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Review

Enhancing Senior Secondary School Students' Achievement in Geometry through the Utilization of Rusbult Problem Solving Model in Keffi Metropolis, Nasarawa State, Nigeria

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Abstract

The study explored the effects of Rusbult problem solving model on students' achievement in Geometry. To guide the study, two research questions and two hypotheses were generated. The design for the study was quasi-experimental design. The instrument for the study was the Geometry Achievement Test (GAT), which had reliability coefficient of 0.91. Multi-stage sampling technique was used to select a sample of 84, made up of 45 males and 39 females, from Keffi metropolis. The responses of the subjects to the instrument were scored and analyzed using mean, standard deviation and the Analysis of Covariance. The results of the data analysis indicated that there was a significant difference in the mean achievement scores of students in the experimental group and control group in favour of the experimental group who were taught geometry using Rusbult Problem Solving Model (RPSM). The result however showed that there was no significant difference in the mean achievement scores in geometry between male and female students exposed to RPSM. The study concluded that achievement of students can be improved upon in geometry by teaching them using RPSM. It was, among others recommended that students should be taught geometry using RPSM in order to improve their achievement.

Keywords: Enhancing, Senior secondary school students, geometry achievement and Rusbult problem solving model (RPSM).

INTRODUCTION

Mathematics is one subject that is globally recognized as important because of its relevance to science and technology. It has been described as the backbone of all scientific investigations and all activities of human development (Kurumeh, 2006). Mathematics has continued to play a significant role in the development of both individuals and nations. Therefore, for any nation to survive and develop, it has to improve on the teaching and learning of mathematics; a subject that has become the bedrock of any technological development. Stressing the importance of mathematics to national development, Iji (2007) opined that any country that aspires for national growth in science and technology must not neglect mathematics.

Mathematics has an important role to play in a modern society as it has become an indispensable tool in many disciplines that are important to modern life. Badmus (2002), emphasizing the importance of mathematics, stated that mathematics has become an important social factor and that it is no longer tenable to think that mathematics is still an exotic good for only an exclusive group of people. The significance of mathematics is further strongly expressed through the Federal Government's policy of making mathematics a

compulsory subject at both primary and secondary school levels (Eniayeju, 2005).

Expressing the everyday life use of mathematics, George (2007) stated that mathematics is used either directly or indirectly in providing solutions to daily basic human problems. For example, in building, quantity of materials required can be calculated; a house wife can do her calculations on what to buy at the store, and other applications by other professionals like engineers, doctors, pharmacists among others. Actually, mathematics is applied virtually in all aspects of human endeavors.

However, despite the importance and relevance of mathematics to the individual and the nation in general, the students' performance in mathematics both at internal and external examinations has continued to deteriorate year after year (Galadima&Okogbenin, 2012). The annual reports of the West African Examination Council show a discouraging picture of students' achievement in mathematics at the Senior Secondary School level. For instance, students' performance in mathematics at the SSCE for the past six years has been on the decline. The percentages pass in mathematics for 2008, 2009, 2010, 2011, 2012 and 2013 are respectively 56.95, 45.49, 42.0, 39.57, 38.81 and 36.57. In the same vein, Agwagah (2000) had posited that the mass failure and consistent poor performance of students in mathematics shown over a decade cast doubts on the country's high attainment in science and technology. Salmon (2002) and Bala and Musa (2006) have all lamented the poor performance of students in mathematics at the senior secondary certificate examinations, positing that some even score as low as zero in such examinations. In addition to this, is the fact that some experienced mathematics lecturers in institutions of higher learning have expressed frustrating surprises at the way some of their students could not defend their good grades in mathematics (Obarakpo, 2009).

Geometry as a basic and important branch of mathematics is the study of size, shape and position of 2-dimentional shapes and 3-dimentional figures. There are many interesting and sometimes surprising results in geometry that can stimulate students. Presenting it in a way that stimulates curiosity encourages exploration that can support learners' intuition; thus enhancing communication, students' learning and interest in mathematics. This would further encourage students to discuss problems in geometry, articulate their ideas and develop clearly structured arguments, skills and recognition of the importance of proofs in mathematics (Tsoho, 2011). As important as this aspect of mathematics is however, students' achievement in this area has not been encouraging. For instance, the report of the Chief Examiners of the West African Examination Council (WAEC) for 2005 had shown that many students avoided or skipped answering certain questions especially those involving geometry in the SSCE. Also, Kurumeh (2007) opined that generally, students fear and hate mathematics which results to lack of interest and poor achievement in mathematics particularly geometry and mensuration.

Studies on the factors responsible for this poor achievement have identified poor teaching methods and non-usage of instructional materials among others (Badmus, 2002; Harbor-Peters, 2002 and Iji, 2005). Most teachers adopt the conventional approach to teaching. The conventional approach is a traditional approach to teaching, whereby the teacher disseminates the information verbally to the students. Sometimes, the teacher writes on the chalkboard while the students listen and take notes and ask questions for clarifications. In the conventional approach, the teacher is in charge of the entire environment and serves as the decision maker. Students are regarded as having 'vacuums' to be filled by the teacher; who is believed to make learning possible. Learning is quite competitive, area of coverage is considered important and knowledge is mastered by students through drill and practice. The curriculum is regarded as absolute and teachers hardly tamper with it even when it is obvious that students do not understand some concepts. Rather than adapting the curriculum to meet the needs of the students, those who have difficulties are viewed as slow learners. In this approach, according to Ogbonna (2003), curricular activities rely mainly on textbooks and workbooks. Students are viewed as just waiting for information from the teacher.

In an attempt to address the shortcomings of the conventional approach and its attendant poor performance of students in mathematics, efforts have been made in contributing towards improving on students' achievement in mathematics especially at the secondary school level. Adepoju (2003) identified the teaching and learning of problem-solving skills as lacking in our mathematics classrooms. He posited that teaching and learning problem-solving skills in mathematics can improve students' achievement in mathematics, and thus recommended that these be taught in our mathematics classrooms.

Problem-solving is a cognitive activity. It involves a process of providing a solution to a mathematical problem. Some literature described problem-solving in various ways. Mayer (2003) defined problem-solving as a process that involved a number of strategies such as a solution rubric, a logical mathematical reasoning, a trial-and-error approach and an outright guess to derive answers on mathematical solving tests. Montague (2006) defined mathematical problem solving as a process involving two stages of problem representation and problem execution. Both of them regarded representing the problem successfully as the basis for understanding the problem and making a plan to solve the problem. A mathematical problem solver not only requires cognitive abilities to understand and represent a problem solution, to create algorithms to the problem, to process different

types of information, and to execute the computation, but also has to be able to identify and manage a set of appropriate strategies to solve the problem.

Thus, a number of problem-solving models have been developed by some researchers to enhance the problem-solving capabilities of students. One of them is Rusbult (1989), who developed a four-step problem-solving model known as Rusbult Problem Solving Model (RPSM). The steps are: Orientation with the problem, Planning to solve the problem, Acting in solving the problem and Checking through.

Statement of the Problem

The major concern of this study was to determine the extent to which teaching geometry using the Rusbult problem solving model enhances achievement of senior secondary school students.

Purpose of the Study

The purpose of this study was to determine the effects of the Rusbult Problem Solving Model (RPSM) on secondary school students' achievement in geometry. Specifically, the objectives of this study were to:

1. Determine which group of SSI students improves on their achievement in geometry when taught using any of RPSM and Conventional Approach.
2. Determine which gender improved more in their achievement in geometry when taught using RPSM.

Research Questions

The following research questions guided the:

1. What are the mean achievement scores of SSI students taught geometry using Rusbult problem solving model and the Conventional approach?
2. What are the mean achievement scores of male and female SSI students taught geometry using the RPSM

Statement of the Hypotheses

The following null hypotheses (H_o) guided the study and were tested at 0.05 level of significance.

1. Ho_1: There is no significant difference in the mean achievement scores of SSI students taught geometry using Rusbult problem solving model and Conventional approach.
2. Ho_2: There is no significant difference in the mean achievement scores of male and female SSI students taught geometry using the RPSM.

Design of the Study

The quasi-experimental pre-test post-test, non-equivalent control group design was adopted for the study. This design was adopted because it was not possible to have a complete randomization of the subjects. Intact classes were randomly assigned to the experimental and control groups by balloting. Both the experimental and control groups were given the same pre-test before the experiment and post-test after the experiment. The experimental group was taught geometry topics using the Rusbult problem solving model, while the control group was taught the same topics using the Conventional approach.

Population and Sample

The population for the study comprises all 5,227 SSI students in the 73 Secondary schools in Keffi Education zone of Nasarawa State (2014/2015 academic session). Two schools were randomly drawn by balloting from the zone, from which two intact classes were also randomly drawn. Treatment and control groups were randomly assigned to the different intact classes by balloting. The treatment group was exposed to teaching geometry using the Rusbult problem solving model while the control group was exposed to conventional method of teaching geometry.

Instrumentation

The instrument for the study was the Geometry Achievement Test, which consists of 35 multiple-choice objective questions with four options (a-d).It was developed by the researcher drawn from the topics on geometry in the SSI scheme of work, which were taught during the study. The contents are: Angles of a triangle, Angles of a polygon, congruent triangles, Parallelograms and Isosceles and equilateral triangles. The GAT was used for both pre-testing and post-testing of students' cognitive achievement.

Experimental Procedure

The researcher used regular school mathematics teachers as Research Assistants for the study. A training programme was organized for them, while the necessary instructional tools were made available for the teaching. Before the commencement of the lessons, GAT was administered as pre-test to both the treatment and the control groups by the teachers. The treatment group was taught geometry topics using the Rusbult problem solving model with the lesson procedure prepared by the researcher adhered to strictly. The control group was

Table 1. Means, Standard Deviations (SD) and Mean Gains of Students in GAT

Teaching Method	Type of Test	N	Mean	SD	Mean Gain
RPSM	Pre-test	39	26.72	6.17	8.31
	Post-test	39	35.03	9.54	
	Pre-test	45	23.85	6.52	3.63
	Post-test	45	27.48	9.61	
Total		84			

Table 2. ANCOVA Result of Mean Achievement Scores of students taught geometry using RPSM and Conventional method

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.	Decision
Correct Model	10852.62	3	3617.54	346.83	0.00	
Intercept	208.52	1	208.52	19.99	0.00	
Pre GAT	9449.74	1	9449.74	905.98	0.00	
Teaching Method	1582.01	2	791.01	75.84	0.00	S
Error	1168.21	82	10.43			
Total	118592.00	84				
Corrected Total	12020.83	83				

Computed at alpha (α) = 0.05

taught the same topics using the conventional method. The researcher supervised the teachers during the teaching process, to ensure compliance with the prepared lesson procedure.

Data Collection Procedure

At the end of the four weeks of twelve periods, the teachers administered the post-test to the subjects. The scripts collected from the pre-test and post-test for both groups were marked and the scores recorded in percentages for further analysis.

Data Analysis

Mean and standard deviation were used to answer the research questions while the hypotheses were analyzed using Analysis of Covariance (ANCOVA) at $p < 0.05$

RESULTS

Results of the study are presented according to research questions raised and their corresponding hypotheses.

Research Question 1

What are the mean achievement scores of students taught geometry using Rusbult problem solving model and the Conventional approach?

From Table 1, it was observed that the students taught Geometry using the RPSM had mean scores of 26.72 and 35.03 in pre-test and post-test respectively, with standard deviations of 6.17 and 9.54 in that same order. For the students in the control group, it was observed that they had mean scores of 23.85 and 27.48 in the pre-test and post-test respectively with standard deviations of 6.52 and 9.61 respectively. It was further observed that the mean gain scores for the students taught using RPSM and the Conventional approach were respectively 8.31 and 3.63.

Research Hypothesis 1

There is no significant difference in the mean achievement scores of students taught geometry using Rusbult problem solving model and the Conventional approach.
The results in Table 2 indicate that the probability level of 0.05 is greater than 0.00 ($p < 0.05$), thus, the hypothesis of no significant difference is rejected.

Research Question 2

What are the mean achievement scores of male and female students taught geometry using the RPSM?

From Table 3, it was observed that the male students taught Geometry using the RPSM had mean achievement scores of 26.71 and 35.27 in pre-test and post-test respectively and standard deviations of 9.21 and 9.43 in that order. Female students taught using the RPSM had mean achievement scores of 26.65 and 34.71

Table 3. Means and Standard Deviation of Male and Female students taught geometry using RPSM in GAT

Model Gain	Gender	Type of Test	N	Mean	SD	Mean
RPSM	Male	Pre-Test	22	26.71	9.21	8.56
		Post-Test	22	35.27	9.43	
	Female	Pre-Test	17	26.65	8.74	8.06
		Pre-Test	17	34.71	8.82	
Total			39			

Table 4. ANCOVA Results on Mean Achievement of Male and Female Students Taught Geometry using RPSM

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected model	1785.93	2	892.97	19.80	0.00	S
Intercept	28.54	1	28.54	0.63	0.43	
Pre GAT	1470.08	1	1470.08	32.59	0.00	S
Method_Gender	11.12	2	11.12	0.25	0.62	NS
Error	1308.00	38	45.11			
Total	30472.00	39				
Corrected Total	3094.00	38				

Computed at alpha (α) = 0.05

in pre-test and post-test respectively, with standard deviations of 8.74 and 8.82 in that same order. It was further observed that the mean gain scores for the male and female students stood at 8.56 and 8.06 respectively

Research Hypothesis 4

There is no significant difference in the mean achievement scores of male and female students taught Geometry using the BSPSM and RPSM.

The result in Table 4 shows that gender is not a significant factor on the achievement of students taught Geometry using BSPSM and RPSM. The significant level in the table is 0.62, which is greater than the probability level of 0.05. Hence, the null hypothesis was not rejected.

DISCUSSIONS

Results showed that the mean gain on achievement scores of the students in the experimental group was higher than that of the control group. It was further revealed that method was a significant factor on students' achievement in Geometry. Thus students who were taught geometry using Rusbult problem solving model achieved better than those taught using the Conventional method. This finding is in line with other previous findings of researchers like (Ogwuche, 2002; Agwagah, 2003; Ogbonna, 2003; Ozofor, 2003; Obodo, 2004; Alio, 2007) where the use of new strategies of teaching mathematics as experimental treatment proved better than the use of conventional strategy.

The results further showed that both male and female students in the experimental group achieved higher than those in the control group. The mean achievement gain for the control group was 3.63; whereas for the students taught with the RPSM, the mean achievement gain for male and female were 8.56 and 8.06 respectively.

The ANCOVA results showed that there was no significant difference in the mean achievement score of male and female students taught geometry using the RPSM. This result is in agreement with that of Fadaka (2004), which revealed that there was no significant difference between male and female achievement in mathematics.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Secondary school mathematics teachers should be encouraged to use this model in teaching their students how to solve mathematical problems relating to geometry. They should observe their students in class situations as they solve problems and make sure that the students adopt the model in problem solving.
2. Mathematics educators, Federal and State Ministries of Education and secondary schools management boards should endevour to organize workshops to acquaint mathematics teachers with how to use the Rusbult problem solving model in teaching mathematics.
3. Mathematics textbook authors and publishers should be encouraged to incorporate the steps of this model in their solved examples in order to offer mathematics teachers and students the opportunity of using the approach even unguided.
4. Teacher educators should include in the training of their student teachers how to use the model to solve mathematical problems.

CONCLUSION

From the results of this study, the following conclusions were made:

1. The RPSM is more efficacious than the conventional approach in teaching Geometry. Students taught Geometry using the model achieved better than those taught using the conventional approach.
2. The mean achievement scores of both male and female students in Geometry got better using the RPSM in the experimental group. The model is independent of gender.

REFERENCES

Adepoju JA (2003).The use of mathematics in solving man's problems. *ABACUS: The J. Math. Assoc. Nig. (MAN),*28(1), 67-77.

Agwagah UNV (2000). Teaching number bases in Junior Secondary Schools. *ABACUS: The J. Math. Assoc. Nig. (MAN),* 19(1),81-87.

Agwagah UNV (2003). A postgraduate research in mathematics education in the University of Nigeria, Nsukka.*J. Nig. Edu. Assoc.* 15 (1), 148-159

Alio AP (2007).Selecting instructional strategies. *J. Higher Edu.* 57 (3), 260-264.

Badmus GA (2002). Changes in contents and teaching of school mathematicsin Nigeria.*A paper presented at the National Mathematical Education summit.* Abuja, September, 15th-17th.

Bala A, Musa B (2006). Effect of the Use of number base Game onSenior Secondary School Achievement in Number Base. *ABACUS: J. Math. Assoc. Nig. 31* (1), 103-114

Eniayeju AA (2005). Training and retention of mathematics teachers in Nigeria.In Ale, S. O. &Adetula, L. O. (Eds.), *Reflective and IntellectualPosition Papers on Mathematics Education issues.*Abuja: Marvelous Ventures Ltd.

Fadaka RO (2004). Girls and Mathematics Education in Nigeria: Problems and prospects. *A paper presented at the conference of Mathematics Education for women in Africa,* University of Benin, Benin City.

Galadima I, Okogbeni AA (2012). The effect of Mathematical games on academic performance and attitude of senior secondary students towards mathematics in selected schools in Sokoto State, *ABACUS: J. Math. Assoc. Nig.,* 37(1),30-37.

George HH (2007). Assessment and grading in high school mathematics classrooms. *J. Math. Assoc. Nig.* 33(2), 412-418.

Harbor-Peters VFA (2002). Teaching strategies: Training and re-trainingMathematics teachers. *ABACUS: J. Math. Assoc. Nig.* 27(1), 23-29.

Iji CO (2005). Effects of Logo and basic programmes on students' achievement in Junior Secondary School geometry.*ABACUS: J. Math. Assoc. Nig.* 30(1), 67-77.

Iji CO (2007). Challenges of primary mathematics for Universal Basic Education (UBE), *ABACUS: J. Math. Assoc. Nig.* 32(1), 14-23.

Kurumeh MS (2006). Effect of ethnomathematics approach on students' achievement in geometry and mensuration, *ABACUS: J. Math. Assoc. Nig.* 31(1), 35-44

Kurumeh MS (2007). Effect of ethnomathematics approach on students' interest in geometry and mensuration, *ABACUS: J. Math. Assoc. Nig.* 32(1), 103-114

Mayer RE (2003). Mathematical problem solving.In J. M. Royer (Ed) *Mathematical cognition.*Greenwich, CT: Infoage Publishing.

Montague M (2006), Mathematical problem solving for middle school students with disabilities, *Research report for the Access centre: improving outcomesfor all students k-8,* Retrieved October 14, 2013 from http://www.k8accesscentre.org/default.asp.

Obarakpo JS (2009). Effect of Active Learning on students' achievement in Mensuration: Implication for secondary school mathematics and the Millennium Development Goals. *The Voice of Teachers*, 1(2), 73-77.

Obodo GC (2004). *Principles and practice of Mathematics Education in Nigeria.*Enugu: Fleotone Press.

Ogbonna EE (2003). Effect of constructivist instructional approach onSenior secondary school students' achievement and interest in mathematics. *An unpublished PhD thesis.University of Calabar, Calabar.*

Ogwuche J (2002). Age and sex as correlates of logical reasoning in Mathematical ratio and proportion tasks. *M.Ed thesis,* University of Nigeria, Nsukka.

Ozofor MO (2003). Effects of target task approach in Senior Secondary III Students' achievement on conditional probability. *An unpublished M.Ed*Thesis, University of Nigeria, Nsukka.

Rusbult C (1989). *Mathematical problem solving.*Princeton, NJ: University Press.

Salman AH (2002). Looking towards the 21st century: Challenges of education, theory and practice, *Education Research*, 28(7), 4-14.

Tsoho LTW (2011). Effects of problem solving and student centered teaching Strategies on students' geometry performance and retention in junior secondary schools in Kano State. *An unpublished M. Ed thesis,* Ahmadu Bello University, Zaria.