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EFFECTS OF PROBLEM SOLVING STRATEGY ON MATHEMATICS ACHIEVEMENT AMONG MALE AND FEMALE PUPILS WITH LOW COGNITIVE SKILLS IN NIGER STATE, NIGERIA.

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Abstract

The study examined the Effects of Problem Solving Strategy on Mathematics Achievement among Male and Female Pupils with Low Cognitive Skills in Niger State, Nigeria. One research question and one Hypothesis guided the study. Pretest – Posttest randomized group design (Fraenkel & Wallen, 2008) was adopted for the study. Six (6) Local Government Areas (LGAs) were randomly selected from the pool of twenty five (25) LGAs in Niger State through raffle draw method. The target population for the study was all the primary six pupils in Niger State while the sample size was two hundred and forty (240) primary six pupils. This was randomly selected from twelve (12) primary schools that were sampled for the study from the six (6) Local Government Areas used for the study. Six (6) primary schools (two from each Local Govt. Area) were randomly assigned to experimental group and the remaining six (6) to control group respectively. Experimental group was taught Mathematics concept using Problem Solving Strategy while the control group was taught the same concepts using conventional teaching method. Instrument used for the data collection was Mathematics Achievement Test (MAT) comprised of 20-item structured questions which was developed by the researcher according to an approved table of specification using three themes under 9-Year Basic Education Curriculum. The instrument was pilot tested using test retest method and r value of 0.86 was obtained. The study reveals that cognitive achievement scores of male pupils are higher than those female peers. It is therefore recommended that Mathematics teachers should adopt Problem Solving Strategy to teach at both primary and secondary levels of our educational system.

Key Words: Achievement, Cognitive Skills, Problem Solving and Strategy.

Introduction

A recurring theme among educators, especially science educators, and the society at large (Ezenwa, 2005), the concept of "Gender" has attracted the attention of many researchers. There is increasing research effort on empowerment or disempowerment of learners. Also in the Nigerian education system, classrooms are composed of boys and girls and learners of different academic ability level. Hence effect of problem solving strategy on boys and girls with different ability levels aimed at finding out which gender will benefit more than the other through problem solving strategy. The study was an attempt to determine whether gender were important variables in pupils' academic achievement.

Objective of the Study

To determine the Effect of Problem Solving Strategy on Mathematics Achievement Among Male and Female Low Cognitive Skills pupils.

Research Question

Is there any disparity in the cognitive Achievement of Male and Female pupils with Low Cognitive skills taught Mathematics with Problem Solving Strategy?

Research Hypotheses

H_0 : There is no significant difference between the mean Cognitive Achievement scores of Male and Female pupils with Low Cognitive Skills taught Mathematics with Problem Solving Strategy.

Methodology

Research Design

The research plan that was adopted for the study was a pretest - posttest randomized equivalent groups design (Fraenkel and Wallen, 2008). The design establishes cause-effect relationships for two variables

(Independent and dependent variables of the study). The experimental group and control category were given the pre-examination and post-examination. Experimental category was subjected to experimental manipulation utilizing problem solving strategy and control category was taught utilizing conventional teaching method. The experimental design is as shown in Table 1

Table 1 Research Design Layout

Groups	Pre-test	Treatment		Posttest
Experimental Group	O ₁	X ₁		O ₂
Control Group O ₁			X ₂	O ₂

Key
 O₁, O₁ = pre-test for the two groups
 O₁, O₂ = post-test for the two groups
 X₁ = treatment using problem solving strategy
 X₂ = control method (conventional method)

This research work was concerned with the under listed varying factors or variables: Input factor, control factor and output factor. The input or stimulus factor or variable in this research work is the Problem Solving Strategy.

The response factor or variable is the Achievement of posttest of the pupils exposed to the problem solving strategy teaching method. This was made of pupils' performance (scores) in the test, Problem Solving Mathematics Achievement Test (PSMAT).

Population

The target population for study was the entire primary six pupils (80,829) in three thousand and sixty six (3,066) primary schools in the 25 Local Government Areas in three senatorial zone of Niger State. The choice of primary six pupils is based on the preparation for entry into JSS1 and they have been exposed to the teaching of Mathematics from primary one to primary five.

Table 2 Distribution of Primary Six Pupils in the three Senatorial zones by Gender

Senatorial zone	M	F	Total
Niger South (NS)	13,626	8,840	22,466
Niger East (NE)	18,942	16,984	35,926
Niger North (NN)	13,938	8,499	22,437
Total	46,506	34,323	80,829

Source: Niger State Universal Basic Education (NSUBEB), 2014.

Sample and Sampling Techniques

Six (6) Local Government Areas (LGAs) were randomly selected from the pool of twenty five (25) LGAs in Niger State. This was done through raffle draw method and the sampled LGA were used for the study.

The sample for this study comprised two hundred and forty (240) primary six pupils out of one thousand two hundred and fifty (1,250) pupils. This was selected from twelve (12) primary schools from six (6) Local Government Areas selected for study. Two primary schools were chosen from each of the six Local Government Areas (LGAs). One school served as the treatment category while the second school acted as control category.

Twenty (20) pupils were randomly selected from each of the twelve (12) primary schools chosen for the

study. However, the study is focused on a special group of pupils who are of low cognitive skill and as a result of this; the group was identified from their third term primary five promotional examination results. Any pupil that scored below 50% in Mathematics is considered a pupil with low cognitive skill (NECO, 2013).

All the pupils in this category in primary six (6) were identified from their primary five third term promotional examination. It was from this group that twenty (20) pupils were selected through a raffle draw to form the experimental group. Similar exercise was carried out in schools that were used as control for the study.

Table 3 Sample Size for the Study

Zone	Total Number of Local Government Areas	Number of Local Government Areas selected	Number of schools selected
NS	8	2	4
NE	9	2	4
NN	8	2	4
Total	25	6	12

Research Instruments

The instruments used for this study are (1) Treatment instruments and (2) Test instruments. Treatment instruments are problem solving strategy and conventional teaching method used on experimental and control groups respectively. Test instruments is 20-items structured questions which were used as pretest and posttest on both experimental and control groups.

Test Instrument

The tool utilized for gathering research data for study was Mathematics Achievement Test (MAT). The MAT comprised of a 20-item structured questions which was developed by the researchers according to an approved table of specification using three themes under 9-Year Basic Education Curriculum which include Number and Numeration, Basic Operation and Algebraic Processes. The specification table is as revealed below:

Table 4 Table of Specification for the 20 Item Questions

Levels	Rememberin g	Understandin g	Applyin g	Analyzin g	Synthesi s	Creatio n	Tota l
Fraction	2	1	1	-	1	1	6
Multiplicatio n	1	1	1	1	-	-	4
Division	1	1	1	1	-	-	4
Word problem	1	1	1	1	1	1	6
Total	5	4	4	3	2	2	20

By authors

This data collection tool was utilized to solicit for data from the treatment and control categories as pre-test as well as posttest.

Validity of the Instrument (Test Questions)

The content appropriateness of Mathematics Achievement Test (MAT) was done by experts in the field of pedagogy, Mathematics teachers and test and measurement unit of Niger State ministry of education. They certified that the MAT has content validity only 20 validated items were utilized for the study.

Reliability of Tool Used

In order to ascertain the consistency of the Mathematics Achievement Test (MAT), a trial test was administered to 10 randomly selected primary six pupils in Chanchaga Primary School, Bosso which is not part of the sampled Local Government Areas for the real study. A test - retest method was adopted with a span gap of 14 days. The two tests were marked and the scores collated and analyzed using Pearson Product Moment Correlation (PPMC) and a reliability index of 0.86 was obtained which is rated acceptable according to a rule suggested by Frankel and Wallen (2008) that a reliability should be 0.70 or probably higher.

Method of Data Collection

Two instructional methods were used for the study. Problem Solving Strategy and Conventional teaching method. Problem solving strategy was used on experimental group, while conventional method was used for the control group. The researchers visited school and administered the teaching using a prepared Problem Solving Strategy Lesson Plan (PSSLP) in order to minimize teacher variable in the study. Before the treatment, a pretest was administered to the pupils to ascertain the initial status of pupils' prior knowledge in mathematical. The actual treatment commenced after the pretest and last for three (3) weeks. The experimental group was tagged as Problem-Solving Strategy Teaching (PSST) while the control group was tagged as Conventional Teaching Method (CTM). After completion of the experiment, the posttest was given to the two groups as posttest.

Method of Data Analysis

The research raw information obtained from the study was processed using statistical tools- ANOVA. For the purpose of accuracy of data processing, version 20.0 of Statistical Package for Social Sciences was utilized for processing statistical data.

Pretest Results of Experimental and Control Groups

To determine the equivalence of pupils with low cognitive skills in treatment as well as control categories, the pretest scores of the two categories were computed and analyzed using ANOVA as presented in Table 5

Table 5 ANOVA of the pretest results of experimental and control groups

	Addition of Squares	df	Average Square	F _{cal}	Sig.
Between Categories	15.000	1	15.000	.209	.648 ^{ns}
Within Groups	17051.250	238	71.644		
Total	17066.250	239			

ns: not statistically relevant at 0.05 alpha level.

Table 5 displayed the ANOVA of pre-examination scores of experimental and control categories. An examination of the table 8 shows that 0.648 P_{value} is greater than 0.05 alpha status (P>0.05). Therefore, there was no statistically relevant disparity between the two groups at pretest. This implies that the two groups were equivalent and comparable before treatment was administered. This also means that there were no effects of intervening variables.

Hypotheses

H₀: There is no significant difference between the mean achievement scores of male and female pupils with low cognitive skills taught Mathematics with problem solving strategy.

Table 6 ANOVA of Posttest Scores of Male and Female in the Experimental Group

	Sum of Squares	df	Mean Square	F _{cal}	Sig.
Between Groups	235.294	1	235.294	4.603	.034*
Within Groups	6031.373	118	51.113		
Total	6266.667	119			

*significant at 0.05 level

Table 6 shows that P_{value} (0.034) is less than 0.05 alpha level ($P < 0.05$). Therefore, the hypothesis was rejected. This means that there was significant difference between the mean achievement scores of male and female pupils with low cognitive skills taught Mathematics with problem solving strategy.

Research Question: Is there any difference in the achievement among male and female low cognitive skills pupils taught mathematics with problem solving strategy?

Table 7 Mean cognitive achievement Scores of Male and Female in Experimental Group

Group	N	Pretest	Posttest	Mean gain	Overall mean gain
Male	78	18.53	63.92	45.39	1.22
Female	42	15.83	60.00	44.17	

Table 7 revealed that the mean posttest score of male pupils is 63.92 and that of female pupils 60.00. It was observed that male and female pupils had improvement as observed in their posttest. However, the males had the higher mean gain scores of 45.39 while the female had mean gain scores of 44.17. The overall mean gain of 1.22 is in favour of male pupils in the experimental group. The figure revealed that problem solving strategy improved the achievement of male pupils with low cognitive skills in Mathematics more than female pupils.

Figure 1 is a schematic presentation of the mean gain scores of male and female pupils are computed and presented.

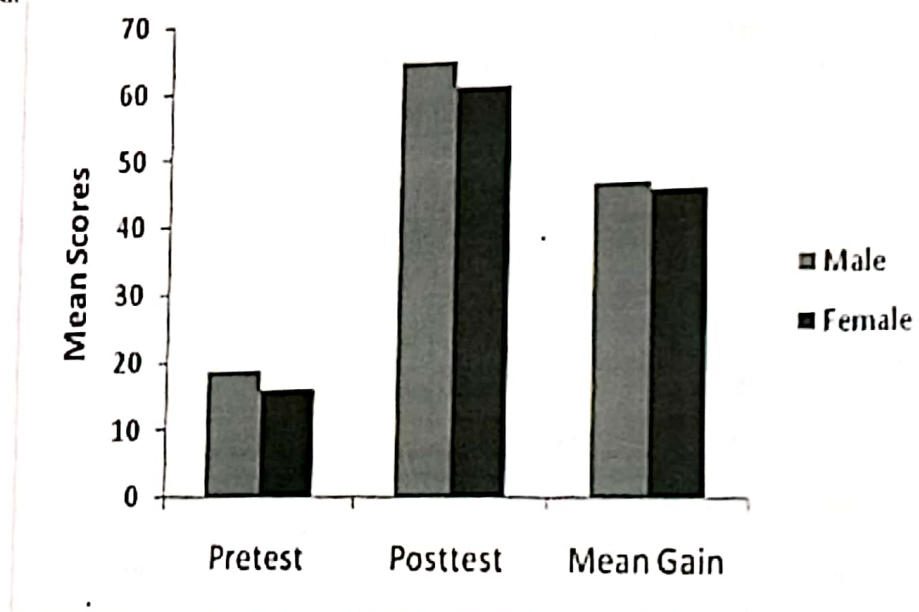


Fig. 1 Mean Gain by Gender

Results and Discussion

This segment shows the output of several statistical tools utilized in the study to provide feed back to the tentative intelligent guess formulated to examine the influence of problem solution strategy on Mathematics achievement among male and female pupils with low cognitive skills in Niger State. Mean and ANOVA were used for the analyses. The results were summarized at different stages of this study such as pretest and post-test upon treatment and these results were discussed in the context of the findings.

Discussion of Results

The research findings of this study are discussed in this section under different aspects dealing with influence of problem solving strategy on Mathematics achievement among male and female low cognitive skills pupils in Niger State. The research information gathered was utilized to test a negatively worded tentative intelligent guesses formulated for the purpose of this study. Results of the pretest

indicated that pupils in both categories were found to be equal in relative to their initial (previous) knowledge before treatment commenced as revealed in Table 5.

Gender influence on poor Mathematics achievement of pupils has been described as a global phenomenon and thus has attracted global interests (Ajai and Imoko, 2015). Saritas and Akdemir (2009) noted that of the numerous factors or constructs which have long been learned as determinants of Mathematics cognitive attainment, gender issues on Mathematics cognitive attainment are learned most frequently by research scholars. Paden and Dereshiwsky (2007) and Omenka (2010) noted gender disparity in Mathematics achievements and attributed this to the kind of instructional modality adopted by teachers.

Findings of the Study

The outcome of this research reveals that the mean cognitive attainment scores of male pupils are generally higher than those of their female peers. This implies unarguably that problem solving strategy has enhanced Mathematics achievement of both sexes, but with much more effect with male pupils. Problem Solving Strategy can promote pupils High Order Thinking (HOT) that can lead to innovation in Technology and dwindling in Economy of the nation and become problem solvers to the society and nation at large.

Conclusion

This work showed that problem solving strategy enhanced Mathematics achievement of low cognitive pupils in the three zones of Niger State and this has been attributed to the pupil-centered approach involved in the application of the method. The study also revealed that problem solving strategy has improved the achievement of male pupils much better than their female counterparts, and the former are more sensitive to the effect of the method adopted for this study than the latter group.

Recommendation

Mathematics teachers should adopt problem solving strategy to teach pupils and students particularly in our primary schools in Niger State and beyond as it is pupils' friendly, learner centered and effective. Hence, it can lead to discovery.

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