COMMUNICATION IN MATHEMATICS: THE ROLE 0F LANGUAGE AND ITS CONSEQUENCES FOR ENGLISH AS SECOND LANGUAGE STUDENTS

Madihah Khalid

Mohd Khairul Amilin Tengah

Universiti Brunei Darussalam

This paper will look at the emphasis on communication in the new Brunei mathematics curriculum for primary schools, the components of mathematics communication to be developed and the approaches to develop communication among Bruneian students as stated and suggested in the new curriculum document. This paper will also present problems pertaining to Bruneian students in terms of communicating using a second language because mathematics is taught in English in Brunei while most of the students are second language users of English.

INTRODUCTION

Renewed emphasis on communication was apparent in recent years as open-ended teaching and the teaching of mathematics via problem solving becomes more popular. This kind of teaching processes requires a look at language in mathematics education. The importance of language in the learning of mathematics has always been underestimated as mathematics has always been thought of as a solitary subject, and the belief that mathematics is mechanical, not creative. However, this thinking is slowly changing in tandem with the emphasis on process-based teaching approach represented by communication in the classroom. Developing classroom communication is important because it helps in the development of thinking ability (first announcement, 2007). Mathematics is the most appropriate subject to develop communications because both mathematical way of communication and mathematical thinking is necessary for students to achieve success in life especially when working in real-life.

Brunei Darussalam employs English as a medium of instruction for teaching mathematics from elementary to tertiary level. Mathematics used to be taught in the National Language in the first three years of the elementary level. However, from next year onwards, mathematics will be taught in English starting from the lowest level. As a second or third language for many students and with the greater emphasis on communication, it is a wonder if this will affect students' performance in mathematics. If so, then what is the best strategy to minimize this effect?

WHY DO WE FOCUS ON MATHEMATICAL COMMUNICATION?

With the adoption of a constructivist philosophy, mathematics educators now advocate more active learning on the part of students and a more facilitative role for teachers. A key component of most new instructional strategies is that students are

expected to discuss mathematics with their peers and their teachers. This new emphasis upon mathematical communication is a challenge for teachers and students in classrooms everywhere. Esty (1992), citing Kaput (1988), regarded the language used in mathematics as both a means of communication and an instrument of thought. The new Brunei Primary Mathematics Curriculum specifically mentioned communication as one of the processes that need to be developed with the teaching of mathematical content. In fact, together with mathematical thinking, the ability to communicate findings and provide explanations is considered as an important outcome of education (CDD, 2006). Figure 1 shows the role of communication in the teaching and learning of mathematics as shown in the conceptual framework of the new mathematics primary curriculum of Brunei Darussalam.

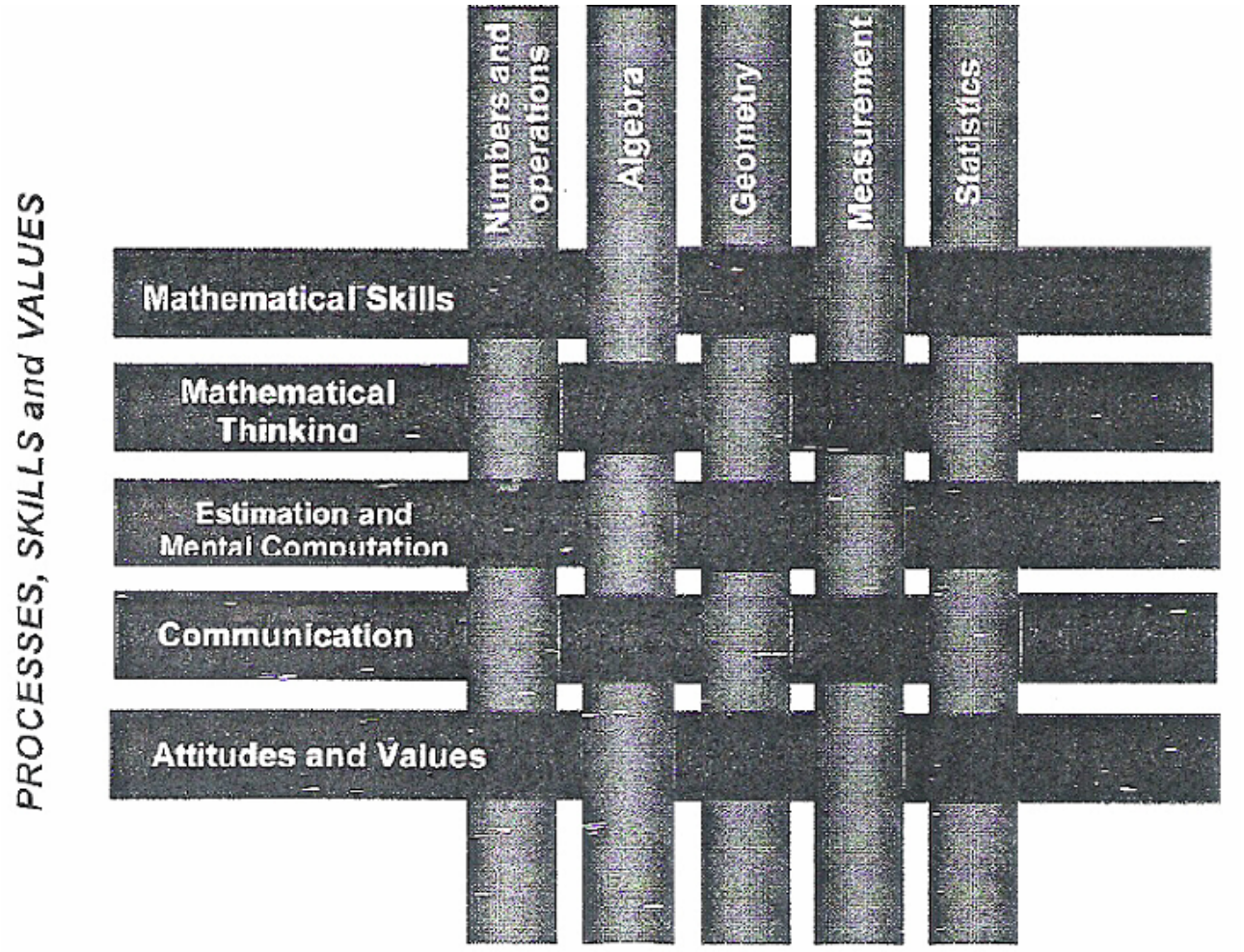

Figure 1: The Conceptual Framework

According to the document, mathematics provides a powerful means of communication which can be used to present information in figures, tables, charts, graphs and symbols (CDD, 2006, p. 2) and the process of communication is to be developed at the same time with the teaching of mathematics content together with other skills such as mathematical skills and problem solving.

Among the main aims stated in the mathematics curriculum is to develop children's ability to interpret and communicate mathematical ideas. In addition, the document

also stated that among the main objective of the curriculum is to provide learners with the opportunity to develop the ability to communicate mathematical ideas clearly and work with others and value their contribution (CDD, 2006, p.3).

The emphasis of communication in the syllabus is also reflected in the suggested assessment and evaluation method. Continuous school-based assessment is supposed to include assessment tasks that have the communication component and are as follows:

- Class discussions or oral presentations
- Written assignments
- Creative work
- Use of ICT

(CDD, 2006, p.3)

WHAT ARE YOUR COMPONENTS OF MATHEMATICAL COMMUNICATION TO DEVELOP?

The first announcement (2007) for this conference mentioned that communication in mathematics can be in the form of argumentation as well as communication where argumentation involves knowing what mathematical proofs are, while the latter involves expressing oneself. The sub-processes of communication mentioned in the Bruneian primary mathematics curriculum are written communication, oral communication and using ICT (CDD, 2006, p. 5). It can be contended that we need both oral and written communication to argue and communicate about mathematics and with the presence and popularity of the new technology, ICT can be brought in to help make communication effortless. I am excited with the prospect and current situation of ICT in helping our children to communicate better especially for students with English as a second language.

As mentioned before, language is considered as an instrument of thought, and many studies have shown that the interaction of the procedural knowledge and language facility in mathematics significantly contribute to conceptual development (Aiken, 1972). Therefore, communication through language would benefit students to make sense of topics in mathematics taught by teachers through procedural knowledge. Mathematics teaching style in Brunei has been critiqued as very procedural and algorithmic and students resort to rote memorization in preparation for examination (Clements, 2002). Communicating in mathematics classes is supposed to change this situation and make students learn with better understanding. Conceptual understanding develops when students reason out or justify their thinking using the language of mathematics, which is made up of the everyday language used together with a set of special vocabulary, symbols, tables, graphs etc.

In the instructional approach section of the primary mathematics curriculum for Brunei Darussalam (CDD, 2006), among the six modes of representation strongly

recommended is the verbal representation and this mode refers to thinking about, and communicating mathematical ideas, where children need to be able to interpret statements made by others, state their own ideas, clarify meanings and construct simple arguments (CDD, p. 7). Other representations such as concrete, diagrams, real-world, ICT and symbolic will help in clarifying meanings and make communication more varied.

From the social constructivist perspective, cognitive development of mathematics in a classroom is socially constructed by students from their past experiences and from teachers through communication. It is therefore necessary for students to participate actively in a conversational interaction that goes in a mathematics classroom to be able to "make sense" of mathematics. For Vygotsky (1978), "thought is not merely expressed in words; it comes into existence through them" (p. 218). A student working alone on a problem depends entirely on self-mediation of previously appropriated mathematical knowledge, while another student working with friends and employing teachers' help receives additional help from interactive mathematical meaning mediation. Vygotsky (1978) again stressed that learning takes place when the learner first collaborates with an adult or more competent peer to accomplish a task just beyond the learner's level of independent functioning, within the "zone of proximal development."

The question remains as to what is the implication of the social constructivist philosophy to students studying mathematics in a second language and what are the best approaches for them to feel comfortable communicating.

WHAT KINDS OF APPROACH WILL YOU PREFER TO DEVELOP THE COMMUNICATION IN CLASSROOM?

In any mathematics lesson, communication cannot be separated from problem solving and mathematical thinking. In a problem solving process, besides playing a role as an instrument for thinking mathematically, language is also important for verbal representations, and together with other representations such as diagrams, concrete materials, symbols, and ICT, students should be communicating effectively. However, this kind of scenario is not happening in Brunei. Students are reluctant to speak in class and this is recognized by Martin (1996) when he said that apart from the choral chanting, there is very little verbal output by students in Brunei classroom, which to him is a disturbing feature. He added that when there is verbal output it is very often in the form of simple verbal recall statements. Single word responses generally do not promote students' thinking ability. Is it the language that is abstaining our students from speaking up or is it the culture? Salleh (2005) suggests that despite being very expressive, pupils in the Bruneian culture are not used to giving their views in a classroom setting. Therefore, what is the best model to enhance communication in mathematics in the Bruneian context?

The document from Curriculum Development Department (CDD, 2006) suggests classroom layout and seating arrangement as in Figures 2A and 2B. This kind of

seating arrangement favors small group discussion and I think is a good way to encourage communication between students. Small group format is also favored by Brenner (1998), who thinks that for many language minority students in California, it may prove to be a comfortable and culturally appropriate instructional format. This is also the format for cooperative learning, which can be a recommended learning teachnique for students in Brunei.

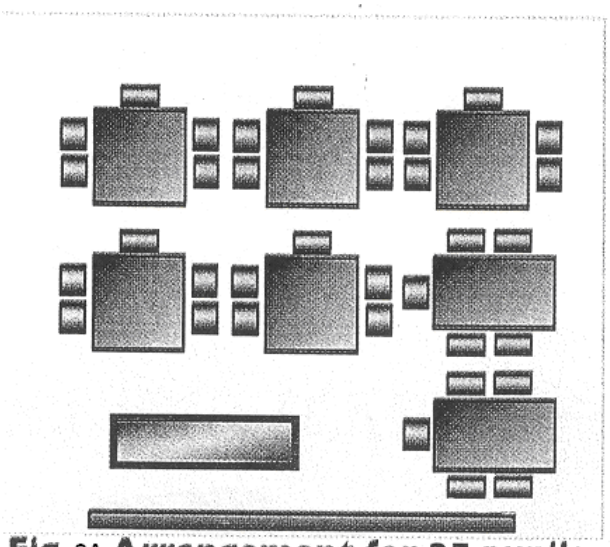

Fig 2A Arrangement for 35 pupils

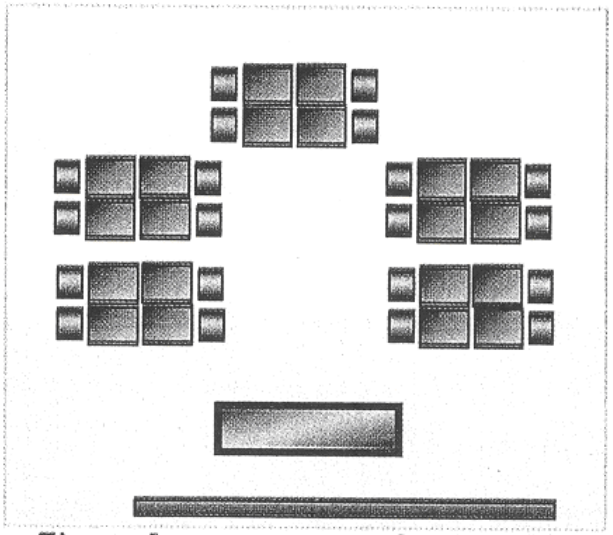

Fig 2B Arrangement for 20 pupils

Peers working together are able to describe their problem solving processes. They are also able to reflect upon them or otherwise support each others' problem solving performance. In addition to benefiting from peer interactions because peers can be a source of help, other work suggests that students benefit from hearing a variety of different perspectives about a problem solving situation. The normal seating arrangement in traditional classrooms sometimes prevents students from participating in classroom discussions. They feel intimidated or uncomfortable when spotlighted and would prefer to keep quiet rather than make mistakes. These classroom arrangements are also suitable for large group instruction when the teacher feels the need to address everybody in the classroom.

Another approach that can encourage communication in the classroom is by giving more open a problem. It is said that the more open-ended a problem is, the more students would communicate, because students would come up with multiple strategies or multiple solutions to discuss about. Nowadays, teachers have no excuse in finding open-ended problem since it is quite easy for them to source for open-ended problems from books and internet.

Communication during teaching should mirror the authentic communication in the real world (Noraini, 1999) and with the curriculum's emphasis on real world representation, problems posed in problem solving classes need to be as close to the real world as possible. This is another aspect of problem selection that teachers need to take into consideration. The ability to communicate is not exclusively dependent on linguistic competence but may rely extensively on external factors and

conceptions such as students' understanding of concept, procedures, social dynamics, prior knowledge and experience etc. Successful communication depends on the analysis of what is particular about the activity and setting. Communication for a particular lesson fails when students just ask other students for answers or when the chatter that is heard is about something else other than the topic that is being discussed or not about mathematics at all.

Lastly, besides writing reports for projects and presenting them, writing about mathematics should be made a regular feature in the mathematics classroom, either in the form of essay or journal writing for reflection and for the purpose of assessment.

LANGUAGE AND ITS CONSEQUENCES TO SECOND LANGUAGE USERS

Brunei has adopted English as a medium of instruction in almost every subject from elementary to tertiary levels. However, with limited English proficiency, pupils in Brunei usually have difficulty in trying to understand their teacher and even mathematics word problems found in books and tests. Teachers are more comfortable code-switching between English and Malay in the classroom or when speaking in normal circumstances. Many times, they take the easy way out by translating the problems into Malay and end up having students (especially those in the lower ability classes) expecting teachers to translate all problems before they start working on it. A major reason cited for students' poor performance in solving word problems is that students are not able to understand the problems. Some teachers resort to teaching using key words and this has been known to bring detrimental consequences (Sainah, 1998; Clements, 1999). If too much weight is placed on key words, students are likely to become confused.

Classes in Brunei are still highly teacher-centred. According to Brenner (1998) where she quoted Cohen and Tellez (1994), teachers who have a transmissionist philosophy, i.e., the belief that students need to be told academic content in lieu of constructing it, are unlikely to use small groups in their classes, and in most of the lessons that I have observed in Brunei, teachers have the tendency to spoon-feed (telling everything or sometimes explain) rather than question or ask students to give reasons. Students seldom ask questions and would answer teachers' questions with one word answer, and teachers seemed happy to get chorus answers.

Salleh (2005) suggested that the direct effect of code-switching from English to Malay has led to the expansion of the English vocabulary not being emphasized, despite it being essential to cope with the demands of the curriculum. Since the quality of student teacher interaction influences students' mathematical understanding, then it is not surprising for students to resort to rote learning to pass examinations.

The study by Brenner (1998) found that ESL students in her study were observed to communicate in the computer lab when they were not seen to be communicating mathematically during the large group instruction or in small group discussions. In the lab setting of the study, students were paired up to work on limited number of

computers. The students had to rely more upon their own resources rather than external help because it was difficult to attract teacher's attention. The computer itself seemed to be engaging for the students. Unlike most class days, the students talked about mathematics for the entire class period with little irrelevant talk interspersed. This is an encouraging sign for Brunei since ICT is one of the modes of representations that are emphasized in the new curriculum and the ministry of education has taken the initiatives to equipped schools with computers. The most recent innovation by the ministry is the introduction of MOBITEL (mobile notebooks with LCD projector), where each secondary and primary school in Brunei is provided with forty and twenty computers respectively.

According to Brenner (1998) again, other authors including Hoyles, Sutherland and Healy (1991) have also noted that working on the computer tends to increase the quantity and quality of student discussion. It has already been suggested in this paper that the altered participant structure in the computer lab made inter-student communication more necessary since there were fewer sources of help from outside the student group. More speculatively, it is possible that the computer also provides support for students who are just beginning to communicate about mathematics. One challenge for students who are learning to talk about mathematics is that they must learn to externalize cognitive processes which they previously accomplished as solitary activities while doing individual seatwork. The computer makes more of this visible as students monitor each others' keystrokes and the subsequent outcomes on the computer screen. The resultant discussion may also seem like less of a discussion about an individual's private thoughts, since the computer appears to do some of the `cognitive' work (Brenner, 1998). She then quoted Dixon (1995) who has shown that strategic use of the computer in mathematics classes can also enhance the achievement of LEP students in classes with English-speaking peers.

DISCUSSION AND CONCLUSION

Anyone who has paid attention to the direction that math has taken over the last several years will notice that it is highly verbal. Teachers should take note of the changes and try to apply the suggestions written in the curriculum document, otherwise pupils who are not used to giving their views in class won't communicate in mathematics lessons. Teachers play a big role in encouraging and determining the success of communication in any class. They should encourage students to make conjectures, to generate generalizations, or to compare alternative solutions. However, in order to do this, teachers need training and support from the appropriate people. Training in the form of teacher professional development should be held every now and then by the Curriculum Development department and Sultan Hassanal Bolkiah Institute of Education of Universiti Brunei Darussalam.

REFERENCES

Aiken, L. R. (1972). *Language factors in learning mathematics*. Mathematics Education Reports, Columbus, Ohio: ERIC

Brenner, M.E (1998). Development of mathematical communication in problem solving groups by language minority students. Bilingual Research Journal, 22(2,3&4), 214-244.

CDD, (2006). *Mathematics syllabus for lower and upper primary school*. Curriculum Department, Ministry of Education: Brunei Darussalam.

Clements, M. A. (1999, May). Language aspects of mathematical modelling in primary school. In Y.P. Leong, M.A. Clements (Eds) (1999). *Proceedings of the Fourth Annual Conference of the Department of Science and Mathematics Education*. Gadong: ETC Universiti Brunei Darussalam

Clements, M. A. (2002, May). *Multiple Perspectives and multiple realities of school mathematics.* Paper presented at the Seventh Annual International Conference of the Department of Science, Mathematics and Technical Education, Brunei Darussalam

Esty, W. W. (1992). Language concepts in mathematics. *Focus on Learning Problems in Mathematics*. 14(4), 31-54.

First announcement (2007). *Third APEC-Tsukuba International Conference Innovation of Classroom Teaching and Learning through Lesson Study -Focusing on Mathematical Communication*, CRICED, University of Tsukuba.

Martin, P. W. (1996). Code-switching in the primary classroom: One response to the planned and unplanned language environment in Brunei. *Journal of Multilingual and Multicultural Development*, 17(1-4), 128 – 144.

Noraini, Idris (1999, May). Linguistic aspects of mathematics education: How precise do teachers need to be. In Y.P. Leong, M.A. Clements (Eds) (1999). *Proceedings of the Fourth Annual Conference of the Department of Science and Mathematics Education.* Gadong: ETC Universiti Brunei Darussalam

Salleh, R. (2005). Undesirable academic performance in science: Is it because of language? In H.S Dhinsa, I.J. Kyeleve. O. Chukwo & J.S.H.Q Perera (Eds) (2005). *Proceedings of the 10th annual international conference of the Sultan Hassanal Bolkiah Institute of Education* (pp. 117 – 125). Gadong: ETC – Universiti Brunei Darussalam.

Sainah, Hajah (1998). *Problem solving errors by primary six children in specialist teachers' project schools*. Unpublished M. Ed. Dissertation, Universiti Brunei Darussalam.

Vygotsky, L. S (1978). *Mind in society*. Cambridge, MA: Howard Press.