Conceptualizing a Framework for Mathematics Communication in Malaysian Primary Schools

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In looking into the culture of the mathematics classroom, communication emerges as an important component to examine and consider. Communication serves as an important an essential tool for the teacher to look and probe the pupils thinking. This paper examines some of the present practices in schools and suggests a plausible framework for communications in the Malaysian primary classroom. Communication is examined in the context where it is collectively considered together with rich mathematical tasks, environment and lesson evaluation as important criteria in the creation of a classroom that focuses on mathematical thinking. Components for communication for the Malaysian context are also suggested.

Introduction

The Malaysian National Philosophy of Education (NPE) which was first drafted in 1988 has been the principal guide in the development of the school curriculum across various disciplines. The NPE states that

> Education in Malaysia is an on-going effort towards further developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious based on a firm belief in and devotion to God. Such an effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards and who are responsible and capable of achieving a high level of personal well-being as well as being able to contribute to the betterment of the family, society and the nation at large. (Curriculum Development Centre, 2006; p.vi)

While placing importance on the development of a wholesome individual through holistic education, the national curriculum also highlights the expectation of good citizenship and the creation of individuals who are able to contribute to society. It is thus seen that with every curriculum revision, the Ministry of Education (MOE) has also endeavored to keep up with the changes and trends of education world-wide. This is reflected in the Mathematics discipline too as was seen in the 2001 revision of the curriculum. Problem-solving, communications, reasoning, connections and application of technology were explicitly included in the curriculum (Pusat Perkembangan Kurikulum, 2001). These

inclusions, which continue to be included in the latest revision of the curriculum (Curriculum Development Centre, 2006) seem to follow closely the standards as envisioned by various institutions concerned with the teaching of mathematics (National Council of Teachers of Mathematics, 2000; Curriculum Planning and Development Division, 2001; Departemen Pendidikan Nasional, 2003). The inclusion of communications can be seen as an initiative by the MOE to make mathematics more meaningful and relevant to children in their pursuit of acquiring mathematical ideas.

Communications in the Malaysian Mathematics Curriculum

Communications in the mathematics curriculum is therefore taken in the context that school mathematics should collectively highlight the processes of communication problem solving, reasoning, and making mathematical connections. In clarifying ways of enhancing mathematical communications the curriculum highlighted three main areas of communication: values and aims of communication, oral communication and written communication.

Values and aims of communication. Several considerations were suggested which includes identifying relevant contexts, pupils' interest and teaching materials, ensuring active, stimulating meta-cognitive skills, inculcating positive attitudes and creating a conducive learning environment (Curriculum Development Centre, 2006).

Oral communication. Some of the suggested communication techniques include story-telling, asking and answering questions, structured and unstructured interviews, discussions and presentation of assignments.

Written communication. The curriculum suggests communication activities such as doing exercises, keeping scrap books, keeping folios, undertaking projects and doing written tests.

State-of-the-Art and Sate-of-the-Practice: The Missing Gaps

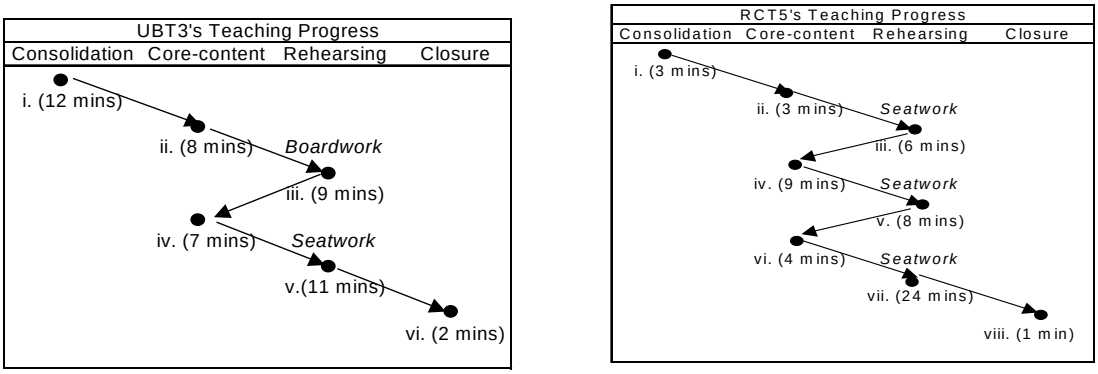
While the curriculum does specify various activities that the teacher can use in classroom communication it does not provide examples nor a model which the teacher can use as a guide in planning a mathematics lesson. Thus even when the teacher does carry out communication using the suggested techniques, it may not achieve the desired purpose i.e. to enhance meaningful acquisition of mathematical ideas. Communication need not always imply that meaningful mathematical discourse that leads to conceptual development of mathematical ideas has taken place. As Richards (1991) pointed out, communication in school mathematics is often trapped in discourse that is focused on teacher-pupil talk that is used to solve habitual unreflective questions. Very often the children just attempts to pick answers that the teacher expects without inquiry.

The state-of-the-practice. In a study conducted on 16 secondary mathematics teachers who were considered effective by the school principals, assistant principals and the head of departments, it was found that 93.2% of the observation time was spent on interacting with pupils (Mohd. Majid Konting, 1997). The teaching episodes were collected though 1,450 observations which covered 604 minutes of teaching time. It was found that the mathematics teachers spent 93.3% of the time making contacts in the interaction while the pupils only 1.6% of the time making contacts with the teachers.

Further the teacher-pupils interactions were more commonly of a low cognitive level. The findings show that communications in the mathematics classroom were more of a one-way process dictated by the teacher.

In a more recent study on communications in a mathematics classroom, Ruzlan (2007) compared two Malaysian primary lessons on fractions; one in an urban setting while the other was in a rural school. From the study it was found that there were four phases that were common in the lessons. The *consolidation* phase deals mainly with the introduction to the lesson. During the *core-content* phase that follows the teacher would introduce the content. In the study it was found that the content of both lessons were essentially the same: finding the value, interpreting the symbolism and developing the procedural proficiency. In the *rehearsing* phase the pupils would practice solving problems which were similar to those given in the core-content phase either in the form of board work or seatwork. For board work the students would be called to work on problems on the board in front of the class. During seatwork the children would remain in their seats while working on problems similar to the one given during the core-content phase. The *lesson closure* phase refers to the activities that bring the lesson to a close. Figure 1 shows a diagrammatic representation of the progress of the lessons.

In his findings, Ruzlan (2007) further found that all the questions posed by the teachers were the closed-ended in nature, where the children were anticipated to arrive at certain answers expected by the teachers only. No open-ended questions were found. Typical of some of the close-ended questions were closed procedural questions (*"Alright, what is one times five?"*), close-routine questions (*"Do you understand?"*), closed complete-the-statement questions (*"Fractions have a numerator and denomina…?*" students complete the statement with "*…tor*"), closed verification questions ("*Is the answer right?*") and closed terminology questions (*"What do we call this fraction?"*). Figure 1 show the progress of the lessons. It can be seen that in both lessons, most of the teaching focus shifted between core-content and rehearsing ultimately emphasizing procedural competence as the aim of the mathematics lessons. Quite clearly the lessons were a deep contrast to mathematics learning as intended in the curriculum.



Urban School Setting Rural School Setting

Figure 1. Teachers use of teaching phases in lessons on fractions (from Ruzlan, 2007).

Some constraints to consider. In attempting to construct a plausible model for communications in the Malaysian primary classroom, it is important to consider some constraints that tend to impede the conduct of a lesson that focuses a more progressive approach to mathematical thinking. Lim (2006) highlighted three of these constraints: (1) teachers' beliefs that it is more efficient to give clear explanations as opposed to allowing students to work on tasks and construct their own mathematical ideas, (2) the examination-centered culture that only reinforces teachers' beliefs about teacher-centered classrooms and procedural competency, and (3) the common belief that hard-work and "practice-makes-perfect" as the key ingredient for success in learning mathematics.

In 2003, the MOE made a bold policy change involving the use of English as the medium of instruction in science and mathematics lessons. However, recently there has been some disquiet towards this policy from several quarters appealing to the MOE to revert the medium of instruction of mathematics back to the mother tongue, claiming that pupils find it difficult to communicate and understand mathematics when it is instructed using the English language. Undeniably, any change in the medium of instruction will pose an added constraint to classroom communications as classroom discourse is embedded in the language of instruction. The use of a second language in teaching mathematics has therefore posed a further challenge for teachers as he communicates with his pupils.

The state-of the-art. Solving mathematical problems is not all about deductive methods only. In his thesis, Lakatos (1976) argues that heuristics and processes such as conjecturing, critiquing and providing counterexamples are important processes in mathematical problem solving. While the work of Lakatos (1976) does provides a philosophical basis for developing a framework for communication in the mathematics classroom, it would however be difficult to imagine that pupils in the primary school would be able conjecture and critique to the level as espoused by Lakatos. Mindful that the Malaysian perception of school is much alike that of the East Asian perspective that places emphasis on product rather that processes, and on effort in achieving success in doing mathematics (Leung, 2000; Lim, Fatimah & Tan, 2003), focusing on mathematical processes would need to consider changing the mindset of the teachers. Teachers would need to be convinced that focusing on mathematics processes will actually be a better alternative in producing mathematical success. However if schools were to be the training ground for future mathematicians, and for the creation of a thinking society that is deemed necessary in the present age of information technology, then it is inevitable that acquiring mathematical processes should be one of the important aims of school mathematics.

A more plausible model for communication can perhaps be found in Mason, Burton and Stacey (1982) which looked into the different phases of problem solving and suggested some heuristics to assist the learner in the problem solving process. Some cues that were suggested to assist the learner in problem solving were to clarify what the pupil already knows and what he needs to know, conjecturing, justifying and convincing, and specializing and generalizing. The role of the teacher is thus to probe and ask relevant questions in order to assist the pupil move towards solving the problem. Much of the suggestions can be seen taking place in the lesson study videos on Japanese classrooms (e.g. Hosomizu, 2006). In the videos the lesson starts with a rich mathematical task

where the pupils work together to arrive at mathematical ideas and formulas. First the teacher probes the students understanding of the problem; what the students already know, and what the students want to know in the problem. The teacher then encourages the pupils to suggest solutions and make conjectures. He probes the pupils' thinking and thoughts, using questions to cleverly invoke the pupils' thinking until they arrive at the solution which was acceptable by the teacher.

A plausible framework for communications in the mathematics should place communications in the context of the classroom together with other important criteria for planning a good lesson: rich tasks which enable the pupils to engage in mathematical thinking, constant evaluation of the lesson by the teacher both during and after the lesson and the creating of a suitable environment so the mathematical discourse can take place (National Council of Teachers of Mathematics, 1991; Bahagian Pendidikan Guru, 1998). Figure 2 shows the four important aspects of a lesson focusing mathematical thinking and the key features of classroom communication. Classroom communication is mutually influenced by the tasks, the environment and the analysis/evaluation of the lesson and the teacher thus needs to consider classroom communications together with these important entities of the lesson.

Components of Mathematical Communication in the Primary Classroom

Communication in the classroom brings along with it the values of the community. In the case of the primary classroom, the teacher who is obviously older, more mature and knowledgeable than the children from the ages of seven to twelve holds the key in value transmission in the mathematics classroom. Not only do the pupils learn mathematical facts and ideas but they also acquire the informal knowledge about mathematics: what it means to study and do mathematics and the values the nature of the subject carries through the informal activities of the lesson such as through communication (Bishop, 1988). Keeping in mind the constraints and impediments in attempting to carry out a more process-focused mathematics lesson as was discussed earlier, I would like to suggest the following features that would be appropriate components of communication in the primary mathematics curriculum in Malaysia:

1. Classroom communication is very much influenced by the multilingual and multicultural nature of the classroom. Communication on a formal level in Malaysia is carried out using English which is often the second language for both the teachers and pupils. Granted that there is a growing urban middle-class that speaks English at home, it is however generally an uncommon occurrence in Malaysia.

2. Communication can be enhanced through various means of representation, such as through symbols, diagrams, drawings, charts and graphs which are commonly used in mathematics. This feature becomes an even more important consideration when mathematical communication is carried out in a second language.

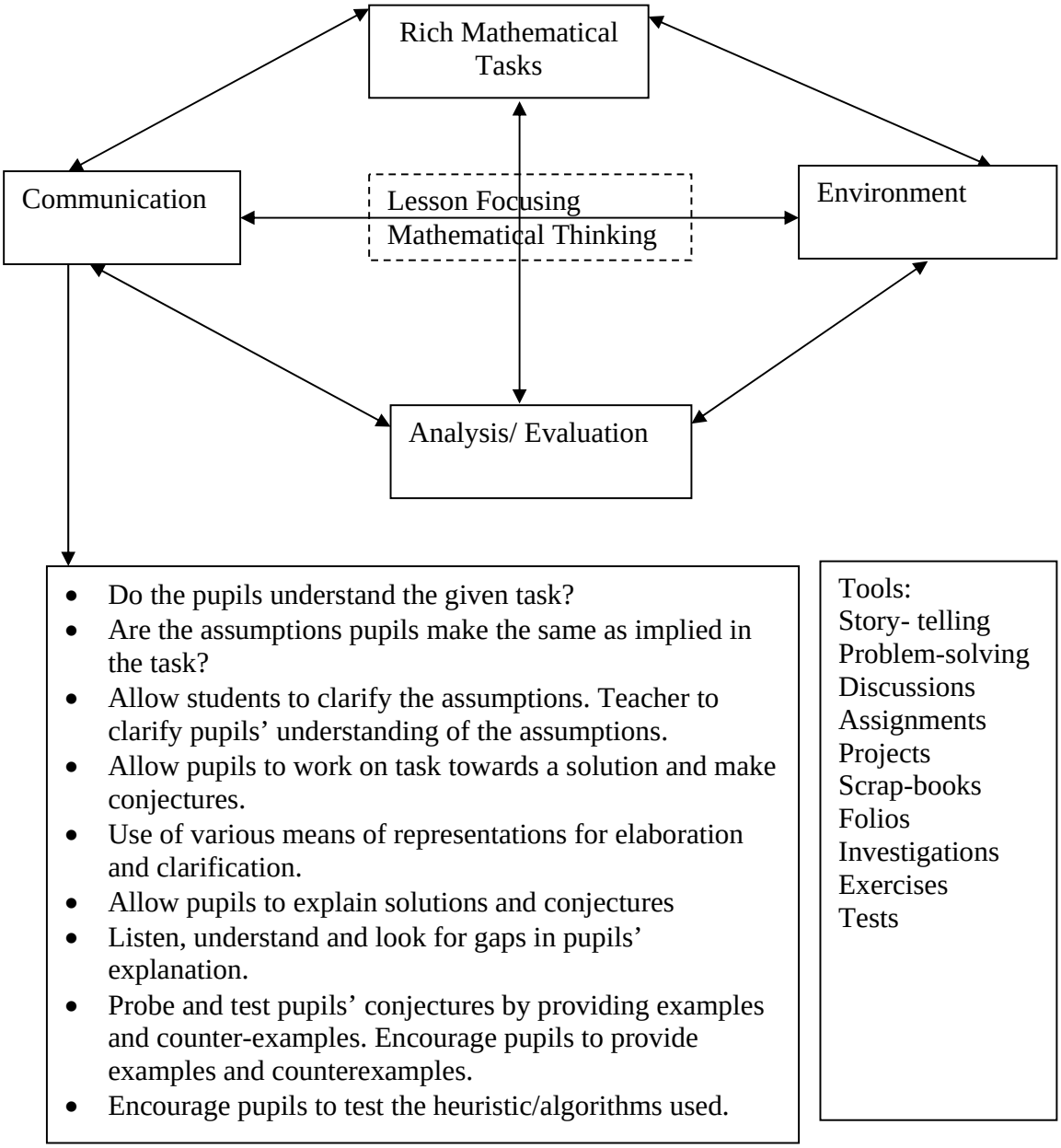


Figure 2. A framework for communications in the Malaysian primary mathematics classroom.

3. Communication is dialectic and to encourage its use in the classroom, teachers need to develop a belief that even when they are in authority; there is a need to empower the pupils and coax them into dialogue. This would mean that teachers should patiently probe pupils' thinking through questioning and allowing and encouraging pupils to elaborate on their ideas instead of just telling.

4. Communication in the mathematics classroom ought to promote the value that mathematics is rationale. What is acceptable as right in the classroom is not through authority but rather through reasoning and logical arguments?

5. Communication is used as a means of promoting the idea that mathematical knowledge is developed through collaboration and not by authority.

Conclusion

Communication is an essential part of the mathematical classroom. Students may use verbal language to communicate their thoughts, extend thinking, and understand mathematical concepts. They may also use written language to explain, reason, and process their thinking of mathematical ideas. Communication thus becomes a tool which can assist pupils to form questions or ideas about concepts. Classroom communication is therefore one of the key components in a classroom that focuses on promoting mathematical thinking. As the teacher is unable to see directly what the pupil thinks, communication then becomes a window to view the pupil thought processes. Through communication the teacher is then able to coax and guide the pupil to develop further his mathematical thinking. Therefore communication is a necessary and important component to be analyzed in the Lesson Study as improved mathematical thinking is very much dependent on good classroom communication.

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