STATISTICAL ANALYSIS ON THE USE OF RECIPROCAL TEACHING STRATEGY IN COMBATING GENDER DIFFERENCES IN STUDENTS INTEREST AND ACHIEVEMENT IN WORD PROBLEMS

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Abstract

The poor performance of students in Mathematics has necessitated the need to search for innovative strategies that could enhance and sustain students' interest and achievement in word problems . This study adopted quasi experimental research design. Two research questions were answered and two hypotheses were tested at 0.05 level of significance. The population of the study was 5,480 Senior Secondary year two students from 61 public secondary schools in Awka Education Zone. A sample of 95 students drawn from two co-educational schools through multistage sampling was assigned to two groups using simple random sampling by toss of coin. The experimental group had 25 males and 30 females, while the control group had 20 males and 20 females. The instruments for data collection were Reciprocal Teaching Strategy Mathematics Achievement Test (RTSMAT) and Reciprocal Teaching Strategy Interest Rating Scale (RTSIRS) developed by the researchers. The instruments were validated by two Mathematics lecturers and one lecturer from Measurement and Evaluation. The reliability coefficient for RTSMAT was 0.87 using Kuder Richardson 21 formula and that of RTSIRS was 0.83 using Cronbach Alpha. Mean and Standard deviation were used in answering the research questions, while Analysis of Covariance ANCOVA was used in testing the hypotheses. Findings revealed that RTS enhanced students' interest and achievement in mathematics irrespective of gender. It was recommended among others that teachers should adopt Reciprocal Teaching Strategy in teaching Mathematics.

Keywords: Reciprocal Teaching Strategy, Gender, Interest, Achievement, Mathematics.

Introduction

Word problems in mathematics can be defined as verbal description of mathematical problems. Word problem is the expression of mathematical problems in sentence forms. Khairunnisa et al 2020 in a study on mathematics communication, identified that students could not change word problem into a settlement model and this is a serious problem. In another research by Bernado (1999), word problems vary in difficulty and require different types of mathematics knowledge and correct interpretation of the situation of the problem in other to determine the appropriate equation and solution. The challenge of comprehension of language of the word problem is always the issue irrespective of the class of student. According to Verschaffel et al (2020). Word problems are among the most difficult kinds of problem that mathematics learners encounter. Bernado (1999) opined that the problem students have with solving word problems often comes from the difficulty in understanding the problem structure embedded in the problem text.

Word problem is more of spoken mathematics. It is a mathematical problem expressed entirely in words. It is mathematics questions written in sentence form that require application of mathematical knowledge. Word problems are mathematical sentences that are used to explore every day experiences or real world scenario or authentic mathematical modeling problem. One must have good foundational knowledge of mathematics before facing the challenge of solving word problem. Venschaffel et al (2020), summarized that word problem solving performance has been shown to be significantly associated with a number of general cognitive resources such as working memory capacity and inhibitory skills. Word problem is mathematics in natural language rather than in mathematical formula on equations. Word problems require the interpretation, translation of mathematical words or texts into mathematical equations or solutions and requires a good combination of reading comprehension, mathematical knowledge and critical thinking skills. Word problems are used to evaluate students ability to; understand mathematical concepts and vocabulary; apply mathematical knowledge

to real world scenario, apply cognitive and critical thinking skills and finally model and solve problems (Communication Skills).

Word problems are essential for the development of deeper cognition of mathematical concepts and practical application. Students should be able to understand, identify relevant information and communicate their solutions effectively.

Chief examiners report of 2019-2021 revealed that students have poor interpretation of questions and inability to apply mathematical principles correctly. If students could not understand what the questions are about, it will be difficult for them to apply necessary mathematics principles, hence word problem still remains serious issue in mathematics.

There are several attempts which have been made to overcome the problems such as training and retraining of teachers, workshop, and selection of appropriate instructional materials. However these efforts will not be effective if mathematics teachers do not use appropriate teaching methods and strategies. Teacher centered strategies that have taken the center stage in teaching and learning makes learning reduce interest and motivation to learn. There is inactive participation of students in their learning process, hence the need for change in strategies that teachers use in the teaching and learning of mathematics.

Reciprocal teaching is a teaching strategy used to improve students reading and writing of English Language through collaboration dialogue. According to Mafarja et al (2023) reciprocal teaching is a cooperative and learning involving learners with similar academic background sharing teacher and student roles. It is a strategy that is student centred, that puts the students in charge of their learning. (Mehmood and Alvim) 2017 Reciprocal teaching strategy was developed by Annemarie and Ann in 1980. Key aspect of reciprocal teaching involves collaboration learning, cognitive strategies, metacognitive awareness, and scaffolding strategy.

In Collaborative learning, students work together in small group to actively discuss and analysis texts. Through active interaction and dialogue, students take turns to assume the role of the teacher by guiding their peers through the comprehension process.

Cognitive strategies: Reciprocal teaching focuses on teaching comprehension. These strategies include predicting, questioning, clarifying summarizing and use of feedbacks.

Predicting: students should be made to predict what the word problem is about on their own.

Questioning: Students should be encouraged to generate questions as they read and listen to the problem. Some questions like: what are the variables involved in the problem? What type of mathematical operations are needed in solving the problem? How many items are required? How can the question be modeled? And finally what is the possible solution?

Clarifying: As the students read and listen to the reading of the word problem, they should be reminded to ask themselves what word s and phrases are unclear to them.

Summarizing: The students take into account the key concepts, formula and procedure in their own words. These strategies help active participation, monitoring of understanding and addresses comprehension difficulties.

Visualizing: Students should create diagrams, graphs or charts to represent mathematical relationships and concepts.

Solving: Solving process in reciprocal teaching involves modeling of the questions ,think aloud sharing of ideas and working together to share there their understanding and approaches. Formative assessment is done by the teacher determine students understanding and adjust the instruction.

Another key aspect of reciprocal teaching in meta-cognitive awareness. According to Hira and Qasim (2024), the capacity to consider and control one's own cognitive functions such as organizing, observing and assessing ones thought is known as metacognition.

Reciprocal teaching encourages meta-cognitive awareness in student by prompting reflective process and strategies through reciprocal teaching student could think aloud, which is to articulate their thoughts and reasoning during group discussions and develop a deeper understanding of how to approach any given problem.

Scaffolding strategy: Reciprocal teaching enables more knowledgeable students in the group to help those lacking behind in comprehension, hence every students is carried along in reciprocal teaching.

While reciprocal teaching primarily focuses on reading comprehensive, it emphasizes collaboration dialogue. Cognitive strategies, meta-cognitive awareness, scaffolding strategy which aligns with boarder principles of effective pedagogy that can be applied across different content areas, including mathematics.

There are influx of studies conducted to determine the strength of reciprocal teaching and many turned out positive (Mehmuod and Alvim 2017, Mafarja et al 2023.) In the study on teaching reading through reciprocal method by Hamdani (2020), the study which was an quasi-experimental, non randomized control group, pretest-posttest revealed that students taught reading through reciprocal teaching method achieved better in reading ability than those who are taught through direct reading thinking activities through the result, it was concluded that reciprocal teaching method can be used as an alternative method teaching. Since reciprocal teaching has been identified as an alternative method of teaching, could it help in sustaining students' interest and achievement in mathematics irrespective of gender?

Interest is one of the motivating factors that encourage learning. According to Ikihwele and Mkomwa(2022), interest is a construct of motivation. According to Obodo cited in Obinweluozo (2015) interest is one of the determinants for students success or failure in mathematics. Kihwale et al (2022) in their study revealed that students revive their interest in studying mathematics when they are involved in activity based learning, hence the need to ascertain if Reciprocal teaching could revive students mathematics learning.

Academic achievement is successful attainment or accomplishment of educational goal. . It could be in the form of grades or degree earned. According to Shear (2020), mathematic achievement is a construct used to represent the level or nature of demonstrated learning in relation to a specified domain od mathematics. Student achievement in mathematics is dependent on their involvement in their learning. Since reciprocal teaching strategy has been acclaimed as active based learner centred strategy it's imperative to ascertain its impact on students interest and achievement in mathematics.

The issue of gender disparity is a growing concern in the field of mathematics. .Mejia-Rodriguez et al (2021) in their study indicated that gender differences in mathematics is significant in most countries in favour of the boys. Wang et al (2020) perceived the male students as being vulnerable in high anxiety and low self efficacy in mathematics than the female students, Awofala and Lawani (2020) in their own study concluded that gender was not significant on students achievement in mathematics. On students interest in mathematics Obinweluozo (2015) reported that there was differences on mean interest scores of students in mathematics, while Subrahmanyan (2021) reported that female students showed more interest in learning mathematics and their cognitive strategies are better than that of their male counterparts, Abimbola and Okechukwu(2023) reported that gender has no influence on students' achievement in Mathematics. As a result of these conflicting reports there is need for further investigation on gender imbalance in interest and achievement of word problems in mathematics.

Statement of the problem

Poor performance of students in mathematics as confirmed by the WAEC Chief examiners Reports of 2019-2021 have necessitated for a change in teaching strategy which is more student centred, hence the question would reciprocal teaching strategy improve male and female students interest and achievement in word problems in mathematics?

Purpose of the Study.

The purpose of this study was to determine the impact of reciprocal teaching strategy on gender differences in students interest and achievement in word problems Specifically the study sought to determine the:

1. difference in the mean interest scores of male and female students taught word problems in mathematics using Reciprocal Teaching Strategy (RTS)
2. difference in the mean achievement scores of male and female students taught word problems in mathematics using RTS .

Research Questions

The following research questions guided the study:

1. What is the difference between the mean interest scores of male and female students taught word problems in mathematics using RTS ?
2. What is the difference between the mean achievement scores of male and female students taught word problems in mathematics using RTS ?

Hypotheses

The following null hypotheses were tested at 0.05 alpha level.

1. There is no significant difference between the mean interest scores of male and female students taught word problems in mathematics using RTS.
2. There is no significant difference between mean achievement scores of male and female students taught word problems in mathematics using RTS .

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METHODOLOGY

The study adopted quasi experimental design specifically pretest, posttest non randomized control group. The population of the study consist of 5480 (2,733 females and 2,647 males) of Senior Secondary II Students from 61 public schools in Awka Education Zone. Multistage sampling technique was used to arrive at the two coeducational schools used for the study. The experimental group had 55 students (25males and 30 females), while control group had a total of 40 students (20males and 20 females). Data collection instruments were Reciprocal Teaching Strategy Mathematics Achievement Test (RTSMAT) and Reciprocal Teaching Interest Rating Scale (RTIRS) developed by the researchers. The validity of the instruments were done by two lecturers from Departments of Mathematics and Educational Foundation of Nnamdi Azikiwe University Awka. The validity coefficients of 0.78 and 0.80 was obtained using Kuder Richardson Formula

20 (K-R20) for RTSMAT and Cronbach Alpha for the RTIRS. The regular SSII mathematics teachers of the two schools were enlisted as the research assistants. The lesson plan for reciprocal teaching was used for training of the experimental group while the regular lesson plan also prepared by the researchers was also used for the control group. The treatments lasted for six weeks. RTSMAT and RTIRS were administered before and after the treatments. The data collected were analyzed using descriptive and inferential statistics

|Analysis of Result

Research Question 1

What is the difference between the mean interest scores of male and female students taught word problems in mathematics using RTS ?
Data related to the research question are presented on Table 1.

Table1: Mean Interest Scores of Male and Female Students Taught Word Problem Using RTS

Gender	N	Pre-interest $\bar{x}$	Post interest $\bar{x}$	Mean again score	Pre-interest SD	Post-interest SD
Male	25	1.88	69.60	67.72	1.24	10.03
Female	30	1.53	69.63	68.09	1.31	9.81

The result on Table 1,shows that male students taught word problem using RTS had a pre – interest mean score of 1.88 with a standard deviation of 1,24, while the postinterest mean score was 69.60, with a standard deviation of 10.03. The mean gain score between the preinterest mean score and postinterest mean score of the male students was 67.72. The female students had a preinterest mean score of 1.53, with a standard deviation of 1.31 and a post-interest mean score of 69.63, with a standard deviation of 9,81. The mean gain scores of the female students was 68.09. Based on the result the female students performed slightly higher than the male students.

Research Question 2

What is the difference between the mean interest scores of male and female students taught word problems in mathematics using RTS ?
Data related to the research question are presented on Table 2.

Table2: Mean achievement Scores of Male and Female Students Taught Word Problem Using RTS.

Gender	N	Pre-test $\bar{x}$	Post-test $\bar{x}$	Mean again score	Pre-interest SD	Post-interest SD
Male	25	11.20	60.60	49.40	20.83	10.03
Female	30	9.33	66.17	56.84	.40	13.75

From Table 2, the male student had a pretest score of 11.20 and post-test score of 60.60 with mean gain of 49.40, while the female students had pretest mean score of 9.33 and a post-test mean score of 66.17 with mean gain of 56.84. This implies that the female students taught word problem using RTS showed slightly higher level of achievement than the male students.

Hypothesis 1: There is no significant difference between the mean interest scores of male and female students taught word problem in mathematics using RTS ?

Table 3: **Summary of Analysis of Covariance (ANCOVA) of the Mean Interest Scores of Male And Female Students Taught Word Problem in Mathematics Using RTS**

Tests of Between-Subjects Effects

Dependent Variable: POSTINTEREST

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	52108.061[a]	3	17369.354	187.470	.000
Intercept	30798.189	1	30798.189	332.410	.000
METHOD	38148.487	1	38148.487	411.743	.000
GENDER	73.257	1	73.257	.791	.376
PREINTEREST	870.353	1	870.353	9.394	.003
Error	8431.265	91	92.651		
Total	297240.000	95			
Corrected Total	60539.326	94			

a. R Squared = .861 (Adjusted R Squared = .856)

From Table 3, Gender has an F-ratio of .791 which is significant at P=.376, which is greater than 0.05 level of significant. Hence the null hypothesis is not rejected. Therefore there is no significant difference on the mean interest scores of male and female students taught word problems in mathematics using RTS.

Hypothesis 2

There is no significant difference between the mean achievement scores of male and female students taught word problem in mathematics using RTS ?

Table 4: Summary of Analysis of Covariance (ANCOVA) of the Mean Achievement Scores of Male And Female Students Taught Word Problem in Mathematics Using RTS

Tests of Between-Subjects Effects

Dependent Variable: POSTTEST

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	33809.253[a]	3	11269.751	45.099	.000	.598
Intercept	46390.542	1	46390.542	185.646	.000	.671
METHOD	26773.263	1	26773.263	107.142	.000	.541
GENDER	280.788	1	280.788	1.124	.292	.012
PRETEST	5999.417	1	5999.417	24.009	.000	.209
Error	22739.694	91	249.887			
Total	285625.000	95				
Corrected Total	56548.947	94				

a. R Squared = .598 (Adjusted R Squared = .585)

From Table 4, Gender recorded an F-ratio of .292 which is significant at P=.012, which is greater than 0.05 level of significant. Hence the null hypothesis is not rejected. Therefore there is no significant difference on the mean achievement scores of male and female students taught word problems in mathematics using RTS.

Discussion of results

Influence of gender on interest and achievement of word problems in mathematics.

Word problem has been tagged as one of the difficult areas of mathematics students face in the cause of studying mathematics. The result of this study has revealed that the gender of student has no influence on students interest and achievement in mathematics. The Analysis of Covariance ANCOVA for gender as the main effect on interest and achievement revealed that gender has no effect on students interest in word problem despite female students slight higher mean interest score . this collaborates with the finding of Obinweluzo (2015) that gender has no significant effect on students learning of mathematics. Similarly the result also is in line with the findings of Gbobola and Okechukwu (2023) that activity centred strategies enhances students achievement in mathematics irrespective of gender.

Conclusion

This study has provided empirical evidence that Reciprocal Teaching strategy is effective in enhancing students' interest achievement in mathematics.

Recommendations:

1. Teachers should go back to activity based teaching methods instead of conventional method of teaching.
2. More training and retraining of teachers should be carried out from time to time to equip mathematics teachers with current activity based teaching strategies.
3. Teachers should be reading widely with the availability of internet facilities.

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