EFFECT OF RUSBULT'S PROBLEM SOLVING STRATEGY ON STUDENTS' INTEREST IN GEOMETRY IN ENUGU STATE

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Abstract

The main purpose of this study was to investigate the effect of Rusbult's problem solving strategy on secondary school students' interest in geometry in Enugu State. Two research questions and three hypotheses guided the study. Design adopted for the study was quasi-experimental research design. Area of the study was Enugu Education zone of Enugu state. The population was made up of all the 5,195 Senior Secondary School 1 (SSI) students made up of 1,806 males and 3,389 female students as at the time of the study. Sample for this study was 410 students 265 in experimental groups and 145 students in the control groups. The experimental group consisted of 130 students in experimental group A and 135 students in experimental group B. The sample was also made up of 195 male students and 215 female students. Geometry Interest inventory (GII) was used for data collection. The instrument was validated by three research experts. The overall reliability coefficient value for the instrument was .72 obtained through Cronbach's Alpha Method. Descriptive statistics of mean and standard deviation were used to answer the research questions while Multivariate Analysis of Covariance, (MANCOVA) was used to test the hypotheses at 0.05 significant level. Based on the conclusions made in this study, it was revealed that those taught geometry using Rusbult's problem solving strategy significantly showed higher interest than those taught geometry using conventional method. Also, male and female students in the experimental and control groups showed equal interest in geometry test although the observed differences was based on their groups. Consequently, it was recommended among other things that mathematics teachers who are already in the teaching field should be trained in the current innovative teaching strategy such as Rusbult's Problem Solving Strategy (RUPSS) through workshops, seminars, conferences and in-service programmes by relevant bodies such as Mathematics Association of Nigeria (MAN), National Teachers Institute (NTI), Science Teachers Association of Nigeria (STAN), National mathematics centre Abuja and, Curriculum organization of Nigeria(CON) to educate and sensitize the teachers on the use of RUPSS in mathematics.

Introduction

Problem solving is an important issue in mathematics teaching and learning process. It is a cognitive activity that involves providing a solution to a mathematical problem. Some

literatures described problem solving in various ways. Kousar (2010), defined problem solving as the process used to solve a problem that does not have an obvious solution. Kousar stated that problem solving is the problem work or pattern within which creative thinking and learning takes place. Skinner further stated that problem solving is a process of overcoming difficulties that appear to interfere with the attainment of a goal. Problem solving is a means by which an individual uses previously acquired knowledge, skills and understanding to satisfy the demands of an unfamiliar situation (Eneze 2016). This is in line with Bruder (2016), when stated that prior knowledge is a key element in problem solving process. This shows that prior knowledge influences the choice of strategy to be employed and problem solvers understanding of the problem.

Problem solving as defined by Olaniyan, and Nwankwo (2015) is a multiple step, process where the problem solver must find relationship between past experience and the problem at hand and then act upon a solution. Olaniyan and Nwankwo opined that problem solving is a process which begins with the initial contact with problem and ends when answer is received in the light of the given information. While Akinwuni and Falemu (2017), stated that problem solving is the process of investigation where the solution is not obvious to the investigator at the initial stage. Akinwuni and Falemu further stated that problem solving entails training the students on how to solve problems by proceeding in a logical step by step manner from a problem state to its solution. This suggests that problem solving involves critical and creative thinking which is an important dimension in developing problem solving skills. It is a systematic approach that checkmates learning competencies.

Problem solving according to George and Enefu (2019) is a system or set of plans which guide a problem solver on the right track to handling and solving a problem. Problem solving is a pathway of getting to a solution of problem which involves identification of the type of problem to be solved, the necessary pre-requisites, the strategies, the heuristics or hints and

element used in applying the strategies. Samson (2020) stated that problem solving method involves the identification and selection of problems arising from individual experiences of the students. Nwoke (2015), noted that problem solving techniques comprises the identification and choosing of mathematical problems which grow out of the experiences of individual students. These problems are placed before the students and they are guided to the solution. Nekany (2013), posited that problem solving in any academic area, involves being presented with a situation that requires a solution. Nekany further stated that being a problem solver requires an ability to come up with means to resolve the situation fully. The main goal of any problem solving approach is to improve students' performance at solving problems correctly. Learning to solve problem is the principal reason for studying mathematics. No wonder Nwoke (2015), opined that mathematics is synonymous with problem solving (doing word problems, creating patterns, interpreting figures, developing geometric construction, pulling theories and so on).

In the problem-based learning strategy, the students turn from passive listeners of information receivers to active free self-learner and problem solver (Fabiyi, 2017). Fabiyi further stated that problem solving enables the students to learn new knowledge by facing the problems to be solved instead of feeling bored. Fabiyi further asserted that problem solving strategies encourage students to arrange and clarify facts or data as well as allow students to learn from their success and failure. These indicates that problem solving strategies allow students to participate actively in their learning. In recent years however, evidence abound showing that problem solving strategies tend to give students opportunities of understanding concepts especially in subject like mathematics (Kousar, 2010). Kousar opined that presentation of mathematical concepts to secondary level pupils through problem solving sequence causes the learner to integrate the content conceptually in such a manner that the students can retain it more readily.

This suggests that when students are involved in learning and participated actively, they tend to understand better and repeat the success recorded whenever they are confronted with similar challenges. Galileo (1564-1642), stated that, you cannot teach a man anything, you can only help him to identify it within himself. Therefore, problem solving is the ability to identify a problem, solve the problem by applying appropriate skills systematically. Problem solving is a process of an ongoing activity in which we take what we know to discover what we don't know (Tudunkanya and Jamilu 2019). Tudunkanya and Jamilu, further said that problem solving involves overcoming obstacles by generating hypotheses, analyzing those predictions and arriving at satisfactory solutions.

One of the notable research experts that worked on problem solving strategy was Rusbult. The description of the 4-step plan of the Rusbult's (1989) problem solving strategy is as follows: (1) Orientation- translate the problem's words, pictures and free information into a clear idea of now (the situation that is defined by the problem statement) and Goal (what the problem is asking you to do). (2) Planning – figure out how to get from where you are NOW to the GOAL (3) Action- start doing your plan and continue until you have reached the goal (4) Check – Ask yourself "Have I answered the questions that were asked?, 'Have I reached the Goal?'.However this study investigates the differential effects of Reda's and Rusbult's problem solving strategies on an important but problematic topic like geometry. The choice of these strategies is that they are both cyclic adaptations of polya's 1957 strategy but differ at the level of posing related problems and checking. Rusbult stated that to check, one needs to ask himself, "Have I answered the questions that were asked? Have I reached the Goal? If yes, then one should move to the next higher learning experience but if no, you need to go through all the steps of the solved problem(s) and correct or complete the solution, (Samson, 2020).

The issue of gender differences in students' interest in mathematics has been a global concern. It has become a great concern to educationist and researchers. Udona (2015), gender

imbalance in favour of male in education enrolment has its beginning from traditional education where boys were looked up to as potential leaders and head of families. This showed that, male students were given preferential treatment than their female students in the past generations. According to Nwaodo and Ogbonna (2019), lack of interest by the of students in mathematics is worsened by the gender differentials associated with it as male students are noted to show more interest in mathematics than their female counterpart. In support of this assertion, Nnakwo (2019) suggested that lack of interest in mathematics is among the real problems that girls in the developing world face. Akinwun and Falemu (2017) studied gender and location as factors on students' interest in mathematics and the result revealed that there is disparity in the cognitive interest of male and female with males. Moreover, study carried out by Nnamani and Oyibe (2016) showed that female do better at all level than males in interest. Fabiyi (2017) also carried out study on geometry concepts in mathematics perceived difficult to learn and the result revealed that gender had a great influence on the learning of concept in geometry in favour of female students.

However, Ajai and Imoko (2015), revealed that there was no significant difference in the interest of male and female students in geometry. Udona (2015) discovered that no significant difference existed between male and female students in geometry although female students had slightly higher mean gain than the male. Eneze (2016), reported that there was no significant difference between male and female mean interest scores of students in mathematics using collaboration method. Nnakwo (2019), also reported that there was no significant difference between male and female students exposed to x-flats instruction on interest. These inconsistency results indicated that, the issue of gender factor on cognitive geometry in mathematics seems inconclusive. Nekany (2013), Olaniyan and Nwankwo (2015) and Osuafor and Orji (2017), have separately claimed that the performance of students in geometry is lower than in other aspect of mathematics. Scholars have attributed this difficulty in learning

geometry to inappropriate use of instructional strategy. Could it be that inconsistency existing between male and female students' interest in mathematics be adequately addressed by Rusbult's problem solving strategy.

Purpose of the Study

The main purpose of this study was to investigate the effect of Rusbult's problem solving strategy on secondary school students' interest in geometry in Enugu State. The study specifically aimed at determining:

1. the mean interest score with standard deviation of students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group)
2. the mean interest scores with standard deviation of male and female students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group)

Research Questions

The following research questions were formulated to guide the study.

1. What are the mean interest score with standard deviation of students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group)?
2. What are the mean interest scores with standard deviation of male and female students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group)?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the mean interest scores of students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group).
2. There is no significant difference between the mean interest scores of male and female students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group).
3. There is no significant interaction effect between method and gender on students' interest in geometry.

Methodology

The main purpose of this study was to investigate the effect of Rusbult's problem solving strategy on secondary school students' interest in geometry in Enugu State. Two research questions and three hypotheses guided the study. Design adopted for the study was quasi-experimental research design. This design is often used in classroom experiment when experimental and control groups are naturally assembled groups as intact class which may be similar (Nworgu 2006). The design according to Anibueze (2021), is a set of activities that make possible the observation of the effects of a variable (independent) on another variable (the dependent variable) in a controlled situation. This design is often adopted when it is not possible to have complete randomization of the subjects (Nnakwo 2019). The specific design is pre-test, post test non-equivalent control group design. Thus, intact classes were used as experimental and control groups since it is not advisable to disrupt existing classes in a school for four (4) weeks. Area of the study was Enugu Education zone of Enugu state. Enugu Education zone is made of three (3) local government area; Enugu north, Enugu East and Isi-uzo local government Areas. Enugu education zone is made up of thirty-one public secondary

schools. The choice of Enugu Education zone was because Enugu Education zone has more qualified mathematics teachers that can teach the subjects matter, mathematics better. The population was made up of all the 5,195 Senior Secondary School 1 (SSI) students in the 31 secondary schools under Enugu Education zone. This is made up of 1,806 males and 3,389 female students as at the time of the study.

Sample for this study was 410 students 265 in experimental groups and 145 students in the control groups. The experimental group consisted of 130 students in experimental group A and 135 students in experimental group B. The sample was also made up of 195 male students and 215 female students. Geometry Interest inventory (GII) was used for data collection. The instrument was validated by three research experts. The overall reliability coefficient value for the instrument was .72 obtained through Cronbach's Alpha Method. Descriptive statistics of mean and standard deviation were used to answer the research questions while Multivariate Analysis of Covariance, (MANCOVA) was used to test the hypotheses at 0.05 significant level.

Results

Research Question 1

What are the mean interest score with standard deviation of students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group)?

Table 1: mean interest scores and standard deviation of experimental and control groups in pretest and posttest.

Group	n	Pretest		Posttest	
		Mean	SD	Mean	SD
Experimental A	130	47.81	3.64	90.21	0.01
Experimental B	135	48.22	3.63	81.66	0.01
Control	145	47.90	3.06	60.25	2.11

From table 1, the pretest mean interest score and standard deviation of the experimental A were 47.81 and 3.64 respectively while for experimental B, the pretest mean interest score and standard deviation were 48.22 and 3.63 respectively. The posttest scores of experimental A were 90.21 and 0.01 for mean interest score and standard deviation respectively while for experimental B the mean interest score and standard deviation were 81.66 and 0.01 respectively. For the control group, the pretest mean interest score and standard deviation were 47.90 and 3.06 respectively while the posttest scores were 60.25 and 2.11 for mean interest and standard deviation respectively. There was very little difference between the three groups in the pretest but there was an appreciable difference in the posttest in favour of the experimental group. Also, experimental group, A showed more interest than experimental group B. The standard deviation values of both groups in pretest did not differ much however, the experimental group had lower standard deviation value than the control group in posttest, indicating less extreme values for the group.

Research Question 2

What are the mean interest scores with standard deviation of male and female students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group)?

Table 2: mean interest scores and standard deviation of male and female students in pretest and posttest.

Group	n	Pretest		Posttest	
		Mean	SD	Mean	SD
Male (Experimental A)	60	48.01	3.55	90.30	0.09
Female (Experimental A)	70	47.61	3.73	90.12	0.11
Male (Experimental B)	65	48.14	3.41	81.56	0.01
Female (Experimental B)	70	48.30	3.85	81.76	0.01
Male (Control)	70	47.53	3.04	60.27	2.10
Female (Control)	75	48.27	3.08	60.23	2.12

From table 2, above the pretest mean interest score of the male (experimental A) was 48.01 while that of female (experimental A) was 47.61. Similarly, the pretest mean score of the male (experimental B) was 48.14 while that of female (experimental B) was 48.30. The pretest mean score of the male (control) was 47.53 while that of female (control) was 48.27. The posttest mean interest score of the male (experimental A) was 90.30 while that of female (experimental A) was 90.12 while the posttest mean interest score of the male (experimental B) was 81.56 while that of female (experimental B) was 81.76. The posttest mean score of the male (control) was 60.27 while that of female (control) was 60.23. These results suggest that the students' interest in geometry did not differ much based on their gender. Rather, differences seen were based on their groups. The standard deviation values followed the same pattern.

Hypothesis 1

There is no significant difference between the mean interest scores of students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group).

Hypothesis 2

There is no significant difference between the mean interest scores of male and female students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group).

Hypothesis 3

There is no significant interaction effect between method and gender on students' interest in geometry.

Table 3: MANCOVA analyses of the student's interest scores

Source		Type III sum of squares	df	Mean square	F	Sig	Decision
Problem solving strategy (A)	Hypothesis Error	379.818 52525.825	1 409	379.818 128.425	2.957	.000	Sig (Reject Hyp)
Gender (B)	Hypothesis Error	159.163 52525.825	1 409	159.163 128.425	1.239	.120	Not Sig (Do not reject Hyp)
Interaction (A*B)	Hypothesis Error	1177.834 90267.96	2 408	588.917 221.245	2.661	.239	Not Sig (Do not reject Hyp)

Problem solving strategies (Rusbult) as main effect gave an f value of 2.957 and this is significant at .000. Since .000 is less than .05 (significant level set for this study), this means that at .05 significant level, the f value of 2.957 is significant. Therefore hypothesis 1 is rejected as stated, indicating that there is significant difference between the mean interest scores of students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group). Gender (male and female) as main effect gave an f value of 1.239 and this is significant at .120. Since .120 is greater than .05 (significant level set for this study), this means that at .05 level of significance, the f value of 1.239 is insignificant. Therefore, hypothesis 2 is not rejected as stated because that there is no significant difference between the mean interest scores of male and female students taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group). The interaction effect (Problem solving strategy*Gender) gave an f value of 2.661 which is significant at .239. Since .239 is greater than .05 (significant level set for this study), this means that at .05 level of significance, the f value of 2.661 is not significant. Therefore, hypothesis 3 is not rejected as stated, indicating that there is no significant interaction effect between method and gender on students' interest in geometry.

Discussion of the findings

Findings of this study reported that there was very little difference between the three groups (A, B&C) in the pre-test but there was an appreciable difference in the post test in favour of the experimental groups. Also, experimental group A showed more interest mean score than experimental group B. MANCOVA analysis of covariance showed that there is a significant difference between the mean interest scores of students' taught geometry using Rusbult's problem solving strategy (experimental group) and those taught with conventional method (control group) in favour of the experimental groups. This indicates that the observed difference was due to treatment administered to experimental groups. The results further revealed that there was no significant interaction effects between method and gender on students mean interest scores in geometry. This showed that method and gender did not produce a combined effect on the mean interest scores of students. This result is in agreement with the result of Ifeanacho (2012) and Nneji (2012), who found that there was no significant interaction between teaching strategies and students' gender on students' interest in mathematics.

The fact the problem solving strategy encourages active free self listener, and increase students' interest may be because it is active oriented teaching strategy. When teaching and learning is student- centred, experimental and democratic students tend to learn with great interest. May be problem solving strategy is student- centred and democratic oriented. Hence interest in geometry concept along this line was enhanced. This result lends credence to the work of Nneji (2012), Ifeanacho (2012), and Samson (2020), who found out in their individual studies that constructivism- Based Teaching strategy and problem solving strategy enhanced the interest of the students. This suggests that problem solving strategy should be use in teaching and learning of mathematics in order to improve students' interest in mathematics.

Moreover, experimental group A showed more interest than experimental group B. MANCOVA analysis of covariance revealed that there is significant difference between the

mean interest scores of students taught geometry using Rusbult's problem solving strategy and those taught with conventional method in favour of Rusbult's problem solving strategy. This indicated that Rusbult's problem solving strategy was more effective in enhancing and sustaining students' interest in geometry. This result contradicts the finding of Nwaodo and Ogbonna (2019) who stated that there was no significant difference between the mean interest scores of students taught mathematics work with Rusbult's strategy and those taught with conventional method. But the findings was in agreement with Nekany (2013) who found that Rusbult's problem solving strategy exhibit more interest in geometry than conventional method.

Conclusion

The results of this study had showed that Rusbult's problem solving strategy enhanced students' interest in geometry. The results further revealed that those taught geometry using Rusbult's problem solving strategy significantly showed higher interest than those taught geometry using conventional method. Also, male and female students in the experimental and control groups showed equal interest in geometry test although the observed differences was based on their groups.

Implications of the Study

The results of this study have some implications for all stakeholders in mathematics education. The use of Rusbult's problem solving strategy have proved to be effective in enhancing students' interest in SS1 geometry contents. This implies that there is need for mathematics teachers, supervisors, curriculum planners, administrators in education sector and textbook authors to adopt the Rusbult's problem solving strategy in order to ensure meaningful teaching and learning of mathematics. The result of this study also revealed that Rusbult's problem solving strategy may have no effect on gender on students' interest in geometry. This implies that teachers should adopt problem solving strategy since it is not gender bias and

capable of enhancing students' interest in mathematics. The study indicated that no interaction effect between the two independent variables (method and gender) on students' interest in geometry. Therefore, emphasis should be focus on the main effect. Rusbult's problem solving strategy should be inculcated in the mathematics curriculum for teacher education programme in other to train teachers to be able to apply it in the teaching and learning of appropriate mathematics content like geometry.

Recommendations

Based on the findings of the study, the following recommendations are hereby made:

1. Mathematics teachers who are already in the teaching field should be trained in the current innovative teaching strategy such as Rusbult's Problem Solving Strategy (RUPSS) through workshops, seminars, conferences and in-service programmes by relevant bodies such as Mathematics Association of Nigeria (MAN), National Teachers Institute (NTI), Science Teachers Association of Nigeria (STAN), National mathematics centre Abuja and, Curriculum organization of Nigeria(CON) to educate and sensitize the teachers on the use of RUPSS in mathematics.
2. The curriculum planners should incorporate and emphasize the use of problem solving strategy like Rusbult's Problem Solving Strategy (RUPSS) in teaching senior Secondary School mathematics contents.
3. Authors of mathematics textbooks should develop books which reflect problem solving strategy like Rusbult's Problem Solving Strategy (RUPSS) with teachers guide.
4. Stakeholders in education sectors should sponsor mathematics teachers in seminars and workshops to keep the teachers abreast with these innovative strategy of teaching geometry.
5. The study also encourages the problem posing strategy as instructional approach, therefore the study recommended that students should be engaged in geometry tasks

and discourse that required problem solving, reasoning and communication, the holistic approach, students self-report and the use of hints and other problem solving evaluative strategies.

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