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Improving Secondary School Students' Achievement in Bearing through Polya's Problem Solving Strategy.

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Abstract

Quasi-experimental design was adopted in this study. Pretest-posttest, non- equivalent control group was used. Six intact classes, three of which were randomly assigned to experimental and the other three to control groups are used for the study. Sample of the study consisted of 284 SSII students from Enugu Education Zone. Two research questions and two hypotheses guided the study. Bearing Achievement Test (BAT) was used for data collection. BAT was constructed by the researcher and validated by three research experts. Mean and standard deviation were used to answer the research questions while the hypotheses were tested at .05 level of significance using Analysis of Covariance (ANCOVA). Experimental groups were taught using Polya's Problem Solving Strategy (PPSS) while control groups were taught the same topic using expository method. Major findings of the study revealed that students taught bearing with PPSS achieved higher than those taught with expository method. There was no significant difference between the mean achievement scores of male and female students in the study. It was recommended that Mathematics teachers should adopt PPSS for teaching Bearing and distances in senior secondary schools.

Introduction

Secondary education is the education children receive after primary education and before the tertiary stage of education. According to Federal Republic of Nigeria (FRN) (2013), the broad goals of secondary education shall be to prepare the individual for useful living within the society and higher education. In pursuance of these goals, mathematics has continued to be a core subject in secondary schools across the federation.

Maduabum and Odili (2006) remarked that mathematics as a science of quantity and space occupies a key position in Nigeria's educational system and reflects accurately the vital role the subject plays in contemporary society. For a nation like Nigeria that is aspiring for scientific and technological take-off, the need to pay due attention to students' academic achievement in mathematics cannot be over emphasized. Mathematics is a human invention borne out of human resolve to solve human problems (Kolawole and Oluwatayo, 2005).

In spite of the aims and importance accorded to mathematics in the educational system the Nigeria Secondary School students' poor achievements in

ordinary level mathematics examinations over a decade now casts doubt on the country's hope of higher attainment in science and technology (Kurumeh 2006; Ado and Inola, 2010). Maduabum and Odili (2006) conducted a study on student's achievement in general mathematics at the Senor School Certificate level in Nigeria over a twelve-year period (1991-2002). Their results showed that students achieved poorly in mathematics.

According to Kurumeh (2006), the West African Examinations Council (WAEC) result for mathematics from 2000 to 2004 show that students' Report from 2005 to 2014 shows that students' performances in mathematics is abysmally poor from year to year (WAEC, 2005, 2006, 2007, 2008, 2009, 2010). It was also revealed that the percentage passes at credit level within these years lie between 7.6% and 36% (Okafor, 2010). These WAEC Chief Examiners' Annual Report further alleged that one of the major causes of poor achievement of students in senior school certificate examination in mathematics is that students tend to avoid questions drawn from some topics which they find very difficult to understand and one of such topics is bearing.

Research evidence (Ameen, 2007 & 2013) also has shown that word problems involving bearing have been identified as a topic students perceived difficult. Several researches have further implicated teaching methods as one of the factors inhibiting students' achievement in mathematics. There exist in several methods and strategies for teaching mathematics in this present time. Such include; discovery, expository, laboratory, programmed instruction, target-task, delayed formalization, polya's problem solving strategy and the computer aided instruction in mathematics (CAIM) with its approaches of Drill and practice, tutorial and problem solving. Each of these has its own advantages and disadvantages in teaching mathematics (Obodo, 2004). This work is based on problem solving strategy.

Roberts (1995), stated that problem solving strategy is a process designed to teach students how to think, not what to think. Global Institute for Corporate Education (2013) defined it as the mental process you fellow when you have a goal but cannot immediately understands how to achieve it. It consists of a sequence of sections that fit together depending on type of problem to be solved. Mathematics problem solving in particular requires specialized skills which are practical and which involves a unique linkage between mathematics, communication and the environment.

Many models have been advanced for the teaching and learning of problem solving. Some of the models are those of George Polya (1957), Roberts, (1995), Global Institute for Corporate Education, (2013), Bransford and Stein (1993). Amongst these models, that of George Polya are clearly defined and sequenced in the sense that it incorporates the other mathematics problem solving models into four-phase strategy, which Include; understanding the problem, devising a plan, carrying out the plan and looking back (Polya, 1957). This work investigated effect of polya's problem solving strategy on students' achievement in Bearing.

Apart from variables like teaching method that can affect students' achievement in learning, evidences abound in literature that gender also has tremendous influence on students' achievement in mathematics. The issue of gender differences in students' achievement in mathematics has been a source of worry to mathematicians, mathematics educators and researchers. However, it is worthy to note that opinions and findings about the issue have been diverse. This gap of no definite position on the effect of innovative teaching strategies such as polya's problem solving on male and female secondary school student's achievement in Bearing necessitated this study.

Purpose of the Study

The main purpose of this study was to investigate the effect of Polya's Problem Solving strategy (PPSS) on secondary school students' achievement in bearing. Specifically, the study investigated the effect of PPSS on senior secondary School II (SSII) students

1. Achievement in bearing
2. Achievement in bearing with regards to their gender

Research questions

The following research questions guided the study;

1. What are the mean achievement scores of students taught using Polya's Problem Strategy(Experimental Group) and those taught using expository method (Control group) in both pre-test and post-test?
2. What are the mean achievement scores of male and female students in the Experimental and Control groups in both pre-test and post-test?

Research Hypotheses

The following research hypotheses were tested at .05 level of significance.

1. There is no significant difference between the mean achievement scores of students in the experimental and control groups in the post-test.
2. There is no significant difference between the mean achievement scores of male and female students in the experimental and control groups in the post-test.

Methodology

The research design adopted in the conduct of this investigation was quasi-experimental design, thus, a pretest-posttest, non-equivalent groups was used. Six intact classes randomly assigned to experimental and control groups were used. The area covered in this study was Enugu Educational Zone of Enugu State. The population for the study consisted of all senior secondary two (SSII) students in the area numbering four thousand seven hundred and sixty-seven (4767) as at the time of the study. The sample for this study is made up of 284 Public Senior Secondary Two (SS2) students consisting of 142 students in the experimental group and 142 students in the control group. In other to study the effect of gender, one boys' school, one girls' school and one co-educational secondary schools were sampled by balloting. In each of the three sampled schools, two streams of SS2 were sampled by balloting. In each school, one stream was assigned to experimental group while the other was assigned to the control group by balloting. Hence, the sample for the experimental group was 142students while the sample for the control group was142 students.

Instrument used for data collection was Bearing Achievement Test (BAT). This instrument was developed by the researcher. It is made up of twenty (20) multiple choice questions. The items were drawn using a table of specification to ensure adequate coverage of the content area covered in the study as well as maintain even spread across the different levels of the cognitive domain.

BAT was validated by three research experts, one of whom was a specialist in Measurement and Evaluation and the other two specialists in Mathematics Education. BAT was also trial–tested and the result obtained was used to calculate the reliability coefficient of 0.72 using Kuder-Richardson's formula 20 (KR-20).

Experimental procedures

A research assistant was trained for three days on the use of Polya's Problem Solving Strategy in teaching bearing. The lesson plans and procedures for presentation were discussed extensively with the research assistant. The research assistant was then required to trial teach an equivalent group of students using the lesson plan for the experimental group only. After the trial teaching, the researcher held discussions with the research assistant on the mode of final presentation. For the control group, the three research assistants (regular Mathematics classroom teachers in the three sampled schools) were trained separately on the use of lesson plans and administration of BAT for two days. Foremost, the BAT was administered to all the students for the study as pre-test. Thereafter, the treatment was administered for a period of six weeks. The experimental group in each school was taught bearing using PPSS while the control group in each school was taught the same topic using expository method. After six weeks of treatment, the BAT was re-arranged and administered to all the students as post-test. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at .05 level of significance.

Results

Research question one:

What are the mean achievement scores of students taught using Polya's Problem Strategy (Experimental Group) and those taught using expository method (Control group) in both pre-test and post-test?

The result is presented in table one below;

Table 1: Mean Achievement scores and standard deviations of experimental and control groups in both pretest and posttest.

Group	Pretest		Post-test		N
	Mean	SD	Mean	SD	
Experimental	9.42	3.81	24.61	5.66	142
Control	8.81	3.06	12.98	4.89	142

Table 1 shows that the experimental group taught with Polya's problem solving strategy had 9.42 and 24.61 in pre-test and post-test respectively. The control group taught with the expository method obtained 8.81 and 12.98 in pre-test and post-test respectively. Hence, the experimental group obtained a higher mean score than the control counterparts in post-test.

Research question two:
What are the mean achievement scores of male and female students' in Experimental and Control groups in both pretest and posttest?
The results for research question 4 are presented in table 2.

Table 2: Mean Achievement Scores and Standard Deviations in Experimental and Control Groups due to Gender.

Group	Pre-test				Post-test			
	MALE		FEMALE		MALE		FEMALE	
	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Experimental	10.21	4.00	8.63	3.48	25.73	6.02	23.49	5.11
Control	8.63	3.01	8.99	3.92	14.00	5.92	11.96	4.28

Table 2 shows the experimental male students had higher mean achievement score (10.21) than their control female counterparts (8.63) in the pre-test. The female control students had higher mean score (8.99) than their male counterparts (8.63). In the post-test, the experimental male student had higher mean score (25.73) than their female counterparts (23.49). The control male students in the post-test had higher mean score (14.00) than the female students (11.96).

Research Hypothesis One

1. There is no significant difference between the mean achievement scores of students in the experimental and control groups.

Table 3 presents the results for research hypothesis 1.

Table 3: One-way ANCOVA results on mean achievement scores of experimental and control groups.

Source of variation	Df	Sum of squares	Mean squares	F	Sig	Decision
Between groups	1	0.5256	0.5256	7.20	0.000	S
Within groups	282	20.5860	0.0730			
Total	**283**					

Where S = significant (p>0.05).

Table 3 shows that the F-calculated value of 7.20 was found significant by the SPSS statistical software at 0.000. This level of significance (0.00) is less than 0.05 level set for this study. Hence, there is a significant difference between the mean achievement scores of students in the experimental and control groups in favour of the experimental group.

Research hypothesis two

There is no significant difference between the mean achievement scores of male and female students in the experimental and control groups.

Table 4 shows the results for this research hypothesis.

Table 4: Two-way ANCOVA results on Mean Achievement Scores of Experimental and Control Groups due to sex.

Source of variation	Sum of squares	Df	Mean squares	F	Sig	Decision
Corrected model	27.745	3	9.248	18.313	0.000	
Intercept	2743.891	1	2743.891	54334.475	0.000	
Method	22.461	1	22.461	44.475	0.000	S
Gender	0.263	1	0.263	0.521	0.481	NS
Method *Gender	0.746	1	0.746	1.477	0.122	NS
Error	140.895	279	0.505			
Total		**283**				
Corrected total		**281**				

Table 4 shows the results for sex and method x sex (interaction). For sex, the F-calculated value (0.521) was found significant at 0.481 which is greater than the 0.05 level of significance set for the study. This means that there is no significant difference between male and female students. On interaction (method x sex), table 14 shows that the F-calculated value (1.477) was found significant at 0.122 which is greater than the 0.05 level set for this study. Hence, the null hypothesis is not

rejected i.e. there is no significant difference between the mean achievement scores of male and female students in the experimental and control groups.

Summary of findings

Here is the summary of the findings made in this study:

1. The students taught bearing with PPSS achieved higher than their counterpart in the expository class.
2. There is no significant difference between the mean achievement scores of male and female students taught bearing with PPSS.

Discussion

Results of data analysis shows that both groups of students had close mean and standard deviation scores in the pretest, apparently showing that they had chances of achieving equally. However, after treatment, the experimental group achieved far higher, with a lower standard deviation. The strategy may have helped students to understand the problem and crosscheck their solutions. These results implicated method of teaching as a major factor affecting students' achievement in mathematics. The finding of the study is in line with the findings of Alio (1997), and Onwuka, Imeka and Moseri (2010).

More so, this result further authenticates the findings of Umar, et al (2006) and that of Eze and Egbo (2007) whose reports revealed that students taught through students-centred method achieved higher than those taught with the traditional lecture method. Ukeje and Obioma (2002); Ezeamenyi (2004); Obodo (2004) and Azuka (2009) all made case for the adoption of instructional methods that promote students' involvement and activity in the teaching of secondary school mathematics so as to enhance students' achievement.

Recommendations

Based on the findings of this study, the following these recommendations are made;

1. Polya's Problem Solving Strategy (PPSS) should be used in teaching bearing in senior secondary schools.
2. Secondary school mathematics and science teachers should be trained through intensive seminars, workshops and in-service trainings on the use of PPSS for teaching and learning of mathematics.
3. Curriculum planners should include the Polya's problem solving strategy in secondary school mathematics curriculum.

Conclusion

Gender difference does not exist in the academic achievement of students when innovative strategies like Polya's problem solving strategy are employed in the teaching and learning of mathematics.

References

Ado, I.B. and Inola, M.W. (2010). Attitude of Male and Female Teachers towards Improvisation of Resources for Teaching of Mathematics in Basic. Educational System. *African Journal of Allied Education*. 4(1), 315-322.

Alio B.C (1997). Polya's Problem-Solving Strategy in Secondary School Students' Achievement and Interest in Mathematics. *An Unpublished ph.D Thesis*, University of Nigeria Nsukka.

Ameen, S. K. (2007). Effect of mathematical language instruction on senior Secondary school students' performance in bearing word problems in mathematics. *An unpublished M. (Ed) thesis*, university of Ilorin, Ilorin.

Ameen, S. K. (2013). Comparative effects of two problems solving models on Nigerian secondary school students' performance in mathematics word problems. *An unpublished Ph.D. thesis*, university of Ilorin, Ilorin.

Azuka, B. F. (2009). Active Learning in the Mathematics classroom.*Training manual for capacity building workshop for secondary and primary schools' Mathematical Science Teachers.* Abuja: National Mathematical Centre.

Bransford, J. & Stein B. (1993).*The ideal problem solving*. A guide for improving thinking, learning and creativity. New York W.H. Freeman Deb (2003) problem –solving

strategies. Retrieved on 7th march, 2007 http://math.about.com/cs/tetprep//rs.htm

Eze, A. E. &Egbo, J. J. (2007) Effect of concept mapping method of instruction on students' achievement and retention in Chemistry. *Nigerian Journal of Functional Education 5 (1)*. Nsukka: Ephrata Press Production.

Ezeamenyi, M. V. O. N. (2004). *Facing challenges of the third millennium through varieties in mathematics, science and computer Education.* Enugu: Royal ventures.

Federal Republic of Nigeria (2013).*National Policy on Education*. (3rd Edition), Abuja. NERDC

Global Institute for Corporate Education (2013).*The six steps Problem-solving Model.* Bangalore: B-School.

Kolawole, E.B. and Oluwatayo, J.A. (2005). Mathematics for Everyday living implications for Nigerian Secondary Schools. Abacus: *The Journal of the Mathematical Association of Nigeria*. 30(1), 51-55.

Kurumeh, M.S. (2006). *Mathematics club for Secondary School Students*: A key to set us free. Makurdi: Azaben Printers and publishers.

Maduabum, M.A. and Odili, G.A. (2006). Analysis of Students' Performance inMathematics from 1991-2002. *Journal of Research in Curriculum and Teaching* 1(1), 64-67.

Obodo, G.C. (2004). *Principles and Practice of Mathematics Education in Nigeria*. Division of General Studies, Enugu State University of Science and Technology.

Okafor, P.C. (2010). Effectiveness of Abacus and Dienes Block on Junior Secondary School Students' Achievement and Retention in Mathematics. An *unpublished M.Sc. Dissertation*, Enugu State University of Science and Technology, Enugu.

Onwuka, P.I., Imeka, S. and Moseri, P.O. (2010). Games and Simulation for Teaching selected concepts in Basic Mathematics. *Abacus: The Journal of Mathematical Association of Nigeria*35 (2).

Polya, G. (1957). *How to solve it*. Garden City, NY: Double day and Co. Inc.

Roberts, A. Wayne (1995). *Faces of Mathematics* (3rd edition). New York: HarperCollins College Publishers, p. 479.

Ukeje, B. O. and Obioma, G. (2002). *Mathematical Games.* Abuja: National Mathematical Centre.

Umar, A., Egunjobi, S., Olude, A. O., Zubiaru, S. and Mu'azu, G. (2006). *General Principles and methods in Education PDE 103.* Kaduna: National Teachers' Institute.