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Writing to Learn, Gender and Effects on Mathematics Achievement of Senior Secondary Students in Akwa Ibom State, Nigeria

[1]Umoren, Unyime John; [2]Allahoki, Nimphas Danusa (Ph.D); [3]Ezeh, Sussan Ijeoma (Ph.D), [4]Prof. Israel O. Inekwe

[1]Mathematics Education Unit, Science Education Department, Michael Okpara University of Agriculture, Umudike, Abia State nyimsy.uu@gmail.com
[2]Mathematics Department, College of Education, Zinc, Taraba State nim1963phas@gmail.com
[3]Science Education Department, Michael Okpara University of Agriculture, Umudike, Abia State ijeoma4mary@yahoo.com
[4]Science Education Department, Michael Okpara University of Agriculture, Umudike, Abia State inekwe.israel@mouau.edu.ng

ABSTRACT

The aim of this study was to investigate writing to learn, gender and effects on mathematics achievement of senior secondary students in Akwa Ibom State. The study adopted pretest posttest non-equivalent groups quasi-experimental design. The population of this study comprised all the senior secondary two students in all public secondary schools in Abak Education Zone, Akwa Ibom State numbered 2025 in 2022/2023 academic session. Simple random sampling was used to select two schools out of 10 secondary schools and to assign schools to experimental and control groups. A sample of 91 students (53 males and 38 females) was used. Two intact classes of 47 students and 44 students for experimental and control groups respectively were employed. Two research questions were raised and two corresponding null hypotheses were formulated. Instrument used to determine the respective achievements of the groups was Mathematics Achievement Test (MAT) which contained fifty objective questions. MAT was well validated by experts and Kuder-Richardson (K-R 20) was used to estimate the internal consistency which was 0.84. Mean and standard deviation were used to answer research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Before the experiment, pretest was administered and at the end of the experiment, posttest was administered. The result of this study revealed that there was significant difference in the achievement of experimental and control groups. Students taught mathematics using writing to learn strategy achieved higher than students taught using conventional method of instruction. The main effect of gender and interaction effect with teaching strategies were not significant. Therefore one of the recommendations was that mathematics teachers should intensively employ writing to learn strategy since it was found to enhance academic achievement devoid of gender.

Keywords: Writing to learn, Effects, Mathematics, Achievement.

INTRODUCTION

In the year 2000, the National Council of Teachers of Mathematics (NCTM) advocated that mathematics teaching and learning should be restrategized to help students gain mathematics knowledge and skills effectively (NCTM, 2013). This they did by stating in their principles and standards for mathematics that students must learn mathematics with understanding, building actively new knowledge from experience and previous knowledge to foster learning effectiveness and understanding in mathematics (Jayanthi, 2019). NCTM identified communication in mathematics class as one of the tools to achieving their principle; and considered it as a measure of having a better academic achievement in mathematics. NCTM believes that it is through communication that students' ideas become objects to reflect on, refine and, discuss (NCTM, 2019). When students are challenged to communicate the result of their thinking to others orally or in writing, they learn to be clear, convincing and precise in their use of mathematical language (Palmer, 2018). The use of communication to think reflectively and gain understanding has given rise to writing to learn mathematics (Uko, 2021).

Writing to learn mathematics can be described as a type of writing that explains mathematical concepts (Pugalee, 2014). Pugalee further explains that writing to learn mathematics can as well be seen as a concept that describes any form of communication expressing mathematical ideas and problem solving scenarios, including, but not limited to written responses and drawings.

Writing to learn is a strategy in mathematics teaching and learning that teachers can employ during or after lesson to engage students to think reflectively across concepts. It is a kind of short and informal writing tasks designed by the teacher to help students reflect on those ideas that are fundamental to trigger learning (Palmer, 2018). Writing to learn in mathematics class can employ a lot of strategies to make the approach effective. The students can be guided to a solution by asking them to solve, check and explain their work. Students are encouraged to write about what made any problem difficult or strategies that helped them solve the problem (Kenney, *et al*., 2014). Students can be asked to collect information about two or more mathematical concepts or examples; the key attributes are recorded on a chart to clarify similarities and differences. Students can be asked to restate main ideas from

mathematics text in their own words. Students can be asked to make marginal notes – short written statements recording their interactions with the text in the margins in the course of reading. Students can be asked to write comments and questions about what they have read (or solve a problem alone) before engaging in small-group discussions (O'Kelly, 2013).

The importance of writing to learn in mathematics class is much and cannot be over-emphasized. Writing offers students a chance to provide their reasoning about each step they employ when they solve a mathematics problem. This enables students capture explicitly the reasoning and thinking that occurs following progress from one step to another. It makes students thinking become realizable and comparison of what they think among peers is enabled. This strategy allows teachers to realize what understanding or misconception a student may have about a problem (Martin & Polly, 2016). In writing to learn, teachers can ask students to write in their own words, some questions based on the mathematics they are studying and solve them. For the questions to be solvable, it must be clear and have complete information. This activity inherently has some form of learning. It helps students think clearly and meaningfully resulting in having deeper understanding of mathematical concepts and principles (NCTM, 2013). Students also get insight into the structure of problems in mathematics. Students choosing to write problems based on their own experience shows them how mathematics applies to their own real lives leading to reflective learning. Writing to learn enables students consider problem solving as cardinal therefore having confidence to read and solve problems in mathematics.

Slow learners can learn better with the writing to learn approach because the writing is informal, no much attention is given to spellings nor grammar therefore all students male and female participate and write freely (Rouse & Graham, 2014). Also the fact that students are guided to write gives teachers insight into what each student knows and as well give guidance based on the need of the student (Martin & Polly, 2016). Writing to learn gives room for collaborative learning since male and female students' problems are shared with their peers in the class. This helps the underachievers overcome learning difficulties, bridge gender gap and create understanding of mathematics concepts among male and female students (Martin & Polly, 2016).

Writing in mathematics classroom allows students monitor their learning, activates students previous knowledge, stimulates questioning and analysis, establishes connection between one topic and another, facilitates individual participation, increases fluency in writing mathematics, promotes learning in a more social milieu through interactions and enhances academic achievement (Palmer, 2018). Writing to learn mathematics enables the practice of inferring, communicating, symbolizing, organizing, interpreting, linking, explaining, planning, reflecting, applying and acting among students of mathematics (Uko, 2021). Writing among students can help the teacher discover what students think, and how they arrived at solutions to problems in case intervention is necessary (Martin & Polly, 2016). The approach is believed to help both male and female students exhibit reflective thinking skills when learning mathematics.

This present study on writing to learn, gender and effects on mathematics achievement of senior secondary students in Akwa Ibom State, considers the following topics: indices, linear and quadratic equations, change of subject formula and variation for experiment. Students of experimental group were exposed to writing one page summary after every class session on the step-by-step solution of examples solved in the class. This summary was meant to highlight additive and multiplicative inverses, and laws of indices applied at each step of the solutions on all the examples solved on all the topics considered in this study. All of this was done as a measure of improving academic achievement of students in mathematics. Gender is one of the factors that is considered as having effects on students' academic achievement especially in mathematics. This is why this study attempts to compare students' academic achievement based on gender.

STATEMENT OF THE PROBLEM

The teaching and learning of mathematics was meant for achievement in all domains of the taxonomy: in terms of inculcating in learners thinking skills, enhancing intellectual capability to solving problems and ability to communicate effectively the solution steps. Also the teaching and learning of mathematics was meant to create opportunities to explore patterns leading to making statements that articulate generalizations. The process of using a few instances to formulate a general rule which can then be applied in other instances was at the heart of mathematics.

Today, a lot of lapses have been observed in terms of achievement in mathematics and application of mathematical knowledge. This may have been the lead cause the NCTM agitated that the teaching and learning of mathematics should be restrategized to help students achieve better academically and use mathematical knowledge effectively.

Consequently, this study considers it necessary to examine writing to learn strategy, gender and effects on mathematics academic achievement in senior secondary students. This is done with the hope of determining if writing to learn strategy can enhance academic achievement of students in mathematics devoid of gender.

PURPOSE OF THE STUDY

The purpose of this study was to investigate the effect of writing to learn on academic achievement of male and female students in mathematics in Abak Education zone, Akwa Ibom State.

The study sought to:

1. Determine the mean achievement scores of students in mathematics when taught using writing to learn and conventional approaches
2. Ascertain the mean achievement scores of students in mathematics when taught using writing to learn based on gender.

RESEARCH QUESTION

The following research questions were raised:

1. What are the mean achievement scores of students in mathematics when taught using writing to learn and conventional approaches?
2. What are the mean achievement scores of male and female students in mathematics when taught using writing to learn teaching approach?

HYPOTHESES

The following null hypotheses were formulated and tested at 0 .05 level of significance:

H_{01}: There is no significant difference between the mean achievement scores of students in mathematics when taught using writing to learn and conventional approaches.

H_{02}: There is no significant difference between the mean achievement scores of male and female students when taught mathematics using writing to learn approach.

RESEARCH METHDOLOGY

The population of this study comprised all the senior secondary one students in all public secondary schools in Abak Education Zone, Akwa Ibom State numbered 2025 in 2022/2023 academic session. Simple random sampling was used to select two schools out of 10 secondary schools and to assign schools to experimental and control groups. A sample of 91 students was used. Two intact classes of 47 students and 44 students for experimental and control groups respectively were employed. Students of experimental group were exposed to writing one page summary after every class session on the step-by-step solution of examples solved in the class. The topics covered were indices, linear and quadratic equations, change of subject formula and variations. This summary was meant to highlight additive and multiplicative inverses, and laws of indices applied at each step of the solutions on all the examples solved on all the topics considered in this study. Control group was taught through conventional method. Before the experiment, pretest was administered and at the end of the experiment, posttest was administered. The instrument used to determine the respective achievements of the groups was Mathematics Achievement Test (MAT) which contained fifty objective questions. MAT was well validated by experts and Kuder-Richardson (K-R 20) was used to estimate the internal consistency which was 0.84. Mean and standard deviation were used to answer research questions while Analysis of Covariance was used to test the hypotheses at 0.05 level of significance.

DATA ANALYSIS AND RESULT

Research Question 1

What are the mean achievement scores of students in mathematics when taught using writing to learn, and conventional approaches?

Table 1: Mean and Standard deviation of students taught mathematics using writing to learn and conventional approaches.

Variable		**Pre-test**		**Post-test**	**Achievement**	
Teaching approaches	**N**	**X**	**ṠD**	**X**	**SD**	**mean gain**
WTL	47	30.40	9.80	58.00	11.53	27.60
Conventional		44	31.05 8.44	45.20	9.90	14.15

where N=Number of students, X=mean, SD = Standard deviation

Table 1 showed that students taught using writing to learn (WTL) had a pre-test mean score of 30.40 with standard deviation of 9.80 and a post-test mean score of 58.00 with standard deviation of 11.53 and a mean gain of 27.60. Students taught with conventional method had a pre-test mean of 31.05, standard deviation of 8.44 and a post-test mean of 45.20with standard deviation of 9.90 and an achievement mean gain of 14.15. This shows that the pretests of the two groups of students are close to each other which indicate that students were at the same level before the experiment began. The standard deviation scores were widely spread since their values are far away from the mean. This indicates that students taught mathematics using the WTL had the higher mean than students taught using conventional approach.

Hypothesis 1

There is no significant difference between the mean achievement scores of students in mathematics when taught using writing to learn and conventional teaching approaches?

Table 2: Analysis of covariance (ANCOVA) of students mean achievement scores when taught using writing to learn and conventional approaches.

Source	Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	4068.851[a]	3	1356.284	13.124	.000	S
Intercept	22261.595	1	22261.595	215.412	.000	S
PRETEST	322.325	1	322.325	3.119	.080	NS
APPROACHES	3798.434	2	1899.217	18.378	.000	S
Error	14054.834	136	103.344			
Total	398558.000	140				
Corrected Total	18123.686	139				

a. R Squared = .225 (Adjusted R Squared = .207)

The result in table 2 showed F-ratio of 18.38for groups with P-value of .000 which is less than the significant value of .05. The null hypothesis of no significant difference is therefore rejected which indicates that there is a significant difference between the approaches in favour of writing to learn.

Research Question 3

What are the mean achievement scores of male and female students in mathematics when taught using writing to learn teaching approach?

Table 3: Mean and Standard Deviation of male and female students taught using WTL teaching approach.

GENDER	**WTL**					
Pretest	**Post-test**					**Mean difference**
	N	**X**	**SD**	**X**	**SD**	
MALE	29	30.90	10.76	58.97	12.49	28.07
FEMALE	18	29.61	8.24	56.44	9.95	26.83

Table 3 showed the means and standard deviations of male and female students in mathematics when taught using writing to learn (WTL) teaching approach. Male had means of 30.90 in pretest and 58.97 in posttest with standard deviation of 10.76 and 12.49 respectively while female students had means of 29.61 and 56.44 with standard deviation of 8.24 and 9.95 respectively. This indicates that males had a higher mean than their female counterpart.

Hypothesis 3:

There is no significant difference between the mean achievement scores of male and female students taught using writing to learn teaching approach.

Table 4: Analysis of covariance (ANCOVA) of male and female students mean achievement scores when taught using WTL teaching approach.

Source	Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	96.255[a]	2	48.128	.352	.706	NS
Intercept	13307.779	1	13307.779	97.206	.000	S
PRETEST	25.665	1	25.665	.187	.667	NS
GENDER	64.928	1	64.928	.474	.495	NS
Error	6023.745	44	136.903			
Total	164228.000	47				
Corrected Total	6120.000	46				

a. R Squared = .016 (Adjusted R Squared = -.029)

The result in table 4 showed F-ratio of .474 for gender with P-value of .495 which is greater than the significant value of .05. The null hypothesis of no significant difference is therefore not rejected which indicates that there is no significant difference between the mean achievement scores of male and female students taught using writing to learn teaching approach.

DISCUSSION OF RESULT

There was significant difference in the achievement of experimental and control groups. The result of this study revealed that students taught mathematics using writing to learn strategy achieved higher than students taught using conventional method of instruction. The reason could be as a result of the fact that slow learners were carried along to participate actively thereby boosting the academic achievement of the class as was submitted by Rouse and Graham (2014). This result also agrees with Palmer (2018), that writing to learn mathematics allows students monitor their learning, activates students previous knowledge, stimulates questioning and analysis, establishes connection between one topic and another, increases fluency in writing mathematics, promotes learning through interactions and enhances academic achievement in mathematics. Although academic achievement of writing to learn class was better than conventional class, the result indicated that conventional method was significant. This means that the conventional method can still play a valuable role in teaching and learning mathematics.

From the result, the main effect of gender and interaction with teaching strategies were not significant. This means that writing to learn could galvanized against gender bias and is in agreement Martin and Polly(2016), who submit that writing to learn gives room for collaborative learning since male and female students' problems are shared with their peers in the class. This helps the underachievers overcome learning difficulties, bridge gender gap and create understanding of mathematics concepts among male and female students.

CONCLUSION

This study investigated the effects of writing to learn and gender on mathematics achievement of senior secondary students. From the result, conventional method was seen to enhance significantly students' academic achievement in mathematics. Therefore, the method should not be condemned rather; it should be used in combination with active learning strategy like writing to learn which had a better academic achievement comparatively. Gender was found to be insignificant from the result. Therefore this study has provided grounds to dislodge gender stereotype since academic achievement in mathematics was not susceptible to gender.

RECOMMENDATIONS

The following recommendations were made:

1. Mathematics teachers should intensively employ writing to learn strategy since it was found to enhance academic achievement devoid of gender.

2. Government should organize seminars and workshops to sensitize mathematics teachers on writing to learn strategy and its utilization.

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