Exploring the Tagalog-English Code-Switching Types Used for Mathematics Classroom Instruction

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Abstract

This study aimed to examine the types of Tagalog-English code-switching used in mathematics classroom discourse. Four purposively selected tertiary level math teachers in a college situated in a rural area in the Philippines were part of the study. Using a qualitative approach, data were gathered through non-participant class observations and interviews with selected math teachers and students. Syntactic analysis of code-switching types was done to categorize the Tagalog-English utterances. The findings showed that Tagalog-English intrasentential code-switching, which accounts for 58% of the code-switched utterances, was the most dominant type present in math teachers' spoken discourse, and this was evident when math teachers had to explain math concepts and solutions, or provide examples, among others. Intersentential code-switching made up 38% of code-switched utterances, while tag switching was used very sparingly. It is recommended that the use of Tagalog-English intrasentential code-switching for math lesson delivery and content knowledge explanation be considered.

Keywords: Tagalog-English code-switching, code-switching types, intrasentential code-switching, tertiary level, math teachers

English was introduced to the Philippine education system at the time of the American occupation in the 1900s and was sustained in the post-colonial years. In higher education institutions (HEIs), the directive of the Commission on Higher Education (CHEd) is to teach mathematics in English or Filipino. For instance, the University of the Philippines (UP), the country's premier national university, prescribes the use of Filipino at the undergraduate level, while English and Filipino are used at the graduate level (University of the Phillipines [UP], 2014). In other Philippine HEIs, English is widely used as the main language in academic discourse, particularly in science and mathematics (Bernardo & Gaerlan, 2012; Commission on Higher Education [CHEd], 2013).

While a new language policy in the basic education program (BEP) is implemented through Mother Tongue-Based Multilingual Education (MTB-MLE), Filipino teachers in the tertiary level and students in the secondary and tertiary levels in the past years up to the present are products of the education system that espoused the BEP, which may explain the difficulty of Filipino learners in mathematics. For a majority of Filipinos who neither use Filipino nor English as the first language, the BEP was cognitively and linguistically challenging (Bernardo, 2008; Gonzalez, 2002; Tupas & Lorente, 2014). When students do not understand what the teacher says because the subject is taught in a second or foreign language, learning challenges may abound. Thus, to address students' learning difficulties, a communication technique that Filipino teachers use in math classes involves the combination of two languages, otherwise known as code-switching (CS).

CS is defined as the "juxtaposition within the same speech exchange of passage of speech belonging to two grammatical systems or subsystems" (Gumperz, cited in Romaine, 1995, p. 121). It is a natural linguistic resource among bilingual and multilingual speakers (Gulzar, 2010; Muthusamy, 2010; Setati, Adler, Reed, & Bapoo, 2002), and a communication strategy used to compensate for missing language (Brown, 2007).

In the Philippines, a widely-used CS variety is Tagalog-English, or Taglish, which is formed by merging the first part of the word **Tag**alog and the last syllable of Eng**lish**. Taglish is the colloquial term for the alternation of Tagalog, a local language from the Philippines, and English in the same discourse. Tagalog has branched out into various dialects used in several provinces in the Philippines, such as Laguna, Cavite, Mindoro, Quezon, and Rizal, among others. it is important to note that Taglish has to be distinguished from Filipino-English CS. Filipino is the national language of the Philippines, and Filipino-English CS is the variety often used in Metro Manila.

As a language of instruction (LOI) in the classroom, CS is identified as short switches from the learners' mother tongue to the official LOI, and vice versa (Probyn, 2015). Considered as a common practice in education (Setati & Adler, 2000), it is argued that CS bridges the gap in classroom discourse (Al-Adnani & Elyas, 2016; Moore, 2002) and is a practical measure that content subject teachers take to aid students with low English language proficiency in understanding lessons (Probyn, 2015). This claim is plausibly supported by a number of studies that show its use in classroom instruction in various levels and in different learning areas (e.g., Abad, 2010; Borlongan et al., 2012; Gulzar, 2010; Lin, 2013; Muthusamy, 2010; Li, 2008; Pitpit, 2004). In the classroom context, the key participants in CS are teachers, students, and teacher aides (Li, 2008).

Types of Code-Switching

The types of CS are commonly included as a variable in studies on CS as they provide insights on the language competence of bilingual and multilingual speakers. Poplack (cited in Hamers & Blanc, 2000) developed a typology often cited in literature which identifies three CS types. CS can occur between sentences (*intersentential*), within a sentence (*intrasentential*), or as a tag in one language into an utterance entirely in another language (*extra-sentential* or *tag switching*). Intersentential switches occur at the sentence or clause boundary. On the other hand, intrasentential switches are considered as the more complex or "intimate" type of switching, "since a code-switched segment, and those around it, must conform to the underlying syntactic rules of two languages which bridge constituents and link them together grammatically" (Poplack, 2000, p. 230). In another study, it was noted that intrasentential switching is the most complex form of CS as "it involves the greatest syntactic risk since the switching between languages occurs within the clause or sentence boundaries" (Liu, 2010, p. 11). Finally, tag switches, together with single noun switches, are described as a less intimate type, and "are often heavily loaded in ethnic content and would be placed low on a scale of translatability" (Poplack, 2000, p. 230).

Related Studies

It is argued that CS is indicative of a speaker's degree of bilingual competence. The alternation between two languages requires a large degree of linguistic competence on the part of the speaker to be able to switch smoothly from one language to another. Poplack's (2000) 1980's study, which observed the Spanish-English CS of non-fluent bilinguals in a Puerto Rican community, showed that in the 1,835 switches made, no ungrammatical combinations of the L1 and the L2 were noted. Skilled CS is characterized by smooth transition between elements of L1 and L2, "unmarked by false starts, hesitations or lengthy pauses" (Poplack, 2000, p. 241). Despite the limited language competence in one of the codes, the non-fluent bilingual speakers were able to produce grammatically-sound switches (Poplack, 2000). It should be noted, however, that the study does not provide the disaggregated results of CS per type.

In the classroom context, the findings of a study on the English proficiency of information technology (IT) instructors and their language use resonate with Poplack's findings (Sarreal, 2008). Thirty tertiary-level instructors from various schools in Metro Manila teaching IT classes in English were observed and interviewed for the study. Among the variables observed were the IT instructors' patterns and types of CS used in class. After identifying the CS types using Poplack's model, the results of the study identified intrasentential CS as the most commonly-used CS type of IT teachers, as concepts pertaining to the subject matter had to be explained further in Tagalog to become clearer and more understandable for students (Sarreal, 2008).

The results of other studies (Martin, 2006; Liu, 2010) show deviations from the previous findings, mentioning that among the three CS types, intersentential switching was used prevalently in classroom instruction. A study of teachers' CS to L1 in English as a foreign language (EFL) classrooms examined the general situation of the switching from English to Chinese (Liu, 2010). Sixty teachers and 261 undergraduate students randomly selected from three universities had their English classes observed. The LOI in all classes observed was English, and the lesson observed was "teaching a text." Survey questionnaires and transcribed class observations were used to gather pertinent data. To categorize CS patterns, Poplack's syntactic structure was used. A major finding of the study was that teachers and students used intersentential CS most frequently to translate from English to Chinese. Tertiary EFL teachers explained that in text analysis, English sentences were discussed with students through

translation as the teachers were having "difficulty in trying to conform to the different syntactic rules" of English and Chinese (Liu, 2010, p. 18). The difference in the syntactic rules of the two languages made the EFL teachers resort to intersentential CS to translate texts and make English content much more comprehensible for the EFL learners.

Another study regarding CS in the tertiary level included the CS type as a variable (Martin, 2006). Two instructors from a private, non-sectarian Philippine higher education institution (HEI) handling science courses for freshmen students were observed. Science courses were required to be taught in English. Both classes which spanned 3 hours and 30 minutes were video-recorded, and teachers were interviewed after class. Filipino-English CS types of both teachers and students were categorized using Poplack's syntactic structure. The findings of the study showed that "[i]n both cases, intersentential switches registered as dominant among the three syntactic structures" (Martin, 2000, p. 56). Both teachers observed used intrasentential and tag switching very minimally. Another observation from the study was that one of the two teachers produced 90% of intersentential CS gathered from the whole sample. Although a large percentage of CS occurred, the researcher claimed that the science teacher was a "skilled code-switcher." The researcher noted that all the code-switched utterances made by both the teachers and the students were grammatical and the utterances were smooth. It should be stated that while the strength of the study is the identification of the types of switches made, it would have helped confirm the claim of the researcher that both teachers observed were "skilled code-switchers" if other instruments were used to further validate the assumption.

This present study is timely and important as it can be a valuable addition to the literature on CS. Data and insights culled from the findings of this research may help set future directions for language planners and policy makers. The reports on the uses of the math teachers' CS in the tertiary level can serve as a guide as they create, review, or modify existing policies on the LOI in content areas in the tertiary level. Additionally, school administrators in the higher education sector become more informed of the in-class language practices of mathematics teachers, so provisions can be made to appropriate codeswitching use in the tertiary-level mathematics instruction when necessary. Moreover, the results of the study can inform content teachers on the types of CS employed in the classroom and the contexts in which these CS types are utilized. For language teachers, this can open collaboration with math teachers for content-based instruction. The findings of the study can likewise provide insights to future researchers on the actual use of language in classroom discourse, identify the CS types used by math teachers, and confirm or disconfirm the findings of previous studies on the CS types used prevalently in the classroom.

Research Questions

In order to examine the CS use in content areas, the study focuses on the following research questions:

(1) What are the types of CS used by tertiary level math teachers in mathematics classroom discourse?
(2) What are the instances in which the CS types are used?

Methods

Research Design

The study used a qualitative approach to identify and describe the CS types used by college level math teachers. Tallying and getting the percentages of CS types from the observed math classes were employed, while interviews with teachers and students were completed to validate the data gathered from class observations (Abad, 2010; Martin, 2006; Sarreal, 2008).

Research Locale and Participants

The locale for this study was a state college in Occidental Mindoro, the Philippines. Since Tagalog is widely spoken in Occidental Mindoro in their day-to-day discourse, conducting the study in a tertiary institution in the province was deemed appropriate as it was a good opportunity for the researcher to observe the language contact and dynamics of Tagalog and English in mathematics discourse. Likewise, the decision to conduct the study in a college from a rural area was due to the high probability of Tagalog-English CS use in the classes to be observed. Unlike in an urban setting such as Metro Manila where English is commonly used as the default language in mathematics discourse, the rural setting was instrumental in allowing the researcher to observe how the two languages operated in mathematics discourse, with Tagalog as the more dominant language.

It is also worth noting that despite the dominance of the use of Tagalog in the community, the College implements an English-only policy for instruction across all subjects, except in the Filipino subject. Adherence to the policy is expected; thus, teachers and students in the College have to use the English language in all forms of spoken discourse in all subjects, except in the Filipino language subject.

The participants consisted of four math teachers who were selected purposively for the study, and whose names were withheld for purposes of confidentiality. The choice of purposive sampling was influenced by the idea of selecting math classes where the use of Tagalog-English CS was *moderate* to *high*, that is, 41 to 100% (Abad, 2010), which implies that CS is substantially present in the observed classes. Alphanumeric codes were instead used to refer to the teachers: T1 for the first teacher, T2 for the second, T3 for the third, and T4 for the last. Trigonometry was selected as it is considered to be a fundamental mathematics subject on which other subject areas, such as physics, architecture, engineering, and other sciences, are hinged (Weber, 2005; Moore, 2009). Also, students struggle with this aspect of math instruction due to its difficulty and abstractness (Gur, 2009; Moore, 2009).

There were 88 students in all four classes observed. Some of the students who were part of the math teachers' classes were selected purposively for key informant interviews (KIIs).

Data Collection Tools

Data were gathered through a profiling form, a tally sheet for CS types, and KII guides for teachers and students. The tally sheet was piloted to a group comparable to the sample. Since the instruments appropriately and sufficiently gathered the pertinent data needed for the study, no changes were made on the tools.

The CS tally sheet was not used during the actual class observations as it would have been very difficult to classify CS occurrences while classes were ongoing. Instead, this tool was used after class observations to organize data and guide KIIs.

Two different sets of KII guides were made for selected math teachers and students, and questions were designed to obtain information on the use of Tagalog-English CS in mathematics classroom discourse.

Data Collection Procedure

Data were culled from several sources, such as class observations, demographic profile of students, and KIIs with teachers and selected students. The data gathering was conducted in two full weeks.

Non-participant observation was used in this study. Preliminary observations were done in all four math classes to check the CS occurrences in classroom discourse and to let the math teachers and the students get used to the presence of an observer. After the initial observations, three class observations were completed for each class. Class observations were recorded using a digital camera, a tablet, and a smartphone. The total number of observation hours for the 12 math sessions was 18.

Two sets of KIIs were conducted individually, one with every math teacher in the sample and another one with selected students. All interviews with math teachers and selected students were digitally recorded. Notetaking was avoided so the researcher would have undivided attention while conducting the interview and would limit a possible source of distraction for students. Overall, there were four hours' worth of interview with the selected math teachers and students.

Data Analysis

All recorded data from class observations were transcribed manually by the researcher using Microsoft Word. To facilitate ease of reading, fillers such as *um, ah*, and the like, were removed as they have little influence on mathematics discourse (Herbel-Eisenmann & Otten, 2011). The task was guided by the transcription conventions adapted from Metila (2007). Checking the accuracy of transcribed data was done. The quantitative data needed to identify the CS types of math teachers were derived from frequency count. In categorizing data, Tagalog-English CS utterances were syntactically analyzed and then classified using Poplack's CS categories, namely intersentential, intrasentential, and tag switching (Poplack in Hamers & Blanc, 2000, pp. 259-260). Categorized data were rechecked by a language expert to ascertain data accuracy.

To corroborate the results of the math teachers' CS types yielded from the quantitative analysis, data were triangulated with the responses of KII participants. Interview data were transcribed, then transcripts were reviewed afterwards. Repeated and similar responses were noted and grouped accordingly to generate themes. Triangulation was done to enrich the data from class observations and to strengthen the credibility and generalizability of the study (Fraenkel & Wallen, 2010; Tracy, 2013).

Results and Discussion

All three types of CS – intersentential, intrasentential, and tag switching – were present in the spoken discourse of the four observed math teachers. However, the most dominant CS type used was intrasentential, accounting for 58% of the code-switched utterances. Intrasentential CS was followed by intersentential CS, which was equivalent to 38% of code-switched utterances. Lastly, tag switching was used sparingly across the 12 class observations. Data are shown in Figure 1, and more detailed explanations for each type follow.

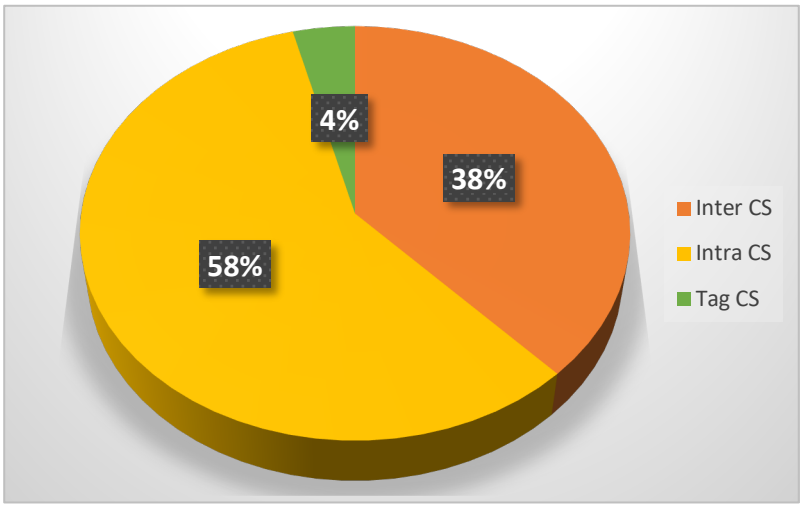

Figure 1: Percentages of CS types

Intrasentential CS

The biggest chunk of the CS type was intrasentential, which is consistent with the findings of the studies of Poplack (2000) and Sarreal (2008), noting that it is the CS type used quite extensively in spoken discourse. This indicates that the utterances of math teachers were characterized by switching between two languages within a sentence, with one language compensating for the other. An example in Extract 1 follows.

Extract 1

T1: So *ibig sabihin, kung hindi* available *yung isang* function *sa* calculator, *pwede n'yong kunin yung kanyang* complementary function *kasi* confident *naman kayong* they are just equal. **(So it means, if one function is unavailable in the calculator, you can get its complementary function because you are confident that they are just equal.)** Can you follow? Can you follow? *Ganun din sa* reciprocal function. **(The same goes for the reciprocal function.)** That's why *kung napapansin n'yo,* in your scientific calculators, only the three functions are there. **(That's why if you could notice, in your scientific calculators, only the three functions are there.)** What are those?

In Extract 1, T1 explained the role of complementary functions by shuttling between English and Tagalog in a sentence. Using the two languages, the math teacher was able to express her points clearly and coherently. Likewise, it can be noted that the sentences from the extract conformed to the syntactic rules of the two languages, Tagalog and English, and the words from the two languages were linked grammatically, thereby facilitating smooth and natural transition between words. This is similar to the observation of Poplack (2000) where she noted that the intrasentential switches she gathered were grammatically sound. The results provide insights that speakers have sufficient awareness of the syntax of the two languages used, which prevents them from violating their syntactic rules.

The observed math teachers had to use English and Tagalog interchangeably within a sentence in explaining math concepts and solutions, among others. In short, both languages are complementary for instruction. Using pure Tagalog or pure English throughout the discussion poses limitations. Speaking in pure Tagalog can be preventive because the math terms which are crucial in understanding math concepts are often in English. Unless math teachers and

students are familiar with the equivalent Tagalog words of math terms, using Tagalog all throughout math discourse can be challenging. The same goes for using pure English. If math teachers were to use only English for classroom instruction, the concerns would be the math teachers' English language proficiency, lesson delivery, and students' capacity to understand the lesson. T1 and T4, for instance, observed that the math teachers themselves may have limited language capabilities to express their ideas fluently and use English in a more complex academic discourse. As regards students' capabilities to understand instruction in English, all four math teachers agreed that most students have basic English-language proficiency, and so the use of English would be a stumbling block for their learning. This is supported by the KII responses of all the interviewed students who all said that using both languages in math discourse is important for students to understand lessons better.

However, while the claim was that the use of intrasentential CS is done by highly-skilled bilinguals (Poplack, 2000), data yielded from the observed math teachers showed that bilingual speakers do not always demonstrate language fluency and accuracy when using intrasentential switching. As in the case of any second-language speaker who has yet to demonstrate mastery of the target language, the math teachers observed in this study had occasional slips and grammar lapses characteristic of non-native speaker speech. There were instances when intrasentential CS utterances did not conform to the standard Tagalog-English syntactic rules; thus, intrasentential CS was not fluid and clear. This could be seen in Extract 2, where an intrasentenial switching caused confusion. In the dialogue, note that the underlined Tagalog-English code-switched utterance is the unclear part of the discourse.

Extract 2

T2: So what is the measure of the corresponding acute angle if the given is 520 degrees?

S: 20

T2: Why 20?

S: Because 540 is equivalent to…

T2: *Okay.* So that's correct. 360 is the one revolution or full *na pag-ikot,* so one revolution is equal to 360, and *iyong* half revolution is 180. *Ito po siya hanggang rito.* *Sabi nga natin kanina* so *kung nasa* quadrant, *dito siya* and *nandito iyong given*, it is minus *kay* 180 so *kapag tinotal siya* is 540. **(We said a while ago, so if it is in quadrant, it is here and the given is here, 180 is subtracted from the given, so when the total is computed, it is 540.)** Unless *ang given natin* is 520 so the acute angle is 20 and this is what we call the corresponding acute angle. **(Unless our given is 520 so the acute angle is 20 and this is what we call the corresponding acute angle.)** *Okay na po?* **(Is it okay?)**

S: Yes.

The underlined statement in Extract 2 is an example of intrasentential CS that is ambiguous and confusing. T2 attempted to explain the process of solving for the corresponding acute angle, but the original translation contained the unnecessary use of the transition word, *so.*

T2: *Sabi nga natin kanina* ***so*** *kung nasa* quadrant, *dito siya* and *nandito iyong* given... **(We said a while ago, *so* if it is in quadrant, it is here and the given is here…)**

Likewise, from the same extract, the phrase, "*kung nasa* quadrant" (if it is in the quadrant) lacked specificity. T2 was not clear about the quadrant being referred to, which could confuse the listeners.

Also, in this clause, "*it* is minus *kay* 180 [degrees]…," the referent for the pronoun, *it,* was unclear, and the use of the Filipino preposition *kay* (from) was confusing as the 180 degrees was given a human referent. When translated to English, the clause "*it* is minus *kay* 180 [degrees]…" could be interpreted as "it [the given] is minus [subtracted] from 180," but since what the teacher meant was that 180 is subtracted from the given, the use of an incorrect Filipino preposition, *kay,* could get in the way of understanding the math teacher's explanation.

Note, however, that when T2 asked during the comprehension check if the explanation was *okay*, the students answered *Yes.* While the students answered in the affirmative, saying *yes* could likewise work as a conversation stopper (Palacio & Gustilo, 2016; Colin-Jones & Colin-Jones, 2008). Also, answering with a *yes* could be indicative of the speakers' attempt to be polite, to lessen friction, or to maintain a cordial atmosphere (Bernardo, 2011).

In sum, contrary to the argument that intrasentential switches generally conform to the syntactic rules (Poplack, 2000), it has to be taken into account that there were notable instances wherein the observed math teachers committed grammar lapses in classroom discourse. While in some cases, the math teachers did self-correction, showing that they were able to detect the ungrammatical utterances they produced and to correct them, there were also instances when grammar lapses remained uncorrected, which may indicate that the math teachers were unaware of the grammar mistakes in their utterances. Table 1 presents the utterances with grammar lapses that were corrected.

Table 1: Examples of math teachers' corrected utterances

Teacher	Utterance	Reference
T1	*Yung* between **(The one between)**, angles between zero degrees and negative 90 degrees. Where can we found *(sic)* that – where can we find that rather?	Observation 3 Line 60
T2	Okay, that's right. But I am asking *kung ano po iyong tawag sa* sine, cosine, tangent **(But I'm asking for the term for sine, cosine, tangent).** So that is the trigonometric functions *(sic)*. *'Di ba nabanggit ko naman iyon?* **(Isn't it that I have told you about it?)** So that is the trigonometric functions *(sic)*. *Iyong pinaka*-simplest *(sic)* **(The most simplest).** *Pinaka na nga,* simplest *pa** *Note: T4 means that adding "pinaka," which means "most," is already redundant.	Observation 1 Line 45
T3	You should familiar *(sic)* – familiarize yourselves with these because it's basic knowledge.	Observation 1 Line 163
T4	To view it more, in a more clear *(sic)* manner, in a clearer manner, for example I have here Giselle.	Observation 1 Line 27

As shown in Table 1, the math teachers were conscious of the ungrammatical statements they produced. For T1, T3, and T4, the correct version of the lapses they produced were later provided. T2, meanwhile, pointed out toward the end of the utterance her use of double superlatives.

Table 2 presents a list of some of the code-switched utterances produced by math teachers

which they were unable to identify as ungrammatical.

Table 2: Examples of ungrammatical statements produced by math teachers

Teacher	Utterance	Reference
T1	O, *eto yung mga things to remember ha* **(O, these are the things to remember)**. That's why I told you to bring at least two colored pens *para sa* first angle *yung isang kulay*, second angle another kulay *kasi* you have to show the two initial sides and the two terminal sides and the two angle (sic) *'pag ikot nung gano'n* **(That's why I told you to bring at least two colored pens so that you can use one color for the first angle, then use another one for the second angle because you have to show the two initial sides and the two terminal sides and the two angles when it rotates)**.	Observation 3 Line 248
T2	Acute angle because 30 degree *(sic)* and 60 degree *(sic)* is *(sic)* less than 90 degree *(sic)* and we cannot form 90 degree *(sic)* or we cannot have an angles *(sic)* with *iyong isa* is obtuse angle *kasi nga lalampas siya* **(Acute angle because 30 degrees and 60 degrees are less than 90 degrees and we cannot form 90 degrees or we cannot have an angle with one as obtuse because it will go beyond)**.	Observation 3 Line 295
T3	And if a line is move *(sic) ano po ang na*-form? **(And if a line moves, what is formed?)**	Observation 1 Line 37
T4	Because the line in between the bubbles act *(sic)* as a border, *hindi makapunta yung hangin sa kabila papunta sa kabila* **(Because the line in between the bubbles acts as a border, the air cannot move to the other bubble).**	Observation 1 Line 340

As Table 2 shows, among the common grammar concerns of the observed math teachers were pluralization (e.g., *two angle, 90 degree*), verb use (e.g., *is move*), and subject-verb agreement (e.g., *line… act*). However, these grammar lapses are examples of local errors which do not seriously interfere with one's understanding of the utterances and are negligible.

These examples indicate that intrasentential CS generally follows sound grammatical patterns, but there were also cases when ungrammatical constructions of Tagalog-English utterances were present, and imprecise word choice can compromise the clarity of a statement. This can lead future researchers to further look into the plausibility of arguments that intrasentential CS is apparent in bilinguals with high language proficiency (Poplack in Berk-Seligson, 1986: 314).

3.2 Intersentential CS

Intersentential CS accounted for 38% of the total code-switched utterances of the four math teachers. This differs from results of some studies (Martin, 2006; Liu, 2010) that intersentential CS is the type used prevalently for classroom instruction. The reason for the disparity of the results could be attributed to the limited sample size and the observation duration (e.g., Martin, 2006) and the lesson type during the class observation (e.g., Liu, 2010). In the twelve math classes observed for this study, intrasentential was used more dominantly that intersentential switching. Extract 3 follows.

Extract 3

T4: So if 3x is equal to 180 degrees, what must be the value of x? X therefore is…
S: 60
T4: 60 degrees. *Sige po.* **(Alright.)** *Malinaw?* **(Clear?)**
Ss: Yes
T4: *Madali lang, ano?* **(It's easy, isn't it?)** Easy as pie.

When T4 asked for the value of *x*, a student answered correctly. So, T4 repeated the answer of the student and provided an affirmation by saying, *Alright.* To check whether students understood the process of arriving at the value of *x*, T4 used a one-word question in Filipino, *Malinaw?* (Clear?) The students replied with a yes, and T4 commented in Filipino that computing for the answer was easy.

As observed, pure English was used when providing mathematical explanations or definitions of mathematical terms. Only when the teacher would need to expound on a certain question or a concept that switching to Tagalog or Tagalog-English would be done.

In Extract 4, note that T4's first utterance was a definition of a ray, which he presented in English. Then, in the second part of the utterance, he switched to Taglish and simplified the information for the students. This is evident in the use of the words *ibig sabihin* (it means), which is an indication that the math teacher expounded on the idea to bring down the information to a simpler level of understanding, allowing students to comprehend the given definition by interspersing math concepts with a familiar language.

Extract 4

T4: So, a ray is a part of a line characterized by a line bounded by a point on one end and that extends indefinitely on another. So *ibig sabihin* **(it means)**, as our figure depicts, *meron kang* endpoint *dito* **(you have an endpoint here)**, *tapos meron kang* **(then you have an)** indefinite line, or indefinite part of a line extending to one direction.

Extract 5 shows a similar example in which intersentential switching was used by a math teacher in her utterances to elaborate on her point.

Extract 5

T2: So in determining the corresponding acute angle, so *(sic)* you need to determine also where the angle is located or [in] what quadrant is the angle located. So *sasabihin rin po natin kung nasa* quadrant 1 *siya*, *nasa* quadrant 2, *nasa* quadrant 3 or *nasa* quadrant 4 **(So we need to identify whether the angle is in quadrant 1, quadrant 2, quadrant 3, or quadrant 4)**. So if the angle is 120, then it is in the…? In what quadrant?

In Extract 5, T2 explained the concept of corresponding acute angle in English, that is, in identifying the corresponding acute angle, it is important to locate the quadrant where the angle is found. Then, the teacher used Taglish in the second utterance to emphasize her point. Finally, to check whether students understood the concept correctly, T2 asked them the quadrant where a 120-degree angle could be found.

In the examples, intersentential CS was useful when mathematical concepts in English had to be explained more thoroughly to students through Tagalog-English CS.

Likewise, intersentential CS was at play when the observed math teachers would ask students to answer a mathematical question or equation. Usually, the delivery of the question was in pure English. Extract 6 provides an example.

Extract 6

T1: So what is the complementary function of – you have your calculator? – what is the complementary function of sine 36 degrees 15 minutes 10 seconds? [This is a] review of the last meeting's lesson.

The math teacher asked her students to provide the complementary function of a given item, and she did not find it necessary to repeat the statement in Tagalog or Tagalog-English because she used a simple sentence construction, which was rather straightforward, and understandable.

It can be noted that the reason for using pure English when asking math questions and presenting math concepts and definitions was in line with the use of mathematics register. During the KII, T2 mentioned that mathematical equations are best expressed in English given that there are already canned expressions and jargons. For instance, she mentioned that the "square root of 2x plus y" does not need to be translated to Tagalog because it is a mathematical expression already understood by students, and that it would otherwise be complicated to translate "square root" or "2x plus y" to Tagalog.

These examples show that intersentential CS is evident when expressing mathematical statements or questions in pure English.

Tag Switching

In this study, tag switching was used least extensively in classroom discourse, noting that in all 12 observations, tags accounted for only 4% of the total code-switched utterances. This is similar to the results of the study of Martin (2006) that noted the minimal use of tag switching in classroom discourse. Extract 6 shows the use of tag switching in an utterance.

Extract 7

T3: *Ano po ang* cosine *ng* zero degrees? **(What is the cosine of zero degrees?)**
Ss: One, sir.
T3: As simple as that *po.* **(As simple as that.)**

In Extract 7, T3 used a Tagalog word, *po,* and appended it to the statement, *as simple as that.* There is no English equivalent for the word *po*, as the word is unique to the Filipino culture. Filipinos commonly use *po* as an indicator of respect or politeness. Hence, the use of *po* as a tag marker fits the description of Poplack (2000) that tag switches "are often heavily loaded with ethnic content and would be placed low on a scale of translatability" (p. 23).

Other commonly used tag switches identified in the study include *tama?* (correct?), *lang* (only), *'di ba?* (isn' it?), *din* and *rin* (also), and some Filipino particles with no direct equivalent in English, like *ba, naman, nga, daw, a,* and *ha. Okay* is also considered as a form of tag switch when appended to the end of the sentence. Note that the basis for categorizing it as a Tagalog

word was because of the teachers' pronunciation, which was characterized by syllabication and a distinct Tagalog accent.

Overall, the findings of this study affirm that math teachers used Tagalog-English CS in the classroom, with intrasentential switching as the most commonly used among the three, to explain math concepts and simplify information for students.

Conclusions, Recommendations, and Limitations

This study was conducted with the idea of contributing to the existing knowledge on the language use in content areas and identifying the types of CS used by math teachers. What prompted this research was the inadequate and inconclusive findings on the CS use by tertiary math teachers and its implications for students' learning.

Intrasentential CS was the most commonly used Tagalog-English CS type, as more than half of the total code-switched utterances by the four observed math teachers were intrasentential. The high percentage of intrasentential CS confirms the findings of studies (Poplack, 2000; Sarreal, 2008) that it is the most pervasive type used by interlocutors in spoken discourse. On the other hand, intersentential CS was used when math concepts and principles have to be presented in English, then afterwards explained in Tagalog. Finally, tag switching was the least used CS type, making up only a negligible percentage of the total codeswitched utterances in all classes observed.

Intrasentential CS is indicative of tertiary-level math teachers' sufficient bilingual knowledge and competence of both English and Tagalog syntax. The dominance of intrasentential CS implies that speakers can switch with ease from one language to another, which, in this case, is Tagalog to English, and vice versa. The observed math teachers had to use English and Tagalog interchangeably within a sentence in explaining math concepts and solutions, among others.

It was noted in this study that both languages are complementary for instruction. Using pure Tagalog or pure English throughout the discussion poses limitations. Speaking in pure Tagalog can be preventive because the math terms which are crucial in understanding math concepts are often in English. Unless math teachers and students are familiar with the equivalent Tagalog words of math terms, using Tagalog all throughout math discourse can be challenging. The same goes for using pure English. If math teachers were to use pure English for classroom instruction, the concerns would be the math teachers' English language proficiency, lesson delivery, and students' capacity to understand the lesson. T1 and T4, for instance, observed that the math teachers themselves may have limited language capabilities to express their ideas fluently and use English in a more complex academic discourse. As regards students' capabilities to understand instruction in English, all four math teachers agreed that most students have basic English-language proficiency, and so the use of English would be a stumbling block for students' learning. This is supported by the KII responses of all the interviewed students who all said that using both languages in math discourse is important for students to understand lessons better.

Hence, Tagalog-English intrasentential switching is both instrumental and inevitable. It is instrumental for lesson delivery because it lessens students' cognitive burden of understanding both language and content at once. Likewise, CS is inevitable because math terms and expressions in English are necessary components in explaining and discussing content

knowledge, and so it is understandable when equations and jargons are expressed in English, while further elaborations are done in Tagalog.

For language planners and policy makers, it might be worth considering to draft clear provisions relevant to language use in the content subjects in the tertiary level. Having identified from the class observations and KIIs that the Tagalog-English CS was not a result of some random and inconsistent language switching, but rather a purposeful attempt to facilitate mathematics instruction and learning, the use of CS will give bilingual and multilingual students who require extra support in the English language a better chance of learning mathematical concepts and processes, and participate productively in classroom discourse through the infusion of their mother tongue.

For tertiary level math teachers, utilizing CS in classroom instruction when necessary helps facilitate learning, instruction, transition, and communication. These insights will allow math teachers to strategize their use of CS to complement the English-language instruction and avoid its unsystematic use. By focusing on elevating the quality of math discourse, CS can be used as a tool for analyzing math problems, understanding logical connections, and evaluating information, among others, since language would not be much of a concern in this context.

Secondary and tertiary level English language teachers can create learning opportunities for students to practice the English language in spoken discourse. Students' limited confidence to use the English language in spoken academic discourse is a concern because of their inadequate exposure to the language or their restricted vocabulary. Secondary and tertiary level English language teachers have to provide means for their students to use English meaningfully and extensively in communication. By creating a rich and safe classroom environment that promotes the use of English and allows the teacher to give meaningful feedback, students are helped to build their confidence in speaking the language, and to practice the English language in academic contexts, which will benefit classroom instruction and learning in the long run. Likewise, exploring a possible collaboration between English and math teachers in light of using content-based instruction in the classroom will allow the former to assist the latter in learning and using math register correctly in language discourse. Also, this will open opportunities for students to be familiar with the common math register and sentence structures in the subject area, and be exposed to the context-specific use of math language.

The findings of the study should be viewed in light of some limitations. Since it focuses on the CS types, it does not extensively discuss the functions and purposes of CS in math classrooms. Additionally, since the sample only includes tertiary math teachers, the CS types used by primary and secondary math teachers, and teachers handling other content areas may differ. However, given the dearth of literature that focuses on the use of CS in tertiary level content areas, this study can be further explored by future researchers in identifying the purposes by which CS is used in content areas, and whether math teachers' CS influence students' performance or learning outcomes.

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