EXPLORING THE EFFECT OF CODE-MIXING AND CODE-SWITCHING ON ACADEMIC ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS IN OYO METROPOLIS, OYO STATE, NIGERIA

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Abstract: The study investigated the effect of code-mixing and code-switching on academic achievement in mathematics among secondary school students. This study employed a quasi-experimental design. The population for the study comprises all secondary school students in the thirty-three (33) public secondary schools in Oyo metropolis. Thirty (30) JS 2 Students were selected from each school to have ninety (90) respondents as a sample. The instrument used was a Mathematics Achievement Test (MAT) which was validated by experts. Three research questions and one hypothesis guided the study. The instrument was tested for reliability using Croabach alpha and a reliability coefficient of 0.89 was obtained. The data collected were analysed using Pearson Product Moment Co-efficient (PPMC) and Analysis of Variance (ANOVA). The finding revealed that there is a mild relationship between the academic achievement of students taught mathematics with English language only and those taught using code-switching; that there is a strong relationship between the academic achievement of students taught mathematics with English language only and those taught using code-mixing; that there is a relationship between the academic achievement of students taught mathematics with code-mixing and those taught using code-switching and that there is a significant relationship between the achievement of students taught with English language only, code mixing and code-switching. Based on the findings, it was recommended among others that Mathematics teachers should strategically and 'gradually' introduce students to the use of code-mixing and code-switching to enhance their understanding of mathematical concepts.
Keywords: Code-mixing; Code-switching; Academic achievement; Mathematics

1 INTRODUCTION

The dismal performance of students in public mathematics examinations in recent decades has necessitated a re-evaluation of the current teaching methods, given its significance as a basis for national growth. It is a fundamental course spanning from basic education to the highest levels of academia worldwide. In a nation with around four hundred languages, Akindele and Adegbite [1] assert that the English language is crucial to the socio-economic, political, and cultural spheres of the populace. It serves as a lingua franca for Nigerians and a unifying language for the roughly two hundred and fifty ethnic groupings in the nation. A minimum level of conversational ability in the English language is therefore anticipated for an average educated Nigerian. Despite fewer than twenty-five percent of Nigerians being proficient in English, there exists a collective aspiration among citizens to acquire the language to integrate into the nation's political and socioeconomic framework [2]. Bilingualism is a prevalent communication phenomenon in Nigeria; so, a commendable Nigerian is fundamentally a bi-multilingual individual who primarily speaks their mother tongue and secondarily the English language. Language is essential in mathematics education for understanding mathematical concepts, problem-solving, and communication [3]. Research has demonstrated that students' language competence can influence their mathematics achievement, with language-minority pupils often encountering difficulty in acquiring mathematical knowledge [4]. Language is essential in mathematics education, functioning as the principal medium for conveying mathematical concepts, ideas, and problem-solving techniques. However, among multilingual pupils, the usage of many languages in the classroom might be a common event. Code-mixing and code-switching are linguistic activities wherein pupils interchange two or more languages within a single discussion or even within a single sentence. Moreover, Mathematics can be referred to be both the gate and key of Science; while every topic is taught through language. Hence, the a necessity to analyze the relationship between the extremely important topic in the light of the first language of the learner in a Nigerian setting where the majority of school children come from households where English is not used at all in communication [5].

Code-switching is defined as a communicative phenomenon of frequently switching between two languages in a bilingual's speech repertoire. Akindele & Adegbite describe Code-switching as a way of communication which entails a speaker shifting between one language and another in communicative events. Moschkovich [4] views the concept as a code switch when an individual who is bilingual shifts between two languages during his or her speech engagement with another bilingual while Essien Okon [6] describes it as an alternate transfer from one language to another. All these definitions suggest that the speaker in a code-switching situation must have communicative competency in two languages for them to be able to switch from one language to another; it may be the mother tongue (MT) and a second language (L2), in the same discourse. In regular discourse between two bilinguals, code-switching consists of eighty-four percent single-word switches, ten percent phrase switches and one percent clause switching [7]. Code-switching executes many roles in its naturally occurring context. Speakers code switch to manage influence or define situations as they like, and to transmit nuances of meaning and personal intention [8].

Code mixing in the context of teaching and language use, refers to the practice of switching between two or more languages or language varieties within a single discourse, sentence or phrase. This occurs in numerous educational settings including classes, seminars and conversations. Code mixing can be intra-sentential code-mixing that is, switching languages within a sentence or inter-sentential, that is, switching language between sentences. Muysken [9] characterizes code-mixing as instances in which lexical elements and grammatical attributes from two languages coexist within a single phrase. According to Bhatia and Ritchie [10], code-mixing denotes the amalgamation of diverse linguistic elements (morphemes, words, modifiers, phrases, clauses, and sentences) predominantly from two concurrent grammatical systems within a sentence. Code-mixing is specifically intrasentential and governed by grammatical concepts. Social psychological variables may also drive it. Notwithstanding these definitions, some individuals may struggle with the terminology, as various scholars employ differing terms for code-mixing. Pfaff [11] utilizes "mixing" as a neutral umbrella term encompassing code-mixing and borrowing. Some individuals struggle to differentiate between code-switching and code-mixing. Code-mixing incorporates features from several linguistic levels and units, from individual lexical items to entire sentences, making it challenging to differentiate between code-switching and code-mixing [12]. Code-mixing incorporates features from several linguistic levels and units, from individual lexical items to entire sentences, making it challenging to differentiate between code-switching and code-mixing [12].

Code-mixing and code-switching are widespread linguistic practices among multilingual individuals when they alternate between two or more languages in the same discussion or even within a sentence. In educational settings, these language patterns can have both beneficial and bad consequences on students' academic progress. Reasons for code-mixing and code-switching in education include clarity, accessibility, cultural relevance and teacher's language competency. Research in linguistics and education has acknowledged code-mixing and code-switching as common language patterns among multilingual individuals [13,14]. These linguistic activities might be motivated by numerous circumstances, including the urge to clarify complex concepts, fill lexical gaps, or develop social interactions [15]. Studies have also explored the impact of code-mixing and code-switching on language learning outcomes, with conflicting results. Some research suggests that code-mixing and code-switching can promote language learning by providing learners with opportunities to negotiate meaning and build linguistic awareness [16]. However, other research indicates that excessive code-mixing and code-switching can impair language learning by causing cognitive overload and distorting linguistic structures [17].

Despite the relevance of language in mathematics education, there is a scarcity of studies studying the impact of code-mixing and code-switching on mathematics achievement. The present work has mostly focused on language learning outcomes, with scant emphasis on mathematics instruction. This study attempts to solve this research gap by studying the impact of code-mixing and code-switching on academic attainment in mathematics among multilingual students. This study will contribute to our understanding of the intricate link between language and mathematical learning. It will also provide insights into the impact of code-mixing and code-switching on mathematical achievement, which can inform teaching techniques and language policies.

1.1 Statement of the Problem

The frequent practice of code-mixing and code-switching among multilingual students in mathematics classrooms has generated concerns about its effect on academic attainment. Despite the prevalence of these language practices, there is a paucity of research exploring their effects on mathematics learning as most of the studies were based on language education. As a result, stakeholders in education lack a clear understanding of how code-mixing and code-switching affect mathematics achievement, making it challenging to develop effective strategies to support multilingual students' learning. This study aims to address this knowledge gap by investigating the impact of code-mixing and code-switching on academic achievement in mathematics among secondary school students in Oyo metropolis, Oyo state, Nigeria.

1.2 Purpose of the Study

The main purpose of this study is to explore the effect of code-mixing and code-switching on academic achievement in mathematics among secondary school students. Specifically, the study sought to determine the;

1. relationship between the academic achievement of students taught mathematics with English language only and code-mixing.
2. relationship between the academic achievement of students taught mathematics with English language only and code-switching.
3. relationship between the academic achievement of students taught mathematics with code-switching and code-mixing.
4. relationship between the achievement of students taught with English language only, code-mixing and code-switching.

1.3 Research Questions

The following questions guided the study;
1. What is the relationship between the academic achievement of students taught mathematics with English language only and code-mixing?
2. What is the relationship between the academic achievement of students taught mathematics with English language only and code-switching?
3. What is the relationship between the academic achievement of students taught mathematics with code switching and code mixing?

1.4 Hypothesis

H_0: There is a significant relationship between the achievement of students taught with English language only, code-mixing and code-switching.

2 Methodology

This study employed a quasi-experimental design. The population for the study comprises all secondary school students in the thirty-three (33) public secondary schools in Oyo metropolis. Oyo Metropolis comprises of Atiba, Oyo East and Oyo East local government Areas. A school was randomly selected from each of the local government areas. Thirty (30) JS 2 Students were selected from each school to have ninety (90) respondents as a sample. The school in Atiba local government area was chosen to be the control group, the school selected in Oyo East local government area was tagged as Experimental Group 1 and the school from Oyo West local government area was tagged as Experimental group 2. The control group was taught using the English language only as an official language in Nigeria. Experimental group 1 was taught using code-mixing while experimental group 2 was taught using code-switching. The instrument used was a Mathematic Achievement Test (MAT) which was validated by experts in the field of test and measurement. Lesson note was developed for uniformity in teaching. The instrument was tested for reliability using Croabach alpha and a reliability coefficient of 0.89 was obtained. The permission of school heads was sought before the exercise was carried out in the various schools. Extensive teaching was carried out in the schools for six weeks with the assistance of research assistants after which the achievement test was administered. The data collected were analysed using Pearson Product Moment Co-efficient (PPMC) and Analysis of Variance (ANOVA).

3 Results

The results are as follows;
Research Question 1: What is the relationship between the academic achievement of students taught mathematics with English language only and Code-Switching?

Table 1 Correlations

		English language	Code-Switching
English language	Pearson Correlation	1	.331**
	Sig. (2-tailed)		.000
	N	30	30
Code-Switching	Pearson Correlation	.331**	1
	Sig. (2-tailed)	.000	
	N	30	30

Table 1 above reveals that there is a mild relationship (0.331) between the academic achievement of students taught mathematics with English language only and those taught using Code-Switching.
Research Question 2: What is the relationship between the academic achievement of students taught mathematics with English language only and code-switching?

Table 2 Correlations

		English language	Code-mixing
English language	Pearson Correlation	1	.893**
	Sig. (2-tailed)		.000
	N	30	30
Code-mixing	Pearson Correlation	.893**	1
	Sig. (2-tailed)	.000	
	N	30	30

The table 2 above shows that there is a strong relationship (0.893) between the academic achievement of students taught mathematics with English language only and those taught using code mixing.

Research Question 3: What is the relationship between the academic achievements of students taught mathematics with code-switching and code-mixing?

Table 3 Correlations

		Code-mixing	Code-switching
Code-mixing	Pearson Correlation	1	.573**
	Sig. (2-tailed)		.000
	N	30	30
Code-switching	Pearson Correlation	.573**	1
	Sig. (2-tailed)	.000	
	N	30	30

Table 3 shows that there is a strong relationship (0.573) between the academic achievement of students taught mathematics with English language only and those taught using code-switching.

Hypothesis Testing

H_{01}: There is no significant relationship between the achievement of students taught with English language only, code mixing and code-switching.

Table 4 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	12.102	1	12.102	43.532	.000[b]
1	Residual	26.488	88	.278		
	Total	38.590	89			

In the ANOVA table 4 above, it was revealed that the significant value of 0.000 is less than the p-value of 0.05. Therefore, we reject the null hypothesis and accept the alternative hypothesis that there is a significant relationship between the achievement of students taught with English language only, code-mixing and code-switching.

4 DISCUSSION OF FINDINGS

Table 1 revealed that there is a mild relationship between the academic achievement of students taught mathematics with English language only and those taught using code-switching. The finding suspected that the students in secondary schools in Oyo metropolis appreciate teaching not done purely with the English language. The mild relationship was a result of the switches. It was also suspected that the aspect taught while switching was the aspect understood by the students more, that is, their mother tongue. The finding is corroborated by the study of Sert [8] that teaching mathematics in the mother tongue contributes to students' achievement in mathematics.

Furthermore, table 2 shows that there is a strong relationship between the academic achievement of students taught mathematics with English language only and those taught using code mixing. The relationship is stronger than that of code-mixing. This is a sign that the students are with the teacher from the beginning of the class to the end unlike using code-switching. The finding is in support of the report of Atolagbe & Sabitu [5] that when the mother tongue is mixed with the English language during teaching, the students tend to learn more and achieve better. Moreover, the finding revealed that there is a relationship between the academic achievement of students taught mathematics with code-mixing and those taught using code-switching.

In conclusion, it was revealed that there is a significant relationship between the achievement of students taught with English language only, code mixing and code-switching. Comparing the outcome of their achievement tests, it was deduced that there is a relationship between their academic achievements in mathematics. This indicates that if mathematics teachers can make use of the methods of code mixing and code switching together during teaching and learning, the students will benefit much and the teaching-learning process will be more effective. This assertion is in line with the study of Atolagbe & Sabitu [5]; Moschkovich [4] and Cook [16].

5 CONCLUSION

The findings of this study reveal a significant relationship between the language of instruction and academic achievement in mathematics. Specifically, the results suggest that students taught mathematics using a combination of code-mixing and code-switching (in addition to English) tend to perform differently compared to those taught using the English language only. This study's outcomes are important for mathematics education, particularly in multilingual settings. The results imply that incorporating students' mother tongue into mathematics instruction through strategic code-mixing and code-switching can be a viable teaching approach. This approach may facilitate deeper understanding, improve academic achievement, and enhance learning experiences for linguistically diverse students. The study's conclusions underscore the need for educators and policymakers to reconsider the role of language in mathematics education. Rather than adhering to a strict English-only approach, teachers can explore innovative, linguistically responsive methods to support students' mathematical development.

6 RECOMMENDATIONS

Based on the findings, the following recommendations were made;
- Teachers of mathematics should be encouraged to use code mixing during the class. They should desist from speaking English language from the beginning of the class to the end
- Mathematics teachers should strategically and 'gradually' introduce students to the use of code-mixing and code-switching to enhance their understanding of mathematical concepts.
- Mathematics teachers need to offer additional language support for struggling English learners, including bilingual materials, language tutors or multilingual teaching assistants.
- Professional development should be provided by the government to teachers to enable them to be informed about effective approaches to teaching mathematics to linguistically diverse students.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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