpovi & Uveruveh, 2016). STEM plays a significant role in the development of any society. It also occupies a central place in the Nigerian educational system. The position of STEM makes it necessary for the use of innovative pedagogical strategy that will enable teachers meet the challenges of teaching and learning of the subject especially in this information age. The development of Mathematics is without question, one of the supreme achievements of man due to its utilitarian role in the natural and social sciences, among others.

The study of STEM fosters logical thinking, emphasizes precision in language and notation, improves pattern recognition, encourages multiple ways of looking at a particular problem, increases one's ability to understand the complex world in which we live and helps us to make sense of our world and appeals to our senses of beauty and reason (Sunday, 2018). Isa (2017) pointed out that Mathematics is the gate and key to science. The importance of Mathematics to nation building has led the Federal Government of Nigeria to make STEM specifically Mathematics a core subject to be offered by students at all levels of education in Nigeria (FRN, 2014). Korau (2006) noted that Mathematics is a compulsory subject required for admission into university especially for science related courses.

STEM has continued to witness consistent poor performance of students as many students regarded it as the most difficult concepts in secondary school mathematics. (Hasheem, Mohammed & Moni, 2014; Sunday, 2018) Despite the key roles mathematics play in the society, students' achievement in the subject has become a source of serious concerns among stakeholders at the secondary school level (Samuel, 2020). This disheartening achievement in STEM at the senior secondary school level has been attributed to series of factors majorly centered on instructional delivery strategies by the STEM teachers (Anaduaka & Hassan, 2017). STEM is mainly concerned with solving problems. Most of the secondary schools students are not adequately equipped with problem solving skills which could have aided their STEM skills and hence their achievement in STEM (Nwaodo & Ogbonna, 2019).

According to Nwaodo and Ogbonna (2019) problem solving in STEM can be described as uninterrupted and related STEM tasks that have the potential of providing intellectual challenges for enhancing students' understanding and development. We have different kinds of problem solving models in STEM which include: Polya, Heuristic, Greeno, Metes, among others. This study utilized the combination of the Greeno and Metes model in teaching and learning of STEM.

Greeno (1973) and Metes, Pilot, Roosnick and Krarnrners-PaIs (1980) developed four-steps in problem-solving models respectively. Greeno (1973) established a

four- step problem-solving model called “GREPSOM” The steps known as RRCC are:

1. Reading test, interpreting concepts.
2. Reading relevant information
3. Constructing solution
4. Carrying out calculation or other operations.

Metes, Pilot, Roosnick and Krammers-pals (1980) on the other hand established also a four- step model known as “MEPSOM”. These steps known as APEC are:

1. Analyzing the problem
2. Planning the process
3. Executing the process
4. Checking and interpreting of solutions.

GREPSOM and MEPSOM have been found to be very potent in enhancing students’ achievement in Biology, Agric Science, Blocklaying, Basic Technology and Algebra (Nwaodo & Ariyo, 2020; Daluba & Mama, 2012, Ogwuche & Kurumeh, 2011). The way the four steps-RRCC and APEC are systematically and logically arranged help students to internalize problem-solving techniques easily. Hence, it was used in this study to teach geometry.

Statement of the Problem

Government, teachers, parents, students and other stakeholders in education are seriously concerned about the declining achievements of students in mathematics and problem solving skills of students in secondary schools. Specifically, parents are anxiously waiting to see the problem solving skills of their children when they have completed secondary schools. But many get frustrated because these skills are not there. These skills which could have helped in solving the security challenge of the country and the globe at large should be inculcated in the students’ because: firstly, it will enhance their achievements in STEM; and secondly prepare them to confront the security challenges ravaging the world.

Just imagine that these over 1,700 students who might be idle are being recruited into any of the criminal groups in the society? Hence this study investigated the impacts of GrepSom and MepSom problem-solving models on senior secondary schools students’ achievement in mathematics: precursor for security tips and sustainable development in Abuja, Nigeria.

Some psychological theories seem to have direct bearing on the problem solving phases. Among them are Constructivism and Gestalt. Constructivism theory, in which a notable psychologists and philosophers such as Gagne, Ausubel, and Piaget among others serves as the foundation of constructivist learning theory. Constructivism that all learners have the ability to construct knowledge in their own minds through a process of discovery and problem solving (Chowdlury, 2006). This indicates that students have the ability to solve security problems for sustainable development when given the proper guidance by the mathematics teachers.

Gestalt theory is also known as the ‘Laws of Simplicity’ or the ‘Law of Pragnanz’ which states that every stimulus is perceived in its most simple form by following the basic principle that the whole is greater than the sum of its part. In other words, the whole (a picture, a car) carried a different and altogether greater meaning than its individual components (paint, brush; or tire, paint, metal respectively). The gestalt theorist on the other hand hold the view that when a learner is placed in a problem situation, he perceives the problem, begins to establish relations between the various parts of the problem and formulate rules and hypothesis that enable him solve the problem. He then tests the applicability of the most relevant rules until he solves the problem Ogwuche and krurumeh(2011). This study uses two problem solving model to facilitates students understanding of geometry, then enable them to develop security tips for sustainable development.

In a study Vareba and Igweagbara(2021) discovered that Greeno problem solving model enhances students retention in blocklaying and concreting significantly better than the conventional methods. Also, Nwaodo and Ariyo(2020) discovered that Greeno problem solving methods enhances students’ achievement and interest in Basic Technology. In separate studies Ogwuche and krurumeh(2011) and Pekene (2002) results showed that Grepson and Mepsom problem solving models significantly increases students achievement in Algebra and Physics respectively

Research Questions

The following research questions guided the study:

1. What is the difference in the achievement of students taught STEM using Grepson and Mepsom problem-solving models and those taught with conventional methods?
2. To what extent does differences exist in the achievement of male and female students when taught STEM using Grepson and Mepsom problem solving model?

Research Hypotheses

The following null hypotheses were formulated for the study:

HO₁: There is no significant difference in the achievement of students taught STEM using Grepson and Mepsom problem-solving models and those taught with conventional methods.

HO₂: There is no significant difference in the achievement of male and female students when taught STEM using Grepson and Mepsom problem solving model.

Methodology

A quasi-experimental design was used for this study. This enabled the researcher to use intact SS2 classes for the research without disrupting the normal academic classes for the selected schools. This also involved pretest, posttest for both the experimental and control groups.

The population of the study comprised of 28,387 senior secondary schools students in Abuja. The sample of 291 students was purposively selected from the Government senior secondary schools in the study area. Multistage sampling technique was used to select senior secondary schools that for teaching and have boys and girls. Two schools were selected (one as control group and the other as control group) from which two intact classes each (total of four intact classes) were selected from the two schools. The instrument used for collection of data is STEM Achievement Test (STEMGAT) designed by the researchers. The instrument is a 40-item test on problems in Geometry, validated by two senior lecturers of mathematics education in the university and one from Educational Psychology whose reliability coefficient is 0.83 using Kuder-Richardson formula 20(K-R20). The experimental group were taught STEM using Grepson and Mepson problem solving models, while the control group were taught STEM using the conventional method. Both teaching lasted for six weeks. Pretest was administered before the treatment and posttest after the treatment. The collected data were analysed using mean, standard deviation and t-test statistics at 0.05 level of significance.

Results

Research question one: What is the difference in the achievement of students taught STEM using Grepson and Mepson problem-solving models and those taught with conventional methods?

Table 2

Mean and standard deviation of students in the experimental and control group.

Variable		N	Pre-test		Post-test		
Method of Teaching	Mean		SD	Mean	SD	Mean gain	
Grepson and Mepson	164	14.72	3.09	27.29	4.12	12.57	
Conventional Method	127	15.01	3.11	20.81	3.89	5.80	

In table 2, the mean achievement scores of the students taught geometry using Grepson and Mepsom is 14.72 and 27.29 and standard deviation 3.09 and 4.12 for the pretest and posttest respectively, and mean gain score is 12.57, while students taught with the conventional method had a mean achievement score of 15.01 and 20.81 and standard deviation 3.11 and 3.89 for pretest and posttest respectively with a mean gain score 5.80. This implies that students taught STEM using Grepson and Mepsom achieved better than their counterparts that were taught with the conventional method.

Research question two: Does differences exist in the achievement of male and female students when taught STEM using Grepson and Mepsom problem solving model?

Table 3
Mean and standard deviation of male and female students in the experimental group.

Variable	N	Pre-test		Post-test		Mean gain
		Mean	SD	Mean	SD	
Male	98	13.31	2.91	28.16	4.01	14.85
Female	66	14.96	3.21	26.94	4.11	11.98

In table 3, the mean achievement scores of male students taught geometry using Grepson and Mepsom is 13.31 and 28.16 and standard deviation 2.91 and 4.01 for the pretest and posttest respectively, and mean gain score is 14.85, while the mean achievement scores of female students taught STEM using Grepson and Mepsom is 14.96 and 26.94 and standard deviation 3.21 and 4.11 for the pretest and posttest respectively, and mean gain score is 11.98. This implies that male students achieved slightly higher than the females taught STEM using Grepson and Mepsom.

HO1: There are no significant differences in the achievement of students taught STEM using Grespom and Mespom problem-solving models and those taught with conventional methods.

Table 4

Summary of T-test of the Academic Achievement Mean scores of Experimental and Control Groups.

Group	N	Mean	SD	Df	t _{cal}	t _{crit}	p-value	Decision
Experimental	164	27.29	4.12	289	12.15	1.94	0.04	Significant
Control	127	20.81	3.98					

*significant at $p < 0.05$

From Table 4, the calculated p value of 0.04 is less than 0.05 significant level at the degree of freedom of 289. Hence, the null hypothesis of no significant difference was rejected. Hence there is a significant difference in the achievement of students taught STEM using Grepson and Mepsom problem solving model and their counterpart in the conventional method in favor of Grepson and Mepsom problem solving model.

HO₂: There is no significant difference in the achievement of male and female students when taught STEM using Grepson and Mepsom problem solving model.

Table 5

Summary of T-test of the Academic Achievement Mean scores of male and female in the Experimental Group.

Group	N	Mean	SD	df	t _{cal}	t _{crit}	p-value	Decision
Male	98	28.16	4.12	162	7.18	1.96	1.12	Not Significant
Female	66	26.94	3.98					

*significant at $p < 0.05$

From Table 5, the calculated p value of 1.12 is greater than 0.05 significant level at the degree of freedom of 162. Hence, the null hypothesis of no significant

difference was not rejected. Hence there is no significant difference in the achievement of male and female students taught STEM using Grepson and Mepsom problem solving models.

Discussion

The results in table 2 and 4 indicated that students taught STEM using Grepson and Mepsom problem solving models achieved significantly better than their counterpart taught with conventional method. This could be as a result of the Grepson and Mepsom problem solving models allowing for more students participation in the learning processes which enhanced their achievement in geometry. This findings is in line with the findings of Ogwuche and krurumeh (2011) who discovered that Grepson and Mepsom problem solving models enhances students' performance significantly in Algebra irrespective of gender. The results of this study is also corroborated by the findings of Pekene (2002) whose study reveals that male and female students benefited equally when taught Physics using Grepson and Mepsom problem solving models.

Conclusion

The findings of this study revealed that students achieved significantly higher when taught geometry using Grepson and Mepsom problem solving models. Hence, it was concluded that Grepson and Mepsom problem solving models increased significantly students' achievement significantly in mathematics.

Recommendations

It was therefore recommended that:

1. Mathematics teachers should endeavor to use Grepson and Mepsom problem solving models when teaching STEM.
2. Government should organize workshops for STEM teachers at the senior secondary school on the effective utilization of Grepson and Mepsom problem solving models.

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