Teacher Communication and the Role of Language Use in the Primary Mathematics Classroom Discourse

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ABSTRACT

Language is central to learning and acts as a medium or a tool through which new learning is assimilated and defined.The teaching and learning of mathematics which mediated by language is complicated in a multilingual context. This paper reports a study that explored the communication and language use in a multicultural Malaysian primary mathematics context. The aim of this study was twofold. Firstly, it investigated the language use by teachers in the mathematics classroom discourse, and secondly, it studied the roles of language use by the teachers in teaching mathematics. Six mathematics teachers from three types of primary schools participated in this study. Data were collected by video recording 12 classroom lessons and interview with each teacher after each lesson. Results showed that language use in the three types of primary schools mathematics classroom reflects the ethnicity of the pupils in the schools. In the weaker classes, both novice and expert teachers, in particular, those from the Chinese schools switched from English to pupils' spoken language to teach for understanding. It was also observed that language use assumed different roles in the mathematics discourse. The three important roles identified are: for explaining, questioning and discussing among peers. This paper concludes with some implications for language use in primary school mathematics within a bi/multilingual context.

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INTRODUCTION

Language is a primary tool through which teachers mediate and through which pupils access the new learning. Setati (2002) argued that mathematical concepts are communicated through the use of language and understood by exploring, explaining, reasoning and arguments accompanied by the use of mathematical symbols. Similar view was presented by the National Council of Teachers of Mathematics (NCTM, 2000, p. 60) that "Communication . . . is a way of sharing ideas and clarifying understanding. Through communication, ideas become objects of reflection, refinement, discussion, and amendment. . ." Likewise, Strong (2016) believes that discussions in the mathematics classroom allow students to formulate logical arguments and strengthen their reasoning skills.

In a multiracial and multilingual Malaysian society the language of instruction for mathematics and science in mainstream education is not spared but has undergone several radical changes. English as the medium of instruction for these two subjects was phased out by 1985 (Loo, 2000) and then systematically reintroduced into the system of education in 2003. The new policy known as the Teaching and Learning of Science and Mathematics in English (PPSMI) was introduced by the Ministry of Education to keep abreast with scientific and technological development, and to increase pupils' English language proficiency (MOE, 2002; Pandian & Ramiah, 2003). However, many studies have found that PPSMI defeated its purpose. In July 2009 the PPSMI policy was abolished by the Malaysian Cabinet. In replacement a new policy known as Upholding the Malay Language and Strengthening Command of English (MBMMBI) policy was introduced in 2012.

Pertaining to the matter above the Ministry of Education Malaysia (2012) announced that the MBMMBI policy will be implemented in staged from the year 2010. A transitional period was set to help teachers and pupils to adjust to the change of policy. In doing so a soft landing approach was implemented school-wide to teach mathematics and science in English and/or Malay Language in national (SK) and secondary schools. English and/or Chinese Language at Chinese national-type schools (SJKC), English and/or Tamil Language at Tamil national-type schools (SJKT) with the purpose to enable primary and secondary school pupils who have learnt mathematics and science in English in or before the year 2010 to continue to do so until they complete From 5. With the soft landing approach, it is anticipated that the teaching and learning of mathematics and science will be carried out fully in Malay Language in 2016 in primary schools and in 2021 in secondary schools.

As always changes in the policy on language as the medium of instruction have received mixed feelings from the society. Such situation has prompted researchers to partner with practicing teachers to gather firsthand information on what is happening in the classroom. Fox (1983) highlighted that teachers and infrastructure are among the factors that contribute to the success and effectiveness of a policy. He stressed that teachers however, still play the key role in the transformation of knowledge process. This paper focuses on teacher communication and language use and reports from a larger study that identified the different roles of languages use and their functions in mathematics classroom discourse. While the larger study was carried out in 13 primary schools in the states of Penang and Kelantan, Malaysia, the discussion here is limited to the data from the mathematics classes of six teachers and 325 pupils across three types of

primary schools in Penang. At the time of the study, pupils were at the transitional period from PPSMI to MBMMBI where English was still the language of instruction for science and mathematics subjects.

Objectives of the Study

The objectives of this study were to explore and compare the language use in mathematics classroom discourse between teachers teaching in different types of schools and among teachers with difference teaching experience. More specifically, this study aimed to address the following research questions:

1. What language do mathematics teachers (across three types of primary schools) speak in their mathematics teaching?
2. Are the any differences in the language use in mathematical discourse between novice and expert teachers?
3. What are the roles of language use in the mathematics classroom discourse from the teachers' perspective?

The Conceptual Framework

Based on the literature reviews, we have developed a conceptual framework that outlines the elements contributing to the language used in primary school mathematics classroom discourse of the larger study (see Figure 1).

The conceptual model is adapted to fit the primary school mathematics curriculum in Malaysia. Featuring in this model is three major components that influence the classroom discourse. These are the teacher component, the pupil component and the discourse. The teacher component is dependent on teacher's language proficiency between mother tongue and English, the types of school and also the number of years in teaching the primary school mathematics. Likewise the pupil component is dependent on pupils' language proficiency and the types of school.

Mathematics discourse in this study concentrates on mathematics teachers' ways and their everyday practices in the classroom. These culturally shaped discourses revolve around the status of English in Malaysia and the use of English as the language of mathematics and assessment (Tan, 2011).
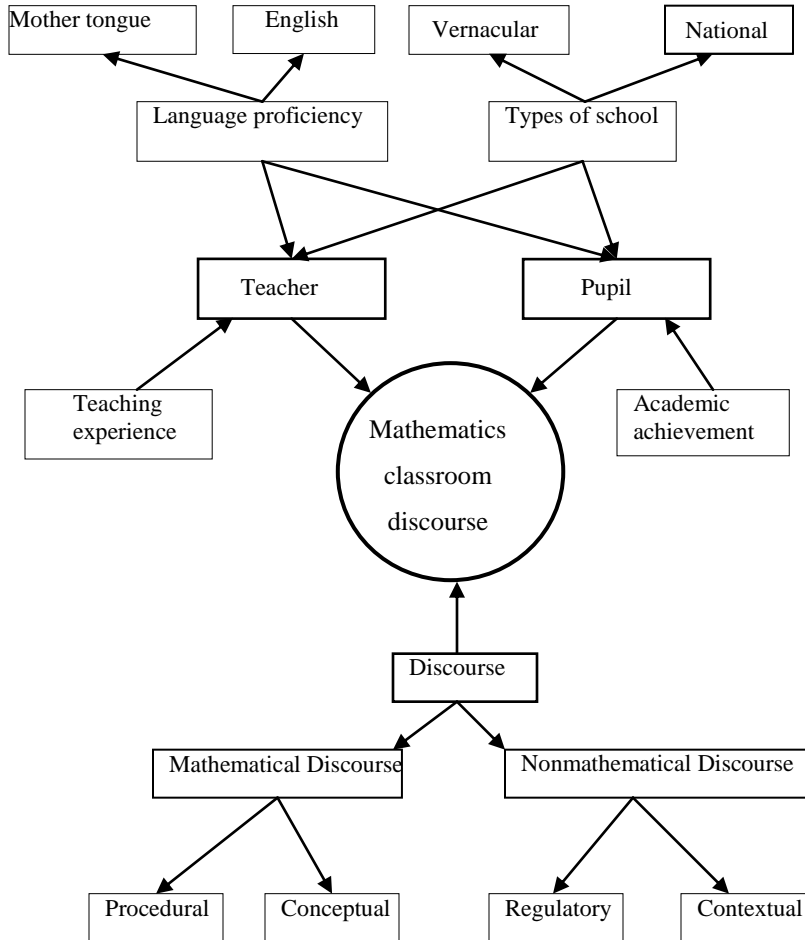
Figure 1. A conceptual model of communication and language use in mathematics classroom discourse (Source: Lim, Chew, Kor, & Tan, 2011, p.18).

METHODOLOGY

This study employed a case study interpretative approach. Qualitative data were collected from video recordings and interviews for the purpose of analyzing and interpreting the language use and its functions in the mathematics classroom discourse.

Six teachers took part in this study. A brief description of the teachers is summarized in Table 1.

Table 1
Descriptions of teacher participants

Teacher	Gender	Race	School	Class/enrolment
T1	Female	Chinese	SJKC	4W/26, 4G/39
T2	Female	Chinese	SJKC	5W/13, 5G/41
T3	Female	Indian	SJKT	6G/26, 6W/12
T4	Female	Indian	SJKT	5G/18, 5W/20
T5	Male	Malay	SK	5G/36, 6W/32
T6	Female	Chinese	SK	4G/29, 4W/33

W = weak   G = good
SK = National School; SJKC= Chinese Vernacular School ;
SJKT= Tamil Vernacular School

Data collection

The data of this study were collected mainly through video-taping mathematics lessons and in-depth interview with the mathematics teachers after each lesson. Two mathematics lessons taught by each teacher were observed, that is, one lesson in a good class and one lesson in a weak class. On average, the time interval of each observed lesson was 40 minutes. Two video-cameras were used to record these lessons. The first video-camera focused on the teacher and captured his/her teaching and actions in the class. The second video-camera was stationed in front of the class at the right hand corner to capture the pupils' activities during the teaching and learning process.

Each teacher was interviewed immediately after the observed lesson to identify the roles and purposes of language use. There were three questions asked in the in-depth interview (see the Appendix). At the end of the study, a total of twelve lessons and six teacher interviews were collected and transcribed for detailed analysis.

Data Analysis

In the data analysis, the video-recorded mathematics lessons captured by the first video-camera were transcribed verbatim for detailed analysis. The images captured by the second video-camera were to supplement and triangulate the data obtained from the first video-camera. This is to minimize ambiguities and biasness in the transcribing process. Prior to analysis using Nvivo the lesson transcripts were first "cleaned up" by removing side notes and unimportant punctuation marks so that they contained only the utterances of the teacher. The analysis basically coded the transcript of each lesson for the teacher's utterances. Rowe's (2004) definition of an utterance as "a unit of analysis of speech that corresponds to any uninterrupted stretch of speaking by one or more people" (p. 79) guided the analysis of the study.

FINDING AND DISCUSSION

The results of the study are discussed in accordance to the objectives of the study.

1. *Language used by mathematics teachers (across three different types of primary schools)in teaching mathematics*

Table 2 shows the percentage of a particular language spoken by the teachers their mathematics classroom teaching.The total percentage for each class does not add up to 100% because the transcript contains symbols such as punctuation marks and time of utterance which have not been coded. Blanks in the table indicate that there were no utterances coded in the categories concerned.

Table 2
Percentage of language used in each mathematics lesson observed

Type of school	Teacher	Class	Percentage of language used (%)				
			English	Mandarin	Tamil	Malay	Total
SK	TN1	N5G	71.95			16.53	88.48
		N6W	89.44			0.68	90.12
	TN2	N4G	87.26			0.63	87.89
		N4W	83.16			1.60	84.76
SJKC	TE3	C4G	87.46	2.72			90.18
		C4W	45.58	47.36			92.94
	TN4	C5G	90.78	0.52			91.3
		C5W	39.91	43.50			83.41
SJKT	TN5	T6G	93.17				93.17
		T6W	87.76		2.51	0.19	90.46
	TE6	T5G	90.51		2.19		92.7
		T5W	86.70		2.39		89.09

T = Teacher;   N = Novice;   E = experienced
N = National;   C = Chinese;   T = Tamil
G = good class   W = weak class
4, 5, 6 = Years 4, 5, 6

The table above shows that all classes except T6G of the SJKT used two languages in their mathematics classroom discourse. Teachers in all three types of schools (SK, SJKC, and SJKT) used two languages to teach their pupils: English and pupils' spoken language according to ethnicity. A noteworthy observation is the Chinese vernacular school (SJKC) mathematics teachers speakmore English (C4G: 87.46%; C5G: 90.78%) and less Mandarin (C4G: 2.72%; C5G: 0.52%) to teach the good classeswhile speaking almost the same amount of English and Mandarin to the weak classes (C4W: 45.58%, 47.36%; C5W: 39.91%, 43.50%). The nation SK and the Tamil SJKTschools used more English and less of pupils' spoken language (Malay and Tamil) in their classroom discourse.

Results of analysis also show that English was used as the medium of instruction in more than 72% of the mathematics classroom discourse in the good classes but only about 40% in the weak classes. This is not a surprising as English is not the first language of the large majority of Malaysian teachers and students. The result confirmed the findings of Lim, Fatimah and Tang

(2007) that only 11% of the mathematics teacher respondents claimed that they taught mathematics entirely using English language and more than half of the respondents espoused that they conversed in other languages (such as Mandarin, Malay or dialects) in most of their teaching time. Figure 2 indicated that overall mathematics teachers across the three types of schools abided by the language policy of PPSMI by practicing English as the medium of instruction in their classroom teaching.
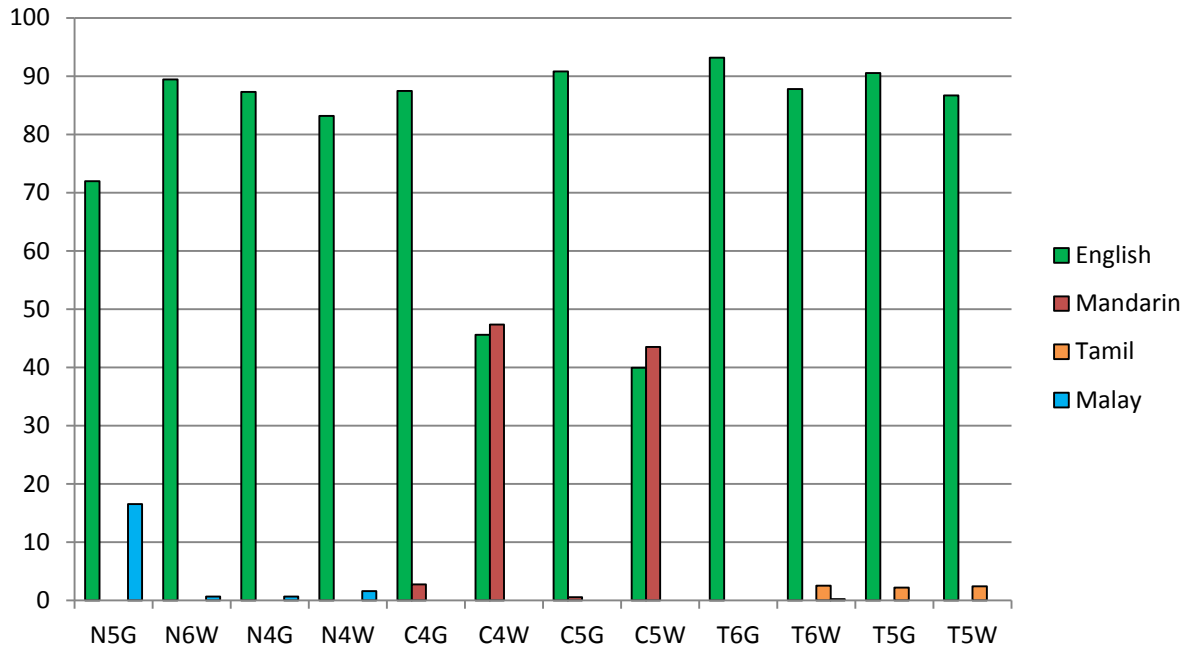

Figure 2.Percentage of language used across three types of schools

2. *Comparison between languages used by expert and novice mathematics teachers*

Besides examining the differences in the language use between good and weak classes, we were interested to see if there is any difference in the language use between experienced/expert and novice teachers. In this study, each participating teacher, whether experienced or novice, taught one good and one weak class of the same grade level. Table 2 shows that both experienced and novice teachers used more English language in good classes than in weak classes. This result implies that the choice of language use is primarily determined by the pupils' language abilities rather than the teachers' number of years of teaching experiences. This implication is reasonable because the medium of instruction is merely a tool of communication while the main aim of mathematics teaching is to transmit mathematical knowledge, concepts and skills. Hence, to ensure meaningful or effective teaching, the teacher must uses the language best understood by the pupils.

3. *The roles of language in mathematical communication from the teachers' perspective*
The teacher interview data were analyzed to examine the roles of language use. All the six mathematics teachers were interviewed immediately after the classroom teaching observation.

During the interview, each teacher was asked which language was used in explaining and questioning the students; as well as when discussing with their fellow colleagues.

Language use for explaining

During the interview both SJKC teachers said that they used English to explain when teaching the good classes but code switch between English and Mandarin for weak classes.

Interviewer: *What types of language do you prefer to use in explaining mathematics and why?*

TE3(SJKC):   *Usually for good class, I will use English. And then for weaker class, I will use Mandarin [to] explain first, make sure they understand, and then I will switch back to English.*"

Her opinion was supported by the novice teacher.

TN4 (SJKC):   *If it is a good class, I will try my best to use English to explain; if weak classes, I will try to use Mandarin.*

Similar preference and role of language used for explanation was also echoed during the interview with the two teachers from the SJKT schools.

TN5 (SJKT):   *For weak students I use Tamil and good students I use English but sometimes I use … Tamil also.*"

Interviewer: *You mentioned "sometimes", so when is the time that you have to use Tamil?*

TN5 (SJKT):   *If they don't know, don't understand about that…then I explain in Tamil.*

The above conversation shows that teachers perceived that pupils from the weaker classes are weak in English language proficiency. Hence, they fall back to use mother tongue to explain mathematical concepts so that mathematics less able pupils can understand.

In SK schools the following interview exchange illustrates the stance:

TN1(SK, Malay):   *Mostly Malay.*

TN2 (SK, Chinese):   *I prefer to teach in English…. if they still don't understand then I speak less English. When I show them an example in English, if they don't really understand, I will translate some parts using Malay. … I prefer to speak English.*

In brief, we observed that teachers' cultural background such as their ethnicity and mother tongue may be a factor in their preference in language used in instruction. Teachers

whose mother tongue same as their pupils may tend to use the mother tongue more than those who do not share the same cultural background. This preference is particularly obvious when dealing with weak students. This is plausible since the main aim of the language used by both teachers and pupils is for communication purpose. If teachers are confident that their pupils can understand better in mother tongue, certainly they will attempt to explain in mother tongue. In fact, this is a logical tendency as most teachers in several studies (see e.g. Alder, 2001; Setati, 2005) have claimed that pupils in bilingual or multilingual classroom can learn better when they are taught in their home language or mother tongue.

Language use for questioning

Questioning skills play an integral role in teaching and learning. Teachers ask pupils questions so as to stimulate pupils' thinking and learning, as well as to assess their understanding of the taughtlesson. Below are the excerpts of the teacher interviews.

Interviewer: *What types of language do you prefer to use when you ask pupils questions?*

Both the expert (TE3) and the novice (TN4) mathematics teachers from SJKC schools had similar view that for the good classes they will ask questions in English. However, in the weak classes, their strategywas"*…will use English first. After I asked in English, if they (the pupils) have no response, then I will use Mandarin."*

Likewise, the two Tamil mathematics teachers (TN5 and TE6) also adopted the same approach saying "F*irst, I ask in English. If some of them don't know I will explain [ask] in their mother tongue*". However, when it's the pupils' turn to give answer to their teacher's questions, the teachers observed that, "*the good ones (pupils), they can answer in English, but the poor ones in Tamil*".

On the other hand, when responding to pupils' questions, teachers from different types of school have different approaches. TN4 of SJKC preferred to answer in English, saying "*When pupils ask questions, I will answer in English.*"For the national school, both teachers mentioned that they would answer in English to pupils from the good classes, but will switch to Malay forpupils in weak classes.

The above analysis indicates that teachers will abide to the language policy in their classroom conversation. However, when English language fails to play its role as a tool of communication, they have no other choice but to switch to pupils' mother tongue. This phenomenon is particularly obvious in teaching the weak classes.

Language use for discussing with peers

During the interview, we asked the teachers what language they speak to their fellow colleagues in their staff room conversation. The finding was interesting. There were some differences between the three types of primary school mathematics teachers. In the SJKC schools, the mathematics teachers tended to discuss using Mandarin with their colleagues. However, if one of teachers initiates to converse in English then the whole group might switch to discuss in English.

Interviewer: *When you discuss mathematics problems with your fellow teachers, what kind of language do you use?*

TE3 (SJKC):   *Except for that teacher, he has that initiative and he wants to speak in English. I try to use English to explain to him. Otherwise we use Mandarin to converse.*

In contrast, the Tamil primary mathematics teachers appeared to use more English in their daily conversation with their colleagues, particularly when discussing mathematical problems. Nevertheless, for those who were less proficient in English, they tended to speak more Tamil and limit English to mathematical terms.

In the SK school, the language choice seems to be influenced by the ethnicity of the speakers. If a Malay teacher meets up with a non-Malay teacher, then the conversation is usually a mixture of English and Malay. If a particular teacher initiates the conversation in English, then both will converse in English. However, if a Malay teacher meets up with another Malay teacher, then depending on the English language proficiency of the speaker, if one of them is weaker, then the other will communicate in Malay to make the communication more comprehensible and non-threatening for each other. The following interview with SK teachers illustrates the phenomenon:

Interviewer: *With your friends, like fellow teacher, when you talk about math, what do you…what language do you use?*

TN1:   *Mixed.*

TN2:   *Mixed.*

Interviewer: *When you have a math problem and talk to a Malay person, the teacher, so you speak inMalay?*

TN1:   *Depend on the teacher...theperson.*

Interviewer: *If Malay and Malay teacher…*

TN1:   *If his English not so good, so we have to mix, Malay and English.*

The above result indicates that even among the teachers, English was spoken only selectively. Perhaps we should not be surprised to observe that the pupils in these bilingual classrooms did not converse much in English.

CONCLUSION

Halai and Clarkson (2016) claimed in the increasingly technological and globalized world alongside the concomitant change in population demographics (e.g., immigration, urbanization) and a change in the status of languages (e.g., English as a dominant language of science and

technology), multilingualism in mathematics classrooms is becoming a norm rather than an exception. The results of this study may offer some firsthand information to enlighten educators about the challenges that many teachers faced in teaching mathematics in a multicultural classroom and confined to using pupils' second language. In addition this study found that it is very common for teachers to switch from the language of instruction to pupils' spoken language in a bi/multilingual classroom whenever the situation calls for a need to teach for understanding. Also featured was novice and expert teachers alike shared the same view in communicative approach that is to speak more English in the good classes and less in the weaker classes. Comparison among three types of schools shows that the Chinese vernacular school teachers speak more Mandarin in teaching the weaker classes. Meanwhile, the National and Tamil schools teachers speak more English most of the time the mathematics classroom than the Chinese schools.

Findings of the study also showed the Chinese school teachers tended to discuss using Mandarin with their colleagues. They only switch to English when the conversation in English is initiated by the peers. The Tamil school mathematics teachers used more English in their daily conversation with their colleagues when discussing mathematics problems. Also, those who were less proficient in English spoke more Tamil and used limited English to state mathematical terms. While in the National schools, the language choice was influenced by the ethnicity of the speakers. A conversation between a Malay teacher and a non-Malay teacher is usually a mixture of English and Malay. However, between two Malay teachers the conversation is dependent on the English language proficiency of the other speaker to make sure the communication is comprehensible and non-threatening to each other.

In conclusion the findings of this study may help to contribute towards producing a theoretical language model that explains the roles of language in enhancing mathematics communication in local and worldwide multilingual context. It is envisaged that the developed model will benefit the process of teaching and learning mathematics in both primary and secondary schools. Lastly, it is also hoped that the findings will provide some baseline data for the policy makers in planning effective future mathematics curriculum reform.

ACKNOWLEDGMENT

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APPENDIX
Interview Questions for Teacher

1. What types of language do you prefer to use in <u>explaining</u> mathematics? Why?

   --any difference when explaining between good and weak students?
   -- any difference when explaining difficult or easy concepts/ skills?

2. What types of language do you prefer to use when you ask students <u>question</u>s?

   --any difference between good and weak students?

3. When you discuss mathematics problems with your fellow teachers, what kind of language do you use?