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EFFECT OF PROBLEM-SOLVING INSTRUCTIONAL STRATEGY ON ACADEMIC PERFORMANCE AND RETENTION IN GEOMETRY AMONG SENIOR SECONDARY STUDENTS IN KATSINA METROPOLIS, KATSINA STATE, NIGERIA

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Abstract

This study examined the effect of Problem-Solving Instructional Strategy on students' academic performance and retention in Geometry among senior secondary school students in Katsina metropolis. A sample of 80 students was selected using simple random sampling technique. The purposive sampling technique was initially used to select four schools which were pretested and subjected to ANOVA and Schaffer's test statistic to obtain two schools that are academically equivalent. The study used the pre-test, post-test, control and experimental group design. One school was randomly assigned the experimental group and the other as the control group. Geometry Achievement Test (GAT) was the instrument used for data collection. The results revealed that there was a significant difference between the mean achievement of students in the group taught Geometry using Problem-Solving Instructional Strategy and those taught using conventional approach. In addition, there is a significant difference between the mean retention scores of students in the experimental group and those in the control group in favor of the experimental group. It is therefore recommended that teachers should incorporate the Problem-Solving Strategy in the curriculum implementation and teaching at all levels since it enhances the academic performance and retention of students.

Keywords: *Solving Instructional Strategy, Students, Academic performance, Mean retention.*

Introduction

Mathematics is the backbone of all scientific and technological investigations as well as all other activities of human development. It is a creative endeavor, a human activity which arises from experiences and becomes an integral part of culture and society of everyday life and work (Uzo, 2002). The study of mathematics is a basic preparation for an informed citizenry and a gateway to numerous career choices in life (Galadima, 2001 & Obodo, 2002). Teaching Mathematics effectively is quite hard because sometimes, the students find Mathematics as a boring subject (Makama, 2008). According to Abubakar (2014), the task of every teacher is to help the students in problem solving process and for that to be achieved the teacher must be well grounded in the Problem-Solving Instructional Strategy. This is very important in the teaching of Mathematics. The classroom teacher can develop a scientific approach to solving problems which should be a guide to the students (Abubakar, 2014).

The teaching of Mathematics is generally a complex interactive social activity that takes place within the classroom. It consists of such activities as abstraction, theory building, concept formulation, problem-solving and generalization. Mathematics is a compulsory subject for all levels of the Nigerian educational system. Abubakar (2014) sees the subject as the process of translating a problem into a mathematical form, deciding what result is

required mathematically, doing the computation, moving from the mathematical beginning to the mathematical end point as well as interpreting the results. Mathematics in secondary schools is divided into Geometry, Algebra, Statistics and Calculus among others. Geometry, according to Obodo (2002).

Problem-Solving is an instructional strategy which can be effectively used to teach any mathematics concept especially geometry. The method engages students in effective mathematics learning. Problem-solving is a teaching method or strategy which is learner-centered and can promote students' understanding and development of active and motivated learning (Abubakar, 2014). Vande-Walle (2004) calls problem-solving a "principle instructional strategy" used to fully engage students in mathematical learning. Problem-solving based learning is a model which centers on students and it is a skill and knowledge based on deep understanding of concepts.

Academic achievement refers to an act of finishing or accomplishing the given work. In other words, anything accomplished successfully, particularly through perseverance, practice, skill or exertion in Mathematics in general and in Geometry in particular can be termed as an achievement (Abubakar, 2014). Adeyemi, (2008) viewed academic performance as the scholastic stand of a student at a given time. Musa (2010) viewed academic performance as the quality of result produced by student as reflected in the quality of their examination score. Usman and Musa (2015) also defined academic performance as the assessment of how much students have learnt, the extent to which a student has acquired certain information or mastered skills usually due to prior information or training. It is worthy to note that performance and achievement in mathematics and Geometry is a resultant effect of retention. Learning is strongly related to memory and retention is the storage of information in the brain.

In Nigeria, Mathematics is generally a compulsory subject for all students at all levels of secondary education and Geometry, an aspect of Mathematics, is an integral part of Mathematics in the Senior Secondary Certificate Examination (SSCE). However, the rate at which students fail Mathematics in SSCE is a worrisome continues to be a worrisome situation. The poor performance has always shown a perennial feature of Mathematics results in secondary schools. More so, the state of performance in Mathematics in Nigeria, especially Katsina State secondary schools is not encouraging. Table 1 illustrates the state of academic performance of students in Mathematics in Katsina metropolis, Katsina State, Nigeria.

Table 1: Summary of Performance of Students in WASSCE General Mathematics from 2005 to 2010 in Katsina Metropolis

Year	Number Registered	Number Passed (A1-C6)	Number Failed (D7-F9)	% Pass	% Fail
2005	2,970	389	2,581	13.10	86.90
2006	3,890	1,110	2,780	28.53	71.47
2007	4,686	1,811	2,875	38.65	61.35
2008	4,078	3,541	537	86.83	13.17
2009	5,241	1,888	3,353	36.02	63.98
2010	4,604	328	4,276	7.12	92.88

Table 1 shows the trend of students' performance in WASSCE Mathematics in Katsina metropolis. As can be observed from the table, no year except 2008 has the percentage

pass rate reached 50%. This gives an indication that something must be done to rectify the students' poor performance in the subject. The big question remains: 'When will this poor academic achievement in Mathematics come to an end?"

Objectives of the Study

The following constituted the objectives of this study: to

i. investigate whether Problem-Solving Instructional Strategy affect students academic performance in Geometry;
ii. determine whether Problem-Solving Instructional Strategy affects students' retention in Geometry.

Research Questions

The study sought to provide answers to the following questions:

i. What is the difference between the mean academic performance scores of students taught Geometry using Problem-Solving Instructional Strategy and those taught the same concept using lecture method.
ii. What is the difference between the mean retention scores of students taught Geometry using Problem-Solving Instructional Strategy and those taught the same concept using lecture method.

Hypotheses

The following hypotheses were formulated and tested at $P \leq 0.05$ level of significance:

i. There is no significant difference between the mean academic performance scores of students taught Geometry using Problem-Solving Instructional Strategy and those taught the same concept using lecture method.
ii. There is no significant difference between the mean retention scores of students taught Geometry using Problem-Solving Instructional Strategy and those taught the same concept using lecture method.

Methodology

The research design of this study is Quasi-Experimental, involving pre-test, Post-test, quasi-experimental and control group design using intact classes as proposed by Kelinger (I973). The study involved two groups: an experimental and a control group. Two intact classes (one as experimental and the other as control groups) were used for the study. The two study schools were selected from the four pre-tested schools out of the study population. The essence of pre-testing is to ensure selection of samples that are not significantly different in abilities in terms of performance and mean retention before the treatment. After pre-testing, two homogeneous schools were assigned into experimental and control groups.

Population of the Study

The target population for this study is all Senior Secondary School 2 students in Katsina Metropolis. There are only 10 public Senior Secondary Schools with a population of 4,900 SS2 students in Katsina Metropolis. The co-educational schools are 6 while 3 schools are only boys and 1 school only girls. The population comprises of 2,529 boys and 2,371 girls.

Sampling Procedure: Kerlinger (1986) explained purposive sampling as non-probability sampling which is characterized by the use of judgement and a deliberate effort to obtain representative samples by including typical areas or groups in the sample. In view of this, a purposive sampling technique was used to select four co-educational secondary schools within Katsina Metropolis. This was to ensure that the schools have similar environmental situation and fair representation of Boys and Girls within the sampled schools. These schools were pretested and their scores were subjected to ANOVA and Scheffe's Test statistics. Later, one class each from the two schools that were found not to be significantly different academically was selected through flip of coin. This is because SS2 students were made up of science and art classes. Only intact classes were used in each of the selected schools as recommended by Campbell & Stanley (1966). Incidentally, each of the classes has 40 students. A total sample size of 80 students was used for the study. The schools were randomly assigned as experimental and control groups represented by School A and School B respectively. Table 3 shows the summary of the sample for this study.

Table 3: Sample of the Study

School	Group	Boys	Girls	Total
School A	Experimental	23	17	40
School B	Control	25	15	40
TOTAL		**48**	**32**	**80**

Instrumentation

The Geometry Achievement Test (GAT) was used to collect data for the study. The instrument contained 40 multiple choice questions (A-D) developed by the researcher on six topics within the concept of Geometry. Geometry was chosen for this study because it is mostly failed by students in SSCE (Mang, 2010; Achor, Imoko & Jimin, 2012). GAT was used for pretest, posttest and post-posttest. The pretest was meant to give information on the present level of the students before treatment while the posttest and post-posttest were to give information on the achievement and retention levels of students after treatment. The GAT items were altered in serial order but still retain the original content of the items before it was used as post-posttest.

Validity and Reliability of the instrument

To ensure validity, the instruments were given to two experienced Mathematics teachers from Senior Secondary Schools and two Mathematics Educators from Ahmadu Bello University, Zaria, who did the content validation. The instrument was also given to two experts in the Department of Measurement and Evaluation from Ahmadu Bello University, Zaria, who carried out the face validity. The validators were to comment on the instrument (GAT) - whether it covered the content and if the instrument was within

the ability of the subjects to ensure it tests and correlated using Pearson Product Moment Correlation (PPMc) statistic and the reliability coefficient obtained is 0.74. With this, the instrument is assumed to be reliable for use since according to Maduabum (2004), any instrument with reliability coefficient of 0.5 and above is reliable for use in data collection.

Method of Data Collection

The researchers personally administered the Geometry Achievement Test (GAT) to collect data for the study. The instrument contained 40 multiple choice questions (A-D) developed by the researcher on six topics within the concept of Geometry. GAT was used for pretest, posttest and post-posttest. The pretest was meant to give information on the present level of the students before treatment while the posttest and post-posttest were to give information on the achievement and retention levels of students after treatment.

Method of Data Analysis and Result

The Data Collected were tested using independent t-test at $P \leq 0.05$ significance level as follows:

Table 1: Summary of t-test Analysis of Posttest Scores of the Experimental and Control Group on Academic performance

Group	N	Mean	SD	Mean Difference	Df	t-value	p-value	Remark
Experimental	40	62.15	10.94	12.10	78	4.22	0.001	Significant
Control	40	50.05	14.45					

Significant at $P \leq 0.05$

The result from Table 1 shows that the mean academic performance scores for the experimental and control groups were found to be 62.15 and 50.05 with standard deviations of 10.94 and 14.45 respectively. The level of significance was found to be 0.001 showing that there is a significant difference in the mean academic performance of the experimental and control groups. the mean academic performance scores of students taught Geometry using Problem-Solving Instructional Strategy and those taught the same concept using lecture method in favor of the experimental group exposed to the Problem-Solving Strategy.

To test this hypothesis, the GAT post-posttest scores of both the experimental and control groups were analyzed using independent t-test statistic. Table 2 shows the results of the analysis.

Table 2: Summary of t-test Analysis of Post-Posttest Scores of the Experimental and Control Group on mean Retention

Group	N	Mean	SD	Mean Difference	Df	t-value	p-value	Remark
Experimental	40	61.40	10.71	17.65	78	8.38	0.001	Significant
Control	40	43.75	7.91					

Significant at $P \leq 0.05$

The result from Table 2 shows that the mean retention scores for the experimental and control groups were found to be 61.40 and 43.75 with standard deviations of 10.71 and 7.91 respectively. The level of significance was found to be 0.001 showing that there is significant difference in the mean retention scores of the experimental and control group. This means that there is a significant difference between the mean retention scores of students taught Geometry using Problem-Solving Instructional Strategy and those taught the same concept using lecture method in favor of the Problem-Solving group.

Conclusion

Based on the findings from the study, the following conclusions were drawn: Problem-Solving Instructional Strategy could effectively improve and enhance understanding of Geometry among Senior Secondary School students more than lecture method. And can also improve retention of Geometry concepts learnt better than the lecture method.

Recommendations

The level of achievement and retention depended on the approach of instructional delivery. The students that were exposed to Problem-Solving Instructional Strategy were better in academic performance than those exposed to conventional lecture method. The strategy therefore proved to be a viable option in promoting meaningful learning. Hence, it is recommended that:

1. Mathematics teachers should be encouraged to use the Problem-Solving Instructional Strategy in Teaching Geometry to Senior Secondary School students.
2. Professional bodies like the Mathematical Association of Nigeria (MAN) should organize Extensive training programs, seminars and workshops for Mathematics teachers in secondary schools across the nation on the effective use of Problem-Solving Instructional Strategy in the Classrooms.
3. Mathematics curriculum developers and teacher educators should incorporate Problem-Solving Instructional Strategy in the curriculum as well as in the training of Mathematics teachers.
4. The government should advise Mathematics textbook authors and the Nigerian Educational Research and Development Council (NERDC) to transform the existing Mathematics textbooks From the conventional style of presentation to a new style as to meet the criteria for Problem-Solving.

Reference

Abubakar, B. (2014). Effects of Problem-Solving Instructional Strategy on Academic Achievement and Retention in Geometry among Senior Secondary Students in Katsina Metropolis, Katsina State, Nigeria. *Unpublished M.Ed. Dissertation, Department of Science Education, Ahmadu Bello University, Zaria.*

Achor, E.E., Imoko, B.I. & Jimin, N. (2012). Improving Some Nigeria Secondary Students' Achievement in Geometry. *New York Science Journal*, **5** (1): 1-7.

Adeyemi, T. O. (2008). Predicting Students' Performance in Senior Secondary Certificate Examination in Ondo State, Nigeria. *Middle-East Journal of Science Research.* **3** (2): 73-81.

Galadima, I. (2001). The Effect of Heuristic Problem Solving Strategies on Senior Secondary School Students' Achievement in Algebra. *Unpublished Dissertation, Ahmadu Bello University, Zaria.*

Kerlinger, F.N. (1986). Research Design in Occupational Education. http://www.okstate.edu/ag/agedcm4h/academic/aged5980a.

Makama, R. (2008). Improving Mathematics Education for Sustainable Development. *Paper Presented at the 2nd National Conference of National Association of Female Teachers Held at Sa'adatu Rimi College of Education, Kumbotso, Kano on 11th–15th Aug, 2008.*

Mang, O. (2010). Difficulty in Further Mathematics as Perceived by Students in Katsina State. *Unpublished M.Ed Thesis Submitted to the Department of Curriculum and Teacher Education, Abia State University, Uturu.*

Maduabum, M.A. & Odili, G.A. (2002). Analysis of Students"Performance in General Mathematics at SSCE Level in Nigeria1991-2002. *Journal of Research in Curriculum and Teaching*, **1** (10): 64-68.

Tuckman, B.W. (1975). *Measuring Education Outcomes*. New York: Harcourt Brace Hovawick.

Udoh, C. (2011). Overcoming Candidates' Poor Performance in the West African Senior School Certificate. *A Presented Paper, Reported by Stella, E. www.LeadershipEditors.com/ins/indexPh. Retrieved on 4th May, 2011.*

Uzo, A.N. (2002). *Mathematics and Students: The Secret of a Solid Background in Mathematics: A Handbook for Parents Teachers and Students.* Abuja: Cradle-Crest Publishing.

Usman, M. A. & Musa L. (2015). Effect of Inquiry Teaching Method on Students' Achievement in Algebra in Bauchi Local Government Area of Bauchi State, Nigeria. A*bacus Journal of Mathematical Association of Nigeria.*

Vande-Walle, J.A. (2004). *Elementary and Middle School Mathematics: Teaching Development.* New York: Pearson Education Inc.