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Taglish Code Switching as a Strategy in Teaching Mathematics

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Abstract

Language plays a vital role in understanding mathematical concepts, especially where English is not the learners' first language. Despite the common use of Tag-lish in classrooms, research on its effectiveness in secondary mathematics under the new normal is limited. This study examined the effect of Tag-lish code switching on students' mathematics achievement, attitude toward mathematics, and problem-solving efficacy using a pretest-posttest quasi-experimental design. The control group (n = 15) received pure English instruction, while the experimental group (n = 15) received Tag-lish instruction. Paired samples t-test and ANCOVA were used to analyze data. Both groups improved from pretest to posttest, but ANCOVA showed that the experimental group outperformed the control group in mathematics achievement and problem-solving efficacy. While both methods had similar effects on attitude toward mathematics, Tag-lish was more effective overall. The study recommends using Tag-lish code switching in teaching high school mathematics.

Keywords: Tag-lish Code Switching, Mathematics Achievement, Problem-Solving Efficacy, Attitude toward Mathematics, Quasi-Experimental Design

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INTRODUCTION

The COVID-19 pandemic brought social changes, influenced languages on a global scale and swiftly changed the educational set-up into virtual classrooms. Teachers and students have adapted the new normal in the teaching-learning process but smooth communications have become a hindrance. Since English as the official language in mathematical instruction was different from the native language of the students and the teacher, teachers use teaching strategies like code-switching (use of Tag-lish) to deliver information easily.

Webb and Webb (2008) noted that directives in math classrooms can be smoothly assimilated by learners if the educators code-switched. There are also studies that show the positive impacts of code switching to the mathematics achievement (Adesokan, 2021) and the academic achievement of the learners (Simasiku, Kasanda & Smit, 2015). The study of Maluleke (2019) also managed to reveal various reasons why teachers use code switching instead of using pure English as a language of learning and teaching. It also highlights the importance of code switching as an empowerment strategy to use in a multilingual classroom to improve the students' mathematical performance.

However, code-switching (CS) as a teaching strategy previously received attention from Filipino scholars and the use of the first language (Tagalog) of students has been consistently discouraged by teachers and policy makers of education (Barnard & Li, 2016). Yet in the context of multilingual countries like Philippines having 170 various languages (Nolasco, 2008), code switching (CS) can be a strategic move to meet communication needs. Some of the teachers are using Tag-lish to explain terms and concepts that are confusing to the students. Besides, to Bernardo (2002) as cited by Borlongan (2012), code switching perhaps permitted as an influential method in teaching and learning for bilingual or multilingual teachers and students. In connection to this, some researchers support the assertion that code switching promotes the educational goals of delivering content knowledge (Simasiku, Kasanda & Smit, 2015) and increases attention to the content and facilitates understanding (Zabrodskaja, 2007). Salehmohamed & Rowland's (2014) study (in Mauritius) also showed that code-switching in a mathematics classroom is a vital support. Thus, the use of code switching between Tagalog and English in teaching mathematics in new normal should be addressed.

Grosjean (1982) defined code switching as the shifting that happens between two or more languages instantaneously in one conversation, which may happen with the speaker being unconscious (Wardhaugh, 1992). Code switching is commonly used in switching from a language one is currently using to another one. As for this study, it made use of the Taglish code switching. Thompson (2003) asserts that this occurrence (CS) have been observed in advertisements, radio shows, and other media sites and then later describes the prevailing use of Tagalog and English code switching as "Tag-lish". Tag-lish is the language commonly used by Filipinos. It is a combination of Tagalog and English words uttered at the same discourse. Recently, Tag-lish has been viewed as a mode of discourse and a linguistic resource in the bilingual's repertoire (Bautista, 2004).

For the past decades, studies in code-switching were developed, great numbers of books have been written, and linguists interested in studying language occurrences (CS) have conducted researches. Examples include the study conducted by Chitera (2009) on how mathematics teacher educators view code switching and how they create a multilingual classroom. Research results show that the mathematics teacher educators favour multilingualism and the communication practices that come with it such as code-switching more as a problem than a means for teaching and learning.

On the other hand, Cook (1989) assert that code switching practice does not only happen in classrooms, in most cases though English is the medium of communication for instruction, some lecturers consider code switching in the classroom as their teaching strategy. Furthermore, in an investigation conducted by Sepato (2003) she found that multiple students, in rural areas (Botswana) in particular, are incapable of answering to the teacher's English language questions. Sepato (2003) accused this condition partially on the teaching strategy/style found in Botswana schools. Setati and Adler (2000) also revealed that when a teacher uses English language mostly for explanation, chances of developing meaningful learner-centered communication and writing become limited, and rote learning of procedures also takes place. Moreover, Adesokan (2021) investigated the effect of code switching on Pre-NCE students' achievement in Mathematics, two of their second semester courses (Mechanics and Statistics) were used for the research. Students were taught using pure English in a week and after a week, using code switching. Results finding indicated that Pre-NCE students perform better when the teacher is alternating between official language and their first language.

Mathematics Achievement

Code switching has been a help for the learners to cope with the subject content. It clarifies meanings and expressions which lead for the learners to gain higher mathematical achievement. Mathematical achievement, defined by Pandey (2017) is the competency shown by students in a mathematics subject which is measured on the score gained by students in a mathematics achievement test. Students with low English proficiency were unable to acquire information given when English is the language of instruction. Oftentimes, terminologies used in mathematics are not common words which become the barrier for the students' understanding of the lesson. Sotelo (2020) recommended the use of Tagalog-English intrasential code switching as the language of instruction to deliver content and knowledge for mathematics lesson.

Attitudes toward Mathematics

Teaching strategy has a large influence on students' attitude toward mathematics. Note that learning mathematics is not simply about solving but it also involves thinking, and reasoning, and also students' attitudes and perception toward learning mathematics (Kele & Sharma, 2014). Feelings affecting person's mood and emotional reaction can be referred as affective, and the students' attitude toward mathematics is an example. Positive attitude towards mathematics subject can cause higher achievement, and high achievement can result in more favourable attitudes. However, the problem is that the students' are already concluding that mathematics is hard without even trying to solve which then later causes them to develop a negative attitude towards mathematics.

Researchers claimed that students' positive or negative attitudes may affect their level of success in mathematics in a good or bad way. In the study of Yasar (2016), findings show that the High School students' attitude toward mathematics is at a medium level. Teklesellassie and Boersma (2018) also examined whether demographic factors like first language and gender could affect the students' (in Ethiopia) attitudes towards the use of local language in an English medium content subjects (like mathematics). Results indicated that both teachers and freshman students had favourable attitudes towards the use of local language (Amharic) in the English medium content subject.

Problem-Solving Efficacy

Problem-solving efficacy is defined as the capability to perform a problem-solving process in a logical context using experiences. Students with higher self-esteem will most likely perform better inside the classroom (Mohammad, 2010). Moreover, low mathematics performance is a result of difficulty to understand the subject content and students' lack of belief to solve a mathematical problem. Students were tested using word problems in English that is not the students' first language (Bernardo, 2002). It was found that 33 to 39 percent of the students' mistakes were related to reading comprehension. These errors occurred due to a low level of English proficiency. Thus, teachers should make consideration on how they will enable the students to perform better in a mathematics classroom. To address the difficulty of the students, teachers and/or policy makers should make or add a teaching method to be used during the teaching-learning process.

Research Gap

Code switching has been employed by teachers as a source of giving the students' opportunities to communicate in the language they know to improve their understanding. Studies conducted on code switching focused more on the teachers' and students' awareness on code switching (Ahmad & Jusoff 2009) and are conducted during non-restricted classroom set-up. Most studies investigated the impact of code switching on students' proficiency in the language of instruction (Garegae, 2004), the learners' and instructors' attitudes (Lee, 2010), the types and reasons of code switching (Zakaria & Kalong 2010), and the implications of code-switching in a math classroom (Jegede, 2011).

Studies conducted about English as a medium of instruction in mathematics revealed that the mastery of the content is challenging. Learners tend to fail in Mathematics because they do not have much understanding of the language used to teach it. Since English is the language of instruction, there are instances that the learners cannot follow the flow of discussions since there are mathematical terms they cannot understand due to the language used by the teacher. This affects the students greatly since they are not fluent in speaking the English language, making the learners pull back on rote learning or being silent. Students who are using code switching in learning are more able to share their knowledge to their teachers and co-learners (Pollard, 2002). In different countries, the use of English as a medium of instruction can cause frustration for both teachers and students (Ahmed & Zarif, 2013; Ariffin &Husin, 2011). Chikiwa and Schafer (2016) suggested that code switching must be done consistently and with accuracy to support learners from different backgrounds. Additionally, the low mathematical achievements of the students are very alarming noting that mathematics is providing an effective way in constructing a mental discipline. It also plays an important role in the understandings the contents of other school subjects.

There are studies that investigated code-switching, but there are yet no available studies on "Tag-lish" code switching as a teaching strategy in the secondary mathematics classroom in the new normal where the modalities of instruction are online and modular. More studies should be done to allow researchers in this field to pull conclusions regarding whether CS should be applied as a beneficial strategy that could support students' learning and achievement. Thus, this study was conducted to assess the influence of Tag-lish code switching in the mathematics performance, attitude toward mathematics, and problem-solving efficacy of Secondary students in a new normal classroom set-up.

Objectives of the Study

This study aimed to assess the effect of the Tag-lish code switching on the mathematics traits of secondary school learners (i.e., mathematics achievement, problem solving efficacy, and attitude toward mathematics), by comparing two groups of subjects: the experimental group (who received Tag-lish code-switching instruction) and the control group (who received the conventional teaching method). Specifically, it aimed to provide answers to the following research queries:

1. What is the mathematics achievement, problem solving efficacy and attitude toward mathematics of the control group and the experimental group?
2. Is there a significant improvement in the mathematics traits of the control group from pre-test to post-test?
3. Is there a significant improvement in the mathematics traits of the experimental group from pre-test to post-test?
4. After controlling for pre-test scores, is there a significant difference between the post-test scores of the control group and the experimental group?

METHODS

This study employed a pre-test and post-test quasi-experimental design. A quasi-experimental design is an empirical interventional approach used to examine the effect of an intervention on outcomes without random assignment (Shadish, Cook, & Campbell, 2002). In this study, participants were not randomly assigned to the control or experimental group to preserve natural classroom conditions. Instead, their pre-test scores were treated as covariates and statistically controlled to allow for a more objective comparison between groups.

Participants

Research with higher sample size is commonly suggested. Conversely, there is a thumb rule in the size of sample in experimental research involving human participants. For instance, an experimental methodology according to Cohen, Manion and Morrison (2007) suggest at least 15 participants while Gall, Borg and Gall (1996) there should be at least 15 participants in control and experimental groups for comparison. Therefore, the participants of this study were 15 randomly selected students from class A and another 15 randomly selected students from class B of the Grade 7 curriculum of Sandiat National High School in Sandiat East, San Manuel, Isabela. Random sampling is a technique wherein each member of the population has an equal chance of being selected as a subject. All these students are speaking Tagalog language as well as the teacher.

Instruments

A teacher-made test (Pre-test & Post-test) was used in gathering the data for the students' mathematical achievement. It is composed of 50 questions covered from the four weeks topic in mathematics for the third quarter of the Grade 7 curriculum. The instrument was validated by three knowledgeable individuals in the field of mathematics.

The students' attitude toward mathematics was measured using the Likert scales developed by Tapia and Marsh (2004) with Cronbach alpha of .963. The inventory is a four-factor survey designed to measure the high school and college students' attitude toward mathematics that consists of 40 statements with a five-point scale namely: 5 – Strongly Agree, 4 -Agree, 3 – Neutral, 2 – Disagree, and 1 – Strongly Disagree. Unlike other mathematics assessments, the Attitude toward mathematics inventory was designed to be brief while also capturing multiple factors that can contribute to one's attitude toward mathematics.

The problem-solving efficacy of the students were measured using the adopted Problem-solving efficacy scales (PSES) in mathematics developed by Dagdag, Anoling, Salviejo, Pascual and Dagdag (2020). The PSES is a five-point scale that consists of 30 statements with four sub-scales namely: (1) Social persuasion, (2) Physiological Response, (3) Vicarious Experience and (4) Mastery Experience. The cronbach's alpha reliability for problem-solving efficacy is .717 to .925 which suggests that the developed scale is both structurally valid and reliable. Lastly, the researcher made a five-point scale survey to measure the degree of agreement (DOA) of the experimental group that received Tag-lish code-switching language of instruction. It is composed of 10 positive statements.

Data Gathering Procedures

This study followed the research ethics and protocols in conducting research. Firstly, the researcher acquired a permit to the office of the School Principal to conduct the study. Secondly, upon approval, the researcher coordinated with the students to guarantee that she would not invade the privacy and hurt the feelings of the participants without their consent, and all of the information that was received from the participant were acknowledged and were accurately presented as consideration of the research ethics. Ethical considerations are vital for conducting research projects as participants of the study have moral and legal rights.

Thirdly, the pre-test (Mathematical achievement, Attitude toward mathematics and Problem-solving efficacy) was distributed both to the Tag-lish code-switching group and traditional group to elicit their entry knowledge, attitude, and feelings. Lesson plans and presentations for the third quarter in mathematics 7 good for one-month classes were made by the researcher. Fourthly, the two groups, code switching group and the traditional group underwent classes. The first group (experimental group) received the Tag-lish code switching as the language of instruction in mathematics while the other group (control group) received pure English as the language of instruction. The type of code switching used by the researcher is intra-sentential. Intra-sentential code switching is done in the middle of a sentence, without interruptions, hesitations or pauses that might show an alteration.

Lastly, after one month, the researcher distributed the post-test (Mathematical achievement, Attitude toward mathematics, and Problem-solving efficacy) to measure whether there is an increase to the mathematics achievement, attitude toward mathematics, and problem-solving efficacy of the students. The researcher also delivered another scale to measure the degree of agreement (DOA) of the participants in the experimental group that received Tag-lish code switching as a language of instruction in mathematics. All of the instruments were delivered through Google forms and the participants are given approximately one and a half hour in answering the mathematics achievement test (Post-test) and another one hour to answer the three scales (ATMI, PSES, and DOA).

Data Analysis

SPSS version 20 was utilized to carry out the analyses. Descriptive analyses using mean (*M*) and standard deviation (*SD*) were performed to describe the mathematics achievement, problem solving efficacy, attitude toward mathematics, and satisfaction. Scores gained by the participants in mathematics achievement scores were interpreted as poor if below 15, fair if 15 to 24, average if 25 to 34, good if 35 to 44, and very good if 45 to 50. The data in attitude toward mathematics (items 9, 10, 11, 12, 13, 15, 20, 21, 25 and 28) and problem-solving efficacy (items 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20) that was gathered from negative statements were recoded using the formula “6 minus the given score”. Then the total mean score for Problem solving efficacy were interpreted as very low if 1.00 to 1.49, low if 1.50 to 2.49, moderate if 2.50 to 3.49, high if 3.50 to 4.49, and very high if 4.50 to 5.00. The total mean score for attitude toward mathematics was interpreted negative if below 2.50, neutral if 2.50 to 3.49, and positive if 3.50 above. Additionally, level of satisfaction was described as very dissatisfied if 1.00 to 1.49, dissatisfied if 1.50 to 2.49, neither satisfied nor dissatisfied if 2.50 to 3.49, satisfied if 3.50 to 4.49, and very satisfied if 4.50 to 5.00.

To test for effect, paired samples t-test and analysis of covariance were conducted since parametric assumptions were met. Paired samples t-tests were performed to test whether the mathematics traits of the control group and the experimental group have increased from pre-test to post-test. On the other hand, analysis of covariance was conducted to compare the post-test scores of the control group and the experimental group while statistically controlling for their pre-test scores. The ANCOVA was necessary since the subjects in the study were not arbitrarily assigned to their entry mathematical trait, which would totally influence post-test scores.

The exact probability (p) values were reported to easily determine the confidence level (1 minus *p*) as to whether a difference could be claimed or not. A statistical result is significant if *p* is less than .05 (because the confidence level is at least 95%) and not significant if *p* is greater than .05 (because the confidence level is less than 95%). Effect sizes were calculated using partial eta squared, which were interpreted based on the guidelines proposed by Cohen (1988) i. e., .01is small, .06 is moderate, and .14 is large.

FINDINGS

Table 1 describes the mathematics achievement, problem solving efficacy and attitude toward mathematics of the control group and the experimental group. Both groups have the same degree of mathematics traits before and after their exposure to instructional intervention. In particular, their mathematics achievement was initially fair but ended good. Their attitude scores toward mathematics were originally neutral but eventually became positive. Their problem-solving efficacy scores were formerly moderate but they attained high during the post-test.

Table 1. Descriptive statistics of control and experimental groups’ mathematics achievement, problem solving efficacy and attitude toward mathematics

Mathematics Traits	Group	*Test*	*M*	*SD*	*Descriptions*
Mathematics Achievement	Control	Pretest	17.00	3.12	Fair
		Posttest	35.07	3.53	Good
	Experimental	Pretest	17.67	3.56	Fair
		Posttest	37.87	2.00	Good
Attitude toward mathematics	Control	Pretest	2.80	.08	Neutral
		Posttest	3.66	.40	Positive
	Experimental	Pretest	2.72	.15	Neutral
		Posttest	3.81	.37	Positive
Problem solving efficacy	Control	Pretest	3.32	.15	Moderate
		Posttest	3.62	.33	High
	Experimental	Pretest	3.33	.12	Moderate
		Posttest	3.97	.20	High

Table 2 shows that there was a significant increase in the mathematics traits of the control group after they were taught using the traditional language of instruction in mathematics. Particularly, their mathematics achievement (t = -21.17; p < .001; η^2 = .9697), attitude toward mathematics (t = -856; p < .001; η^2=.8395), and problem-solving efficacy (t = -3.56; p < .001; η^2=.4751) increased largely from pre-test to post-test.

Table 2. Paired samples t-test of the pretest and posttest scores of the control group

Mathematics Trait	Test	*M*	*SD*	*t(14)*	*P*	η^2
Mathematics Achievement	Pretest	17.00	3.12	-21.17	.000	.9697
	Posttest	35.07	3.53			
Attitude Toward Mathematics	Pretest	2.80	.08	-8.56	.000	.8395
	Posttest	3.66	.40			
Problem-solving efficacy	Pretest	3.32	.15	-3.56	.003	.4751
	Posttest	3.62	.33			

Table 3 displays that there was a significant increase in the mathematics trait of the experimental group. The group's mathematics achievement increased largely from pre-test (M = 17.66) to post-test (M = 37.86), t = 26.46, p <.001, η^2 = .98. Their attitude toward mathematics also revealed a large significant increase from pre-test (M = 2.71) to post-test (M = 3.81), t = -12.72, p <.001, η^2 = .92. Similarly, their problem solving efficacy largely improved, t = -11.60, p <.001, η^2 = .90.

Table 3. Paired samples t-test of the pretest and posttest scores of the experimental group

Mathematics Trait	Test	*M*	*SD*	*t(14)*	*P*	η^2
Mathematics Achievement	Pretest	17.67	3.55903	-26.46	.000	.9803
	Posttest	37.87	1.99523			
Attitude Toward Mathematics	Pretest	2.72	.14780	-12.72	.000	.9203
	Posttest	3.81	.37295			
Problem-solving efficacy	Pretest	3.33	.11629	-11.60	.000	.9057
	Posttest	3.97	.19553			

Table 4 shows that except for attitude toward mathematics, there was a significant difference between the post- Mathematics achievement (F = 7.32; p < .01; η^2= .213) and problem solving efficacy (F = 11.95; p < .01; η^2 =.307) of the two groups when their pre-test scores were statistically controlled.

Table 4. ANCOVA between the posttest scores of control group and the experimental group while controlling for entry characteristics

Mathematics Trait	Group	Unadjusted		Adjusted		*F*	*P*	η^2
		M	*SD*	*M*	*SE*			
Mathematics Achievement	Control Group	35.07	3.53	35.21	.655	7.318	.012	.213
	Experimental Group	37.87	2.00	37.72	.655			
Attitude Toward Mathematics	Control Group	3.66	.40	3.61	.098	2.966	.096	---
	Experimental Group	3.81	.37	3.86	.098			
Problem-solving efficacy	Control Group	3.62	.33	3.63	.070	11.945	.002	.307
	Experimental Group	3.97	.20	3.97	.070			

Note:--- means no effect size calculated due to non-significance

Table 5 shows that the experimental group was satisfied with Tag-lish code switching as the language of instruction they received in learning mathematics (M = 4.08).

Table 5. Experimental group's level of satisfaction with Tag-lish code switching

	Statements	*M*	*SD*
1	Facilitates easier understanding of mathematics	4.00	1.00
2	Makes mathematics classes more enjoyable	4.00	.65
3	Encourages idea sharing in class	3.93	.80
4	Creates a positive classroom atmosphere	4.13	.74
5	Promotes clearer understanding of mathematical concepts	4.00	.85
6	Provides a helpful way of teaching mathematics	4.20	.41
7	Enhances learning in mathematics	4.00	.65
8	Increases interest in mathematics	4.33	.49
9	Motivates learning in mathematics	4.20	.68
10	Represents the best way to teach mathematics	4.00	.76
	Total	4.08^{s}	.28

Note. "s" means satisfied

DISCUSSION

The study found that both Tag-lish code-switching and pure English instruction significantly improved students' mathematics achievement, attitudes toward mathematics, and problem-solving efficacy. This aligns with earlier evidence that well-structured instructional interventions enhance learning outcomes regardless of the language used (Adesokan, 2021; Simasiku et al., 2015). However, the more substantial gains in achievement and problem-solving efficacy among students exposed to Tag-lish instruction demonstrate the distinctive pedagogical advantage of code-switching in mathematics classrooms (Hafnidar et al., 2021; Sarte et al., 2021).

The stronger mathematics achievement observed in the Tag-lish group reinforces the idea that language plays a central role in conceptual clarity. Pandey (2017) emphasized that mathematical achievement depends on students' ability to understand subject content, while Sotelo (2020) recommended using Tagalog–English intra-sentential code-switching to make concepts more accessible. Since many mathematical terms are unfamiliar to students in English, switching between Tagalog and English helps close comprehension gaps. This is consistent with Webb and Webb (2008), who found that students assimilate instructions more effectively when teachers shift between languages. In multilingual contexts, code-switching reduces linguistic barriers and enables students to focus on the mathematical ideas rather than on language decoding.

Problem-solving efficacy also improved more in the Tag-lish group. Clarkson (1991), cited in Bernardo (2002), showed that language-related comprehension difficulties contribute significantly to errors in mathematical problem-solving. By lowering linguistic obstacles, code-switching allowed students to concentrate on logical reasoning and problem-solving strategies. This is supported by Mohammad (2010), who highlighted that higher self-efficacy correlates with better classroom performance. When students receive explanations in a familiar linguistic form, their confidence to engage with mathematical problems increases, leading to better outcomes.

Although both groups improved their attitudes toward mathematics, no significant difference was found between the two instructional approaches in this domain. This suggests that positive attitudes develop as students experience academic success, regardless of the language of instruction. Kele and Sharma (2014) underscored the importance of teaching strategies in shaping affective engagement, while Yasar (2016) and Teklesellassie and Boersma (2018) noted that attitudes toward mathematics are also influenced by personal and demographic factors. Thus, while Tag-lish instruction improved performance, its effect on attitudes may not be substantially different from English-only instruction when both lead to academic gains.

These findings echo Maluleke's (2019) view that code-switching empowers learners in multilingual classrooms by legitimizing their linguistic identities and easing communication. Similarly, Salehmohamed and Rowland (2014) showed that code-switching provides essential instructional support, and Zabrodskaja (2007) highlighted its role in sustaining attention and improving understanding. Together, these studies suggest that Tag-lish code-switching should not be seen merely as a compensatory strategy but as an intentional pedagogical tool that enhances both inclusivity and efficiency in teaching mathematics (Adam et al., 2022; Matt et al., 2022).

The results also have implications for language-in-education policy. Barnard and Li (2016) observed that the use of students' first language has often been discouraged in the Philippines, despite its potential benefits. Nolasco (2008) argued that a multilingual country with over 170 languages requires flexible approaches to language use in education. The present findings support this view by demonstrating that strategic code-switching improves achievement without diminishing students' exposure to English. Cook (1989) and Setati and Adler (2000) also cautioned against exclusive reliance on English, as it limits meaningful communication and encourages rote learning.

Finally, the high level of satisfaction reported by students in the experimental group reinforces the effectiveness of Tag-lish code-switching. Students found mathematics easier to understand, more enjoyable, and more engaging when Tag-lish was used. This reflects Thompson's (2003) and Bautista's (2004) observations that Tag-lish is a widely accepted and natural mode of discourse in Philippine society. Bringing this linguistic resource into the classroom creates a more comfortable environment that encourages participation and interaction (Nengsih & Handrianto, 2022; Ramadhani et al., 2022).

Overall, these findings strengthen the case for Tag-lish code-switching as a legitimate and effective instructional strategy in secondary mathematics. They bridge the gap between restrictive language policies and classroom realities, align with evidence from other multilingual contexts (Sepato, 2003; Chitera, 2009; Chikiwa & Schafer, 2016), and provide empirical support for integrating code-switching into formal mathematics instruction. By improving both comprehension and problem-solving efficacy, Tag-lish code-switching addresses persistent challenges in mathematics learning in the Philippines.

CONCLUSION

It is true that code switching influenced the students' mathematical traits as studies of different researchers provide statistical evidence to prove their claims. This study also proves that the use of Tag-lish code switching increases their mathematical traits. The descriptive result above verified the findings of the previous studies of Adesokan (2021), Maluleke (2019), Simasiku, Kasanda and Smit (2015), and Teklesselassie and Boersma (2018) that code switching helps the students in increasing their mathematics trait. Interestingly, the current findings showed that both groups had increased their mathematics traits from pre-test to post-test. However, students who received Tag-lish code switching as a language of instruction had a higher performance when statistically comparing the two groups. Mathematics teachers should consider the use of Tag-lish code switching as one of the strategies to effectively teach the mathematics subject. However, teachers should still control or know when to use Tag-lish code switching since too much use of Tag-lish code switching might affect the students' English proficiency and grammar construction in turn. For policy makers, the use of Tag-lish code switching in a mathematics classroom might be an interesting action to make provisions or guidelines for the language of instruction to be used by the Secondary school mathematics teachers. As it does not only allow the teacher to deliver the information more conveniently but it also allows the students to understand the lesson much easier when the teacher code switch. It is also for the consideration allowing multilingual students to cooperate actively during the discussion. For secondary mathematics teachers, utilizing CS should not stop as it helps learners to understand difficult aspects of math lessons, enables learners to express themselves and helps teachers with classroom management. It can also be used as a tool in analyzing and solving math problems, understanding logical connections, and evaluating information. To future researchers, same studies should be conducted with the use of larger and more diverse samples. They may explore other types of code switching (e.g. inter-sentential) to test whether these can improve mathematics achievement, problem solving efficacy and attitude towards mathematics. Studies across different regions and linguistic contexts are also necessary to further assess the role of students' mother tongues and second languages in mathematics instruction.

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