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Code-Switching and the Academic Performance of Learners in Mathematics Subject Toward Teacher Development Program

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Abstract

The school is an integral part of a community that embraces diverse cultures and languages, significantly influencing the teaching and learning process within classrooms. The presence of multiple languages in classrooms results in teachers and students using more than three languages, a phenomenon known as code-switching. This means that speakers use two or more languages to communicate a message to their audience. Code-switching affects not only language subjects but all subjects. This study specifically investigates the use of code-switching during Mathematics discussions to determine its impact on students' academic performance. The findings indicate that code-switching is frequently used by teachers and students during classes, but it does not have a significant relationship with students' academic performance. Moreover, as students' academic performance, as indicated by their grades, improves, code-switching serves as a beneficial tool during the teaching and learning process and does not hinder the amount of learning students receive. Additionally, code-switching is found to be an effective teaching and communication tool during Mathematics discussions.

Keywords: *Code-Switching, Academic Performance, Mathematics Education, Medium of Instruction, Teacher Development, Language Proficiency, Bilingual Education, Teaching Strategy, Learning Outcomes, Junior High School*

INTRODUCTION

The Philippines is a multilingual community with rich culture and traditions. It has over 171 languages, four of which have no known speakers (Ethnic Groups of the Philippines, 2021). In the 1987 Philippine Constitution on Bilingual Education, Filipino and English language was recognized as the official Medium of Instruction (MOI). The Department of Education adopted this through DepEd Order 52, s 1987. Both languages were used in specific curriculum areas at both primary and secondary levels. The English language was used in science, mathematics, and technology subjects while the rest of the curriculum areas were taught using Filipino. The Republic Act 10533, known as Enhance Basic Education of 2013, learners use their mother tongue as the MOI in teaching Kindergarten to Grade 3 which aims to

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aid the learners' language development and skills. While the Grade 4 to Grade 12 use Filipino and English as MOI. These acts enabled learners to speak more than three languages, thus resulting in code-switching.

Code-switching (CS) is the juxtaposition of sentences using two or more languages within sentences and phrases (Mabule, 2015). It had three types: inter-sentential, intra-sentential, and tag-switching (Mangila, 2018). Each type functions differently depending on the purpose of the communication. CS, as MOI, in which it is highly discouraged in the researcher's locale. It is also supported by research reviewed by the researcher in the literature review. It is feared to have long-term effects and may cause poor development in English proficiency, the MOI to be used when teaching Mathematics (DO 52, s 1987).

According to Anthony and Walshaw (2009) in their study titled "Characteristics of Effective Teaching of Mathematics A View from the West," mathematical language is among the ten principles of effective mathematics pedagogy of teaching. Learning is more effective if the teacher uses more familiar words, such as their first language. The acquisition of the mathematics lessons is better if the learners can reflect and relate with it. This is unconsciously or consciously applied in the teaching-learning process by the teachers and learners in the form of code-switching. Upon the initial observation and interview of the researcher, it is noted that Mathematics teachers admitted that they used code-switching in class discussion especially in introducing complex words.

Furthermore, studies conducted in relation to code-switching in class discussion mostly pertains in English language acquisition. It is used to find equivalent word for complex English word so that learners will understand the lesson. No study is conducted with Mathematics as subject, where code-switching is used in discussion and its effect on the academic performance of learners.

This study aims to study the effect of the use code-switching in class discussion on learners' academic performance in mathematics. The result of this study will give insight to the curriculum planners, teachers, school heads, and stakeholders on how code-switching affects academic performance. It will give an insight into how language learners and mathematics can be used to bridge the teaching-learning process. The findings of this study will provide valuable support on how to improve the language development of learners towards improving learning mathematics concepts and lessons.

The language employed during instruction plays a pivotal role in its dissemination and effectiveness. Learners hailing from diverse social and cultural backgrounds often exhibit unique learning styles. Code-switching, the use of multiple languages by speakers to convey meaning, is a conscious practice employed based on the objectives and audience of the speakers. Educators utilize code-switching as a scaffolding tool to facilitate the learning process, thus enabling students to grasp concepts comprehensively and in a relatable manner.

The relationship between learners' thinking, learning, and language is closely intertwined. Language serves as a tool for exploring and synthesizing new concepts based on past experiences, knowledge, and educational attainments. In the Philippines, educational institutions are embedded within a multilingual environment. Both students and educators engage with and master more than three languages, including their native tongue, the national language (Filipino), and English. Consequently, code-switching (CS) - the act of alternating between two or more languages within a conversation - is prevalent. The implications of CS on learning outcomes have been the subject of much scholarly inquiry, with conflicting views on its impact. The K to 12 Basic Education Program, also known as the Enhanced Basic Education Act of 2013, stipulates that the Mother Tongue is the medium of instruction for Kindergarten to Grade 3, while Filipino and English are gradually introduced in specific subjects from Grade 4 to Grade 12. Nonetheless, some scholars assert that reliance solely on the learners' native language or the prescribed medium of instruction presents constraints to effective learning. Consequently, the question arises as to the implications of code-switching in Junior High School mathematics discussions and its potential effects on academic performance.

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Functions of Code-Switching as Medium of Instruction

In his 2019 research, Roxas analyzed the code-switching behavior of learners in academic settings. He investigated the purposes, influences, and types of students' code-switching. Roxas administered surveys that delved into the participants' demographic details, reasons for employing code-switching, and the specific forms of code-switching they often utilized. His findings revealed that learners resorted to code-switching when they struggled to find the right words to articulate themselves, which he described as personification—a manner through which learners conveyed their thoughts and viewpoints. Moreover, code-switching was observed to aid learners in comprehending the subject matter. Roxas concluded that code-switching could signify inadequate proficiency in English and suggested that educators strategically integrate both the first language and the second language for more effective learning. Throughout the research, the predominant form of code-switching observed was inter-sentential.

In Sert's (2005) discussion, the functions of code-switching (CS) were explored in relation to both teachers and learners. For teachers, CS serves three main functions: topic switching, affective expression, and repetition. Topic switching involves adapting language to enhance learning opportunities, while affective expression is used to convey emotions and build solidarity. Additionally, CS is utilized for repetitive purposes, ensuring the effective transfer of essential knowledge.

Sert identified four functions of code-switching among learners: equivalence, floor-holding, reiteration, and conflict control. Equivalence involves using the native language equivalent of the target language. Floor-holding refers to maintaining communication through code-switching, and conflict control uses code-switching to convey intended meanings and prevent miscommunication. Code-switching serves communicative purposes and provides support. Sert concluded that code-switching does not obstruct learning but has a long-term impact on learners. Therefore, it is the teachers' responsibility to prevent this long-term impact.

As Roxas and Sert mentioned, CS serves many functions and implications in students' learning development. In 2018, Sanchez et al. conducted a study investigating CS in the early-age development of number sense. Their research delved into how educators perceive and utilize mathematical language when teaching young children. They observed that teachers often employed familiar terms instead of precise mathematical language. Through extensive observations, interviews, and video recordings, it became evident that teachers focused on building conceptual understanding by adapting their approach to meet the student's level of comprehension. Moreover, they leveraged the students' prior experiences within their context to support the development of mathematical language. Emphasizing the complexity and abstract nature of mathematics, Sanchez et al. concluded that CS is an empowering tool for constructing meaning and teaching mathematical concepts to young learners.

Effect of Code-Switching as Medium of Instruction

In Sanchez et al.'s study, the research participants ranged from preschoolers to Grade 1 learners. Within the Philippine context, K-3 students used their mother tongue as the medium of instruction (MOI), with Grade 4 students transitioning to the use of the national language and English as the MOI. However, the potential impact on intermediate level learners remains uncertain. Malik (2014) conducted a study on the impact of code-switching (CS) at the intermediate level in Pakistan, exploring its utility, its correlation with learners' success, its influence on their emotional well-being, and the perceptions of both teachers and learners towards CS in English Language Teaching (ELT) classrooms. The findings revealed that students responded positively to CS, finding it conducive to more effective learning and easier acquisition of new knowledge. Increased use of CS by teachers was associated with improved emotional states in learners, increased participation, and a greater enjoyment of the learning process, creating a comfortable environment and reducing anxieties.

Malik captured the positive effect of CS on instruction; this is supported by Manny et al. (2018). They researched the impact of CS and the effect of CS on the English learning and teaching of two schools in the Sibbinda Circuit. He thematically analyzed the perceptions of teachers and learners toward the use

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of CS. The results of their research reveal that CS has not only positive but also adverse effects on learning. These were in terms of appropriateness, impact, and participants' perceptions.

There are varying opinions among teachers regarding the use of Code-Switching (CS). Some argue that CS should only be used when necessary. They believe that incorporating CS with unfamiliar words helps learners better understand and reflect in real-life situations. Additionally, it is thought that the use of CS allows learners to follow instructions, express themselves, and ask questions more effectively. However, it has been pointed out by some teachers that CS may not be beneficial, as learners may become overly reliant on being taught in their native language. It was also suggested that teaching learners using CS at a lower level may lead to increased reliance on CS at higher levels. Consequently, it is recommended that the use of CS should be based on the specific needs of the learners.

Furthermore, some learners have shown resistance to CS due to their lack of familiarity with the language context. Their conclusion is that while CS can assist students in understanding the lesson, it should, like Malik's viewpoint, only be utilized when truly necessary. It is advised that learners at lower levels should be taught in English to establish a strong foundation in the target language.

In addition, research conducted by Malik (2014) and Manny et al. (2018) was conducted in Pakistan and Namibia. Similarly, a commentary article by Borlongan (2012) discusses the context of CS in the Philippines. CS is regarded as a valuable resource for teaching and learning, serving as a tool to facilitate the learning process. These findings align with Mangila's (2018) research on the language practices of Filipino teachers during English language instruction, highlighting CS as a pedagogical strategy that supports learners' cognitive development. Through CS, teachers can assess comprehension, clarify points, explain context, and provide practical examples. CS actively promotes learners' participation, allowing teachers to better engage with their students and receive valuable feedback. This facilitates student comprehension and enhances the overall learning experience.

The aforementioned research delves into the practice of code-switching (CS) in the context of acquiring the English language and its implications for learning. The study focuses on early learners in the process of building proficiency in English as stipulated in their curriculums. Bravo-Sotelo's (2020) study examined the use of Tagalog-English CS in mathematics classrooms, with tertiary-level math teachers serving as participants. The goal was to identify the most prevalent types of CS in mathematical discourse. The findings revealed that the inter-sentential type of CS was predominantly utilized in explaining mathematical concepts, with teachers seamlessly transitioning between Tagalog and English. The study concluded that using either pure Tagalog or pure English might present limitations, emphasizing that both languages complement each other in instructional contexts. It also emphasized the potential of CS in enhancing learners' mathematical skills. Additionally, the study underscored the importance of collaboration between English and Math teachers to further cultivate learners' proficiency in the target language and mathematical concepts.

Sert (2005) defined the diverse functions of code-switching (CS) in learning, which have been substantiated by the research. It was posited that CS does not indicate a lack of proficiency in the language of instruction, but rather serves as an effective tool in teaching and concept-building (Bravo-Sotelo, Roxas, Sanches et al.). Although CS can have both positive and negative effects on learning, it is crucial to address its negative effects early on to prevent long-term consequences (Malik, 2014). The question remains: What are the implications of using CS at the junior level on learners' cognitive development? The existing research focused on language acquisition and the perceptions of teachers and learners, but none utilized learners' performance as a measure of the effect of CS on the learning process. Additionally, while research was carried out at the primary and tertiary levels for mathematics, none specifically addressed the intermediate level. Consequently, a gap in research has been identified that necessitates exploration: What are the implications of CS on academic performance in mathematics at the intermediate level?

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METHODOLOGY

This study utilized a descriptive quantitative design. Descriptive research describes the characteristics of a particular individual or group (Kothari, 2004). One of its main purposes is to describe the state of affairs as it currently exists. It described the level of frequency of using code-switching between the two groups: Mathematics teachers and Junior High School learners. It also reflects the effect of CS in the subject mentioned above on the JHS learners' academic performance.

It also adopted the quantitative method of gathering and analyzing data to answer the research questions and arrive at a sound interpretation and conclusion. A quantitative research method is based on the measurement of quantity or amount (Kothari, 2004). It involves an interplay among variables allowing the researcher to measure the study's outcomes (Martin & Bridgmon, 2012). It is the most coherent way of proving a hypothesis, especially when the raw data speaks for itself. It provides more concrete evidence disapproving or approving the claims of the researcher.

The research study involves one school division with eight secondary schools. The population had diverse languages but the native tongue in the research setting is Ivatan. Consequently, students in this setting learn to speak three or more languages, making it a suitable environment for their study. The population of mathematics teachers in the division is relatively small. It was opted to consider them all while the secondary students were chosen using stratified random sampling.

The researcher adapted survey questionnaires to determine the level of frequency of using CS in Mathematics classroom discussions (Malik, 2014; Kumar, Nukapangu, & Hassan, 2021; Momenian & Samar, 2011). It was contextualized to match the research locale and subject area. The first part of the survey involves the demographic and language profile of the respondents. The second part was composed of 35 question statements. A five-point Likert scale is used to rate the level of the frequency of each question statement. The first ten questions pertain to the function of CS in Mathematics classroom discussion, while the other ones pertain to CS's effect.

Weighted Mean	Descriptive
4.50 – 5.00	Always
3.50 – 4.49	Often
2.50 – 3.49	Sometimes
1.50 – 2.49	Rarely
1.00 – 1.49	Never

Another research instrument used in this study is the academic grades during the first to fourth grading period of the Junior High School learners of the school year 2022-2023.

The study used the following statistical tools in making the in-depth analysis. (1) Mean was used to describe the level of frequency of using code-switching during Mathematics class discussions. Also called the arithmetic mean and as one of the measures of central tendency, it is the average of group scores (Jackson, 2009). (2) Standard deviation, a measure of variability, measures the average distance of data from its mean (Jackson, 2009). This was used to better infer the general use of CS as a medium of instruction in teaching mathematics at the junior high school level. (3) An independent sample t-test is an inferential statistical test of the null hypothesis. It was used to determine if there is existing significance between the mean of two unrelated variables. The independent sample t-test was used to statistically test the significance between the assessments of the two groups of respondents on the level of frequency of using code-switching during mathematics discussions. The researcher used an alpha level of 0.05 on whether to reject or accept the null hypothesis. (4) To answer if there is a significant relationship between the frequency of using code-switching and the academic performance of students in mathematics, the

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researcher used Pearson's r. It measures both variables are measured on an interval or ratio scale (Jackson, 2009). The researcher used an alpha level of 0.05.

RESULTS

1. **What is the frequency of using code-switching during mathematics class discussions as assessed by two groups of respondents?**

Table 1 Teachers' and Students' Responses on the Extend use of Code-Switching During Mathematics Discussion

Indicators	Teacher			Student			Group		
	Mean	SD	Int	Mean	SD	Int	Mean	SD	Int
1. Code-switching as an instruction medium increases the confidence of learning interaction between the teacher and learners.	4.11	0.67	Often	3.84	0.91	Often	3.87	0.90	Often
2. Code-switching should be used as the medium of instruction in Mathematics.	3.68	0.85	Often	3.72	0.91	Often	3.72	0.91	Often
3. Teachers should use another language other than English in teaching Mathematics.	3.96	0.73	Often	3.57	1.20	Often	3.61	1.17	Often
4. Lectures are better explained when the teacher uses code-switching.	4.11	0.72	Often	3.89	0.95	Often	3.91	0.93	Often
5. Lessons are more exciting and relatable when code-switching is used as the medium of instruction.	3.82	0.93	Often	3.76	0.95	Often	3.76	0.95	Often
6. Code-switching promotes the efficiency of learning and time management.	3.96	0.82	Often	3.74	0.88	Often	3.76	0.88	Often
7. Code-switching does not complicate the mathematics lesson.	3.71	0.96	Often	3.28	1.18	Often	3.32	1.17	Often
8. The class actively participates when code-switching is used as the medium of instruction.	4.26	0.64	Often	3.72	0.90	Often	3.77	0.89	Often
9. My numeracy skill was improved when teachers	4.08	0.78	Often	3.80	0.94	Often	3.83	0.93	Often

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used code-switching to explain the lesson.									
10. The interaction within the classroom is more effective and exciting when two or more languages are used.	4.14	0.74	Often	3.78	1.00	Often	3.81	0.99	Often
11. The intentions are best explained when I code-switch with two or more languages.	4.11	0.67	Often	3.74	0.95	Often	3.77	0.94	Often
12. New vocabulary and concepts in Mathematics are explained clearer when it is explained in two or more languages.	4.04	0.91	Often	3.83	0.92	Often	3.85	0.92	Often
13. Misunderstandings and misconceptions are clarified using code-switching.	4.07	0.75	Often	3.81	1.04	Often	3.83	1.02	Often
14. Code-switching is used when discussions in Mathematics demand more explanation and relatable real-life examples.	4.25	0.69	Often	3.83	0.97	Often	3.87	0.95	Often
15. Code-switching gives Mathematics discussion life and emphasis.	4.00	0.76	Often	3.88	0.98	Often	3.89	0.96	Often
Overall	4.02	0.57	Often	3.75	0.66	Often	3.77	0.66	Often

Table 1 shows the responses of the two groups: teachers and learners, on the level of frequency of code-switching during mathematics discussions. Teachers and students used code-switching to deliver and understand the mathematics lessons comprehensively while actively participating in class. This is supported by the table provided above wherein all indicators are generally and verbally interpreted as "Often" with a mean of 3.77 (SD=0.66). These indicators reflect the effects and functions of CS in Mathematics discussion. Furthermore, this claim is also supported by indicator item number 4 which states that "Lectures are better explained when the teacher uses code-switching." which has the highest mean ($\mu = 3.91$, SD = 0.93) among the 15 indicators which are verbally interpreted as "Often".

Teachers used code-switching in promoting learners to an active participation and comprehensive understanding of the lesson. Supported by the indicators items 8 and 14 that state, "Class actively participate when CS is used as MOI." and "CS is used when the discussion in Mathematics demands more explanation and relatable real-life examples." having a mean of 4.26 (SD=0.64) and 4.25 (SD=0.69), respectively where both are verbally interpreted as, "Often".

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These attest to the findings of Sert (2005) and Mangila (2018) on the functions of CS inside the classroom. It is considered as a useful strategy to promote classroom interaction. It aims to provide clearer meaning and efficient transfer of knowledge. By providing practical and familiar examples to learners, they will easily understand the content of the discussion. It provides learning environments of active participation as such teachers can use this as an instructional strategy to ensure the effective and efficient transfer of knowledge.

With the diversity of learners, from their learning development and language proficiency, the learning gaps should be closed by providing scaffolding to learners and breaking the language barrier. The interpretation of "Large extent" ensures that learning should take place by aiding the learners with language they can understand and relate to. Code-switching is a learning strategy tool to address the language proficiency gaps and the affective state of learners.

2. What is the academic performance of junior high school students in mathematics where code-switching is used as a medium in mathematics class discussions?

3.

Table 2 Academic Performance of JHS in Mathematics Subject SY 2022-2023

Quarter 1			Quarter 2			Quarter 3			Quarter 1-3		
Grade Level	**Mean Grade**	**SD**	**Grade Level**	**Mean Grade**	**SD**	**Grade Level**	**Mean Grade**	**SD**	**Grade Level**	**Mean Grade**	**SD**
7	85.14	2.38	7	85.57	2.74	7	86.59	3.32	7	85.77	2.90
8	85.30	2.22	8	86.16	2.70	8	87.88	1.35	8	86.45	2.41
9	86.66	1.86	9	87.52	2.39	9	87.77	1.79	9	87.32	2.09
10	86.45	2.96	10	86.67	2.89	10	87.89	2.99	10	87.00	3.01
Overall	85.87	2.46		86.47	2.78		87.52	2.54		86.62	2.68

Table 2 represents the academic performance in mathematics subjects from the first to the third quarter of SY 2022-2023. The use of CS impacts the learning outcomes of the learners in both cognitive and affective states. As shown in the table, the overall academic performance of JHS students in Mathematics, where code-switching is used as a medium of instruction, is 86.62 with a standard deviation of 2.68. Deductively, the general weighted average of learners shows slight progression from the first to the third quarter.

This attests to the findings of Memory (2018), wherein the learners that were taught in the mother in the lower years increase the use of CS at the upper level. Learners became comfortable with CS and more reliant on the use of another language rather than the required medium of instruction. Though the academic performance of the learners also signifies that there is increasing academic performance. It means that the learners understand the lesson and gain mastery of the lesson (Roxas, 2019).

Learning can be complicated because of language proficiency, lack of understanding, and comprehension of what is being taught. Teachers used CS to choose more compatible language appropriate for the part of the learner. With the increasing level of learning competency, teachers are subject to using the language that the learners are most comfortable. The positive relationship between the academic performance of learners and the extent of use is a reflection that the use of CS as a learning tool provides learners with better academic performance in mathematics.

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4. Is there a significant difference between the assessments of the two groups of respondents regarding the frequency of code-switching during mathematics discussions?

Table 3 Result of Independent Sample T-test Between the Assessment of the Two Groups

Teachers		Student		Computed t-value	Critical Value	p-value	Decision	Interpretation
Mean	SD	Mean	SD					
4.02	0.17	3.75	0.51	2.048	1.96	0.000	Reject H_o	There is a significant difference between the assessments of the two groups of respondents on the frequency of using code-switching in mathematics discussions.

Table 3 shows the result of the independent sample t-test of the two groups on the frequency of using code-switching in mathematics discussions. With the computed p-value of 0.000 is less than the 0.05 significance level (95% confidence level), it is therefore concluded that there is a significant difference between the use of code-switching by teachers and students during mathematics discussion.

According to Borlongan (2012), CS can be used with a purpose and could even use as a resource in teaching and learning. Teachers clearly used more code-switching than learners to provide more comprehensive discussion with the learners. It provides a comfortable environment for learners and decreases the learners' anxieties (Malik, 2014). For learners with low proficiency in language, CS can be used to define unfamiliar words (Memory, 2018). It is clear that teacher uses more code-switching to provide learners with quality and relevant education.

5. Is there a significant relationship between the frequency of code-switching and students' academic performance in mathematics?

Table 4 Pearsons' r Result and Significance Between the Extend of Use of Code-switching and Academic Grades of JHS Learners

Paired Variables		The computed value of r	Strength of relationship	Tabulated value of r at $\alpha = 0.05$	p-value	Decision	Interpretation
Variable A	Variable B						

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Extent use of code-switching in Mathematics discussion	General Weighted Average of JHS Learners	0.121	Very small positive correlation	0.707	0.775	Accept H_o	There is no significant relationship between the frequency of code-switching and the academic performance of students in mathematics.

Table 4 shows the result of the correlation and significance of the relationship between the extent of use of code-switching and the general weighted average of JHS learners. With the computed p-value of 0.775 greater than the 0.05 significance level (95% confidence level), it can be concluded that there is no significant relationship between the use of code-switching by teachers and students during mathematics discussions.

According to Sanchez et al. (2018), educators' choice of language is grounded in assuring good communication flow and allowing for mathematics meaning to be interpreted. Code-switching is a language aid by using familiar terms to make meaning of mathematical concepts. Though CS does not have a significant relationship with the academic grades of learners, it is important in conceptualizing mathematical concepts and unlocking vocabulary words (Mangila, 2018).

These findings on the use of code-switching in Mathematics discussion do not have an effect on the academic grades of JHS learners in mathematics. However, it is used as a learning tool to provide learners with a quality education where they use it as an aid in comprehension and introduction of new mathematical concepts. Also, learners were more comfortable with a language that they understood and related to. The two groups highly recommend using the required medium of instruction; thus, further training and improvement of learners' proficiency in the target language should be considered.

Discussion

Code-switching serves as a teaching tool, providing an alternative medium to facilitate learning and enhance learners' understanding, particularly in emphasizing mathematical concepts. It significantly impacts the development of learning by allowing students to relate through contextualized real-life examples. Real-life applications of mathematical concepts not only deepen learners' understanding but also encourage the application of these concepts to real-life scenarios. Furthermore, code-switching has a practical function (Sert, 2005); teachers use it to foster active participation in mathematical discussions, facilitating academic discourse among learners and teachers. The use of familiar languages to students in teaching mathematical lessons contributes to their improved comprehension of the content.

The use of code-switching is a common practice in Mathematics discourse for both teachers and learners. It acts as a support system for the learners; the teachers utilize language that the students are proficient in, providing clear interpretation and delivery of the lesson. However, it's important to note that code-switching is limited to English, the required medium of instruction for teaching Mathematics.

The degree of code-switching has been found to have a positive impact on the academic performance of learners. The effectiveness and comprehension of lessons are influenced by code-switching, indicating that it offers more engaging learning opportunities for a diverse group of students. Furthermore, an increase in the use of code-switching has been linked to higher academic grades in

Mathematics. However, this may lead to dependency on code-switching as students' progress to higher levels, as noted by Malik (2018).

It's worth mentioning that the perspectives of teachers and learners on the extent of code-switching usage differ. Teachers tend to code-switch more frequently during Mathematics discourse compared to students, using it to establish connections between the lesson content and the learners.

While there is a weak positive correlation between the level of frequency of using code-switching and academic performance, it's important to acknowledge that other factors, such as teacher influence and learning competency, also play a role in academic success. On the whole, it's suggested that code-switching does not have a significant impact on the academic performance of learners in Mathematics. With the findings mentioned above and conclusions, this study here by recommending the following:

1. Recognize code-switching as a crucial learning tool that does not impede the teaching and learning process. It must be acknowledged as more than just an alternative instruction medium, but as an effective teaching tool for providing quality and relatable education. This approach is particularly beneficial for learners with low proficiency in the required language, enabling them to better understand and relate to concepts based on their rich life experiences.
2. It is essential to establish comprehensive policy guidelines regarding the use of code-switching as an alternative medium of instruction. These guidelines should encompass limitations, appropriateness, and proper usage. Importantly, it should be specified that mathematics discussions should not be conducted solely using code-switching. The policy should provide clear direction on when and how code-switching can be utilized.
3. A program or training session should be organized for mathematics teachers. It should focus on the appropriate and effective use of computer science as an alternative medium of instruction. Since the language of mathematics is English, the training should also address the importance of English language proficiency. This could include proficiency training or enhancement to ensure that teachers are fluent and capable of translating mathematical concepts into simple English terms suitable for students' language development.
4. Mathematics and English teachers should collaborate in improving learners' comprehension and thinking out of the box. It will develop their critical thinking and ability to understand mathematical concepts, thus, able to solve mathematics problems.
5. Further study on Code-switching is needed, particularly the most used type of code-switching used in the classroom of the two groups. The implications of using code-switching in both short- and long-term. This study incorporates the effect of code-switching starting from Grade 3 up to Grade 12. Its ripple effect on learning shall be measured using standardized tests where their comprehension and application of their understanding mathematical concepts will be applied.

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