EFFECT OF BILINGUAL INSTRUCTIONAL METHOD IN THE ACADEMIC ACHIEVEMENT OF JUNIOR SECONDARY SCHOOL STUDENTS IN MATHEMATICS

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INTRODUCTION

The importance of mathematics in the modern society is overwhelming. The importance of mathematics has long been recognized all over the world, and that is why all students are required to study mathematics at the primary and secondary school levels, whether they have the aptitude for it or not (Ojo, 2015; Adebayo, 2008; Adeleke, 2007). However, despite the importance of mathematics in the Nigerian education system, the students' performances continue to deteriorate year after year. Several reasons have been proffered for the high failure rate in mathematics. Given the options, many students will not offer mathematics (Agwagah, 2013). Agwagah noted that an increasing number of students find it difficult to do well in mathematics because of the teaching method used in teaching most of the themes are not interesting. In other words, the prime position accorded mathematics in the society is at risk because of persistent poor performance. According to Kurumeh and Achor (2008), the difficulties of students in learning mathematics could be attributed to the approach to which the contents are being presented to the students, the abstractness of mathematical concepts, and poor foundation, among others. Most students, especially, at the Junior Secondary School (JSS) have difficulties in understanding mathematics because of the language of instruction (which is English Language) (Ifeanacho, 2012). Majority of the students who are highly proficient in performing mathematical operations, in solving symbolic problems are less proficient in solving problems when it is algebraic (Iji, Abakpa, & Takor,2015).

In recent years, the language of instruction has become an active focus of investigation in education research, including research in mathematics education. Such focus is a symptom of a relatively recent paradigmatic shift whose main characteristics are a new understanding of the student and increasing awareness of the learning contexts, such as, notably the complexities arising from cultural and linguistic diversity (Radford & Barwell, 2022). When students' conceptualizations are perceived to be incorrect, language is often then seen as an obstacle or barrier to the effective communication of the desired knowledge or structures. Language, however, is clearly more than a hindrance or an obstacle; language, talk, text and the production and interpretation of symbols are integral to the creation of learning, teaching and assessment, particularly in mathematics. The contributions of language, the politics of discourse, and critical studies, with most emphasis on the issue of multilingual classrooms need the urgent attention of education stakeholders. Multilingualism is the ability to speak two or more languages fluently. There are many benefits of multilingualism, such as improving cognitive, social, emotional, and economic skills. Multilingualism does not seem to have a significant impact on mathematical reasoning or problem-solving. However, multilingual students who are allowed to use many languages to discuss and solve problems have increased mathematical productivity, creativity, and problem-solving skills. Teachers working in a multilingual setting should be aware that the use of the first language may have a great influence on mathematics learning, especially when the students are involved in cognitively complex issues. The study of multilingual mathematics learners requires theoretical notions that address not only the cognitive and domain-specific aspects of learning mathematics but also the linguistic and cross-cultural nature of this work.

Multilingualism has multiple benefits for students, such as giving them an academic advantage and improving their employment prospects once they leave school. Moreover, multilingualism gives them access to more than one culture and improves their understanding of different cultures and languages (Halai & Clarkson, 2016). Language plays a crucial role in learning amidst a multilingual classroom (Adetuyi, 2017). Essien (2018) opined that learning of mathematics is through language, and involves reading, writing, listening and discussion, all of which are heavily language-based activities. Natural language and language of mathematics play different roles. With their own specificities, each of them provides individuals with access to different layers of mathematical consciousness. They provide individuals with different forms of expressiveness and aesthetic experience.

Several studies (e.g. Atweh, Bose, Graven, Subramanian & Venkat, 2014) noted the concerns about primary school students' poor achievement in numeracy across many countries in Africa, Asia, and Latin America. Essien (2018) observed that various mathematics education research on multilingualism point to the intricate link between language competence and mathematics classroom practices. However, systematic review of literature on multilingualism (e.g. Setati, Chitera & Essien, 2009; Essien, 2018) found insignificant number of publications that focused on multilingual classroom practices and students' achievement. In addition, research on the role of language in multilingual primary school level was insignificant compared to the role of language in mathematics at other levels of education. While literature has focused on pedagogical practices, role of language and conceptual framework necessary to support teaching and learning in a multilingual classroom (e.g. Freeman & Freeman, 2014; Viesca & Teemant, 2019). Van Laren and Goba (2013) suggested that when teaching mathematics to second language students, teachers should introduce two languages simultaneously for clarity of the mathematical terms and concepts for good academic achievement. Kasma Suwanarak (2014) opined that balanced-language instruction to some extent promote academic achievement in bilingual students. Hence, the more bilingual experience and the more balanced exposure to both of their languages the students have, the more advantages they gain for promoting their learning success.

The importance of language in the teaching and learning of mathematics can never be over emphasized. Teaching mathematics with two languages most especially with the local language can increase the rate of comprehension by the students. Different ways of understanding learning contribute to our knowledge of the relationship between language and mathematics in bilingual classrooms. According to Moschkovich, (2007) the relationship between language and mathematics in research began in the field of psychology and examined the cognitive functioning of bilingual learners during arithmetic computations and the solving of word problems.

Achievement is the result, the successfulness, the extent or ability, the progress in learning educational experiences that the individual indicate in relation with his/her educational learning (Olga, 2008). Achievement in mathematics, which is the focus of this study, is viewed as a very important factor in teaching and learning of mathematics and it refers to students' cognitive achievement and psychomotor skills, which are measured in terms of pass or fail (Adebayo, 2008;

Popoola & Ajani, 2011). When achievement is below expectation, it is referred to as under-achievement or poor achievement. When students are successful in examination they will have the feeling of pride that they made success with their own efforts and skill. Small success can give students sense of achievement. On the other hand, persistent failure dampens students' interest.

Statement of the Problem

Literature is filled with evidence that teachers are using ineffective methods and strategies in teaching mathematics, which among other factors, have contributed to the students' poor achievement in mathematics especially at the Junior Secondary School Certificate Examination (JSSCE) (Usman and Eze, 2011). Research efforts over the years have not only indicated poor performance in mathematics among senior and junior secondary school students, but have shown that the traditional teaching method (like chalk-and-talk) has proved ineffective in achieving the desired achievement of students in algebra (Usman and Eze, 2011). The need to find ways of improving students' performance in mathematics is obvious. Teaching strategies have known to influence students' performance in mathematics. Perhaps, the use of bilingual instructional method can enhance students' performance in mathematics.

Purpose of the Study

The purpose of this study was to determine the effect of bilingual instructional method on mathematics achievement of junior secondary school students. Specifically, the objectives of the study were to:

1. Ascertain the mean achievement scores of students taught with bilingual instructional method and conventional instructional method.
2. Compare the influence of gender on mean achievement scores of students taught with bilingual instructional method and conventional instructional method.

Research Questions

The following research questions were raised to guide this study.

1. What is the mean achievement score of junior secondary school students taught mathematics using bilingual instructional method and conventional instructional method?
2. What difference exist in the mean achievement scores of male and female junior secondary school students taught mathematics using bilingual instructional method.

Hypotheses

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

H01: There is no significant difference in the mean achievement scores of junior secondary school students taught mathematics using bilingual instructional method and conventional instructional method.

H02: There is no significant difference between the mathematics achievement of male and female junior secondary school students taught with bilingual instructional method

H03: The interaction effect of Bilingual instructional method and gender on mathematics mean achievement of junior secondary school students is not statistically significant.

METHODOLOGY

This study employed a quasi-experimental research design. Specifically, it was non-equivalent control group type as intact classes were used for the research and there was non-randomization of the students.

The array of the experimental design is as shown below:

E1: O1 X1 O2: Bilingual (Experimental group)

C1: O3 XC O4: Conventional (Control group)

Where:

O1, O3 - Observation before treatment (Pre-test)

O2, O4 – Observation after treatment (Post-test)

X1 – Treatment via Bilingual instructional method

XC – Treatment via Conventional instructional method

According to Tuchman (2008), this design helps to compare scores and means of two groups (pre-test and post-test). Non-equivalent groups specifically means that participants' characteristics may not be balanced equally among the experimental and control groups. The study used two groups: one experimental group and one control group, the experimental group was exposed to bilingual instructional method while the control group was taught with conventional instructional method and both groups were subjected to pre-test and post-test. The target population for this study consisted of all Junior Secondary one (JSS1) students in Abia State (An Igbo speaking state), Nigeria. The choice of JSS1 students was appropriate for this study because it is the first level of the upper Basic in Nigerian schools. Multi-stage sampling technique was adopted to select the sample for this study. First, Southeast was stratified along the six (6) geopolitical zones in Nigeria and Abia State was selected using the lucky-dip technique. Also, Ohafia Local Government Area was selected from the 17 Local Government Areas in Abia State using simple random sampling technique. Next was to randomly select two (2) schools using the simple random sampling technique from the public Senior Secondary Schools in Ohafia Local government Area. The two schools which had equivalent mean scores were further randomly assigned to experimental and control groups. A total of 76 JSS1 students were involved in the study. The selected sample has 30 students for the experimental group and 46 students for the control group. Due to attrition caused by natural phenomena

during the period of study, 20 students (13 male and 7 female) for the experimental group and 18 students (7 male and 11 female) for the control group making a total of 38 students that completed the research study.

The researchers designed and developed a Teaching Module (T.M) in English language based on JSS1 mathematics syllabus covering Geometry Mensuration, Volume of Solids, Angles and Geometric Construction while an expert in mathematics with proficiency in Igbo language translated the T.M to a Bilingual Teaching Module (BTM) in Igbo language.

A Mathematics Achievement Test (MAT) was used to collect data for the study. The MAT was developed by the researchers based on JSS1 mathematics syllabus covering Geometry Mensuration, Volume of Solids, Angles and Geometric Construction. Fifty (50) multiple-choice items were constructed following specifications on a test blue print and principles of test construction. The validity of the instrument was ascertained by giving the Mathematics Achievement Test (MAT) items to two experts in Mathematics education and two Tests and Measurement experts for face, and content validity. For the reliability of the instrument, the researchers administered the instrument in another school in another Local government Area that did not participate in the main study, using the Split-half method of obtaining reliability. The Pearson Product Moment Correlation Coefficient statistical analysis was employed to analyze the scores and the half length of the coefficient of reliability was obtained while Spearman Brown formula was used to calculate the full length thus, reliability coefficients **r = 0.86** was obtained which showed that the instrument was reliable enough for use. The study lasted for a period of four weeks. Descriptive statistics such as Mean and Standard Deviation were used to answer the research questions while hypotheses were subjected to inferential statistics such as Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Results and Discussion

The data collected for the study were analyzed and the results presented as follows:

Research Question 1: What is the mean achievement score of junior secondary school students taught mathematics using bilingual instructional method and conventional instructional method?

Table 1: Mean and Standard Deviation of Junior Secondary students in Mathematics Achievement Test (MAT)

Method	Number	Pre-test		Post-test	
		Mean	S.D	Mean	S.D
Bilingual	20	9.90	2.92	27.50	9.71
Conventional	18	11.72	2.95	22.67	4.85
Mean Difference		-1.82		4.83	

Table 1 shows the difference in mean achievement of group taught mathematics with Bilingual instructional method and other group taught with Conventional instructional method in Mathematics Achievement Test (MAT). The table shows that the mean post-test achievement in MAT of students taught with Bilingual instructional method (27.50) was higher than the mean in pre-test achievement test (9.90). Also, the post-test achievement of those taught with Conventional instructional method was higher than the mean of pre-test achievement test with mean 22.67 and 11.72 respectively. However, students taught with Bilingual instructional method had a higher mean score than those taught with the Conventional instructional method in the post-test. Therefore, the difference in the mean scores 4.83 was in favour of the students taught mathematics with Bilingual instructional method.

Research Question 2: What difference exist in the mean achievement scores of male and female Junior Secondary School students taught mathematics using bilingual instructional method.

Table 2: Mean and Standard Deviation of Junior Secondary School Male and Female students Taught with Bilingual Instructional Method in Mathematics Achievement Test (MAT)

Bilingual	Number	Pre-test		Post-test	
		Mean	S.D	Mean	S.D
Male	13	10.38	2.87	29.54	10.46
Female	7	9.00	3.00	23.71	7.34
Mean Difference		1.38		5.83	

Table 2 shows the difference in mean achievement of male and female students taught mathematics with Bilingual instructional method in MAT. The mean post-test achievement in mathematics for male was 29.54 which was greater than their mean pre-test achievement (10.38). Similarly, the mean post-test achievement in mathematics for female was 23.71 which was greater than their mean pre-test achievement (9.00). In general, the male students have a greater mean score 5.83 greater than their female counterpart when Bilingual instructional method was employed as shown in the mean difference.

Test Hypotheses:

Table 3: ANCOVA of the Difference in Mean Scores of Junior Secondary School Students Taught With Bilingual Instructional Method and Those Taught with Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Correlated Model	1989.904[a]	4	497.476	38.864	.000
Intercept	4.961	1	4.961	.388	.538
Pretest	1572.690	1	1572.690	122.863	.000
Group	644.585	1	644.585	50.357	.000
Gender	2.728	1	2.728	.213	.647
Group * Gender	81.289	1	81.289	6.351	.017
Error	422.411	33	12.800		
Total	26564.000	38			
Corrected Total	2412.316	37			

a. R Squared = .825 (Adjusted r squared = .804

H01: There is no significant difference in the mean achievement scores of junior secondary school students taught mathematics using Bilingual instructional method and conventional instructional method.
To determine whether significant difference existed between the achievement mean scores of the two groups, **ANCOVA** was used to analyze the scores obtained from the two groups. Table 3 shows **df (1, 37)** and **F – ratio = 50.357** which is significant at **p-value of 0.000**. Thus, the null hypothesis of no significant difference in the mean achievement scores of junior secondary school students taught mathematics using Bilingual instructional method and conventional method was rejected since P value 0.000 was less than 0.05 alpha level that is 0.000 < 0.05. This implies that there was a significant difference in the achievement means scores of students taught Bilingual instructional method and those taught with the conventional Monolingual method.

H02: There is no significant difference between the mathematics achievement of male and female junior secondary school students taught with bilingual instructional method

Table 3 shows the computed **F** - ratio for the effect of gender on achievement of students in the Mathematics Achievement Test (MAT) was **0.213** and **p–value = 0.647** which was not significant at 0.05 alpha level. Since 0.647 is greater than 0.05 then, the null hypothesis of no significant difference between the mathematics achievement of male and female junior secondary school students taught with bilingual instructional method was not rejected.

H03: The interaction effect of Bilingual instructional method and gender on mathematics mean achievement of junior secondary school students is not statistically significant.

Table 3 shows that the interaction effect of method and gender on the students' achievement in the **MAT** was **F = 6.351 and p-value = 0.017** which was less than 0.05 level of significance. Since p-value 0.017 is less than the 0.05 alpha level then, the null hypothesis H03 was rejected. Thus, there is significant interaction effect of Bilingual instructional method and Gender on mathematics mean achievement of junior secondary school in Mathematics Achievement Test.

Discussion of Results

The findings of this study revealed that the experimental group taught with Bilingual instructional method had a higher mean score than those taught with the Conventional instructional method in the control group, the difference in the mean scores of 4.83 was in favour of the students taught mathematics with Bilingual instructional method. Also, the male students have a greater mean score of 5.83 greater than their female counterpart when Bilingual instructional method was

employed as shown in the mean difference. The result of ANCOVA as showed in table 3 revealed that there was statistically significance difference between mean achievement of students subjected to Bilingual instructional method and those exposed to conventional instructional method (Monolingual). The implication of this finding is that the Bilingual instructional method is more effective than the conventional instructional method and that students exposed to Bilingual instructional method have higher achievement in mathematics. This finding is in conformity with the finding of Ibode and Adeteju (2013) that there was a significant effect of bilingual teaching strategy than the conventional group achievement in Mathematics

The result of ANCOVA as showed in table 3 also revealed that there was no statistically significant difference between the mathematics achievement of male and female junior secondary school students exposed to the Bilingual instructional method. In addition, there was significant interaction effect of Bilingual instructional method and Gender on mathematics mean achievement of junior secondary school in Mathematics Achievement Test. This is in agreement with the finding of Sinnes A.T (2006) as cited by Uche Anaduaka, Olaoye and Sunday (2018) that if males and females are given the same opportunity in scientific inquiry, they will produce exactly the same result in science. This shows that the Bilingual instructional method is gender-unbiased and improves students' performances regardless of their gender.

Conclusion

The study concluded that Bilingual instructional method is a potent and good pedagogy for the teaching and learning of mathematics topics in schools, since Bilingual instructional method has been found to enhance the academic achievement of students in mathematics. It is therefore,

recommended that Government, School Authorities, and all Stakeholders put up policies that adequately provide enabling environment and opportunities that would allow Mathematics Teachers to adopt the Bilingual instructional method in the teaching and learning of mathematics in schools.

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