

## **Improving Assessment in the Primary Mathematics Classroom through Lesson Study**

**Ui Hock CHEAH**

Southeast Asia Ministers of Education Organisation  
Regional Centre for Education in Science and Mathematics (SEAMEO RECSAM)  
Penang , Malaysia

### *Abstract*

*This paper provides a snapshot on the assessment practices in a project that utilizes the Lesson Study approach in an attempt to improve lessons that focus on student mathematical thinking. Assessment was seen by the teachers as integral to the lesson. The findings show that the teachers placed primary importance on following the learning outcomes stipulated in the curriculum and on designing activities to help students understand the mathematical concepts. The common modes of assessment include the use of worksheets, observations of students on tasks and questions posed. The teachers practice shows the perceived importance of closely following the curriculum and indirect link of the classroom assessment modes to the examinations.*

### **Introduction**

There is a notion that public examinations dictate the way teachers teach. This has consequently generated suggestions that the public examinations should be reviewed or even abolished. There are three public standard examination in Malaysia, namely, (1) the Ujian Penilaian Sekolah Rendah (UPSR) [Primary School Assessment Test] which is administered at the end of primary school, (2) the Penilaian Menengah Rendah (PMR) [Lower Secondary Assessment] at the end of the lower secondary education and, (3) the Sijil Pelajaran Malaysia (SPM) [Malaysian Certificate of Examination] at the end of five years of secondary education. While the Ministry of Education has been mulling over the abolishment of the standard examinations, the reactions from the public have been varied (The Star, 20 June 2010; New Straits Times, 20 June 2010). Two main issues have been raised. First is the question of accountability. How will the public know if the schools have indeed been educating the students well since the public examinations have been traditionally perceived by the public as a standardized measure of student cognitive abilities? The second issue is that the standard examinations have become so high-stakes that they seem to dictate how teaching is done in the classroom. The common perception is that teachers teach and students learn only what is being tested. Besides, it is also commonly known that there are other important attributes for students to acquire. These, however, seem difficult to measure well through pencil and paper tests. But while this big debate is going on it is undeniable that teachers accept that there must be some form of suitable assessment in the classroom. It is through assessment that the quality of teaching and learning can be appraised and improved (Popham, 1988).

Assessment also forms an important and critical part of the mathematics classroom. While the main aim of the mathematics classroom is to provide the students with experiences in order to build and then to apply mathematical ideas, there is a need to systematically evaluate whether pupil learning has been achieved (Curriculum Development Centre, 2003). Assessment

is therefore not something viewed as apart but rather as integral to the teaching and learning process.

[Assessment] has to be well-structured and carried out continuously as part of the classroom activities. By focusing on a broad range of mathematical tasks, the strengths and weaknesses of pupils can be assessed. Different methods of assessment can be conducted using multiple assessment techniques, including written and oral work as well as demonstration. These may be in the form of interviews, open-ended questions, observations and assignments. Based on the results, the teachers can rectify the pupils' misconceptions and weaknesses and at the same time improve their teaching skills. (Curriculum Development Centre, 2003; p. xx)

The purpose of assessment in the mathematics classroom is shifting away from the traditional focus of just grading and reporting students' learning results particularly to the stakeholders. As the mathematics classroom becomes more focused on students, assessment now emphasizes the processes of learning in both the cognitive and affective domains for the purpose of improving teaching and learning (Quek & Fan, 2009; Stiggins, 2007).

The current focus of teaching and learning in Malaysia places emphases on the processes of mathematical thinking in addition to the integration and application of technology (Curriculum Development Centre, 2003). The importance of mathematical thinking is translated in the curriculum to include the various mathematical processes: problem solving, mathematical communication, mathematical reasoning and mathematical connection. As was noted by Ruzlan (2007), the current classroom practice seems to focus on getting the students to arrive at the procedures as determined by the teachers. Subsequently, students acquire instrumental understanding as opposed to relational understanding (Skemp, 1988) which is contrary to the aim of the curriculum. To actualize the recommendations in the national curriculum would therefore require changes in the traditional classroom practices of teachers. A possible factor that seems to restrain teachers from planning lessons that emphasize mathematical thinking is that learning outcomes in behavioural terms for each topic are explicitly stated in the curriculum. Teachers seem to misinterpret this to mean that they are not required to go beyond the documented learning outcomes to enhance student learning.

Furthermore, traditional modes of assessment are often used and seem to be the choice of teachers in the classroom. Teachers' self reports on assessment practices in the classroom show that homework is the most preferred method of assessment (Ong, 2010). Often in the primary school, homework takes the form of exercises sourced from textbooks and also in the form of worksheets prepared by the teacher. It is a form of pencil and paper test to assess whether the pupils have achieved the learning outcomes as stated in the curriculum. This mode of assessment is however unable to accurately assess the mathematical processes that occur in the classroom. How then can the assessment of mathematical processes be carried out in the classroom? There have been suggestions that one way of assessing process competencies is through the use of rubrics (Lee & Muaz Ghazalie, 2005). However, this raises the point about its practicality since using rubrics in a classroom would simply require too much time. Moreover, teachers might question its practicality to individually assess all the students in the classroom, bearing in mind that classroom size sometimes reaches 40 students in the primary

school. Nonetheless, it is also clear that one important factor in assessing the processes is through the use of cleverly crafted mathematical tasks that facilitate mathematical thinking in the classroom (Cheah, 2010; Hwa & Lim, 2008). Subsequently, by assessing the strategies that the children use to carry out the tasks, one is then able to make an assessment of how well the children are thinking mathematically (Doerr, 2006).

This paper provides a snapshot on the assessment practices in a project that utilizes the Lesson Study approach in an attempt to improve lessons that focus on student mathematical thinking in the primary school.

### **The Lesson Study Project in Penang 2010**

Lesson Study is in its infancy in Malaysia. While there have been efforts to encourage schools to adopt Lesson Study, not many schools have begun to use it as a teacher professional development program over a sustained period of time. In the present project, three primary schools consented to take part in the project as a follow-up from the Lesson Study project conducted in the same three schools in 2008. The three schools were different in terms of student population as well as the medium of instruction used in the school. School A is a medium-sized sub-urban school using Malay as the medium of instruction with 970 students and 60 teachers. School B is an urban school which uses Chinese as the medium of instruction and has a student population of 1687 with 81 teachers. School C is an urban school and uses Tamil as the medium of instruction with a student population of 339 and a teacher population of 25. There were five Lesson Study groups, one in School A, three in School B and one in School C. Each group conducted one research lesson each. The groups in school A and C decided and carried out a re-teach of the lesson after the first post-lesson discussion was conducted. The classes were conducted in their respective media of instruction except for School C which decided to carry out the lessons in English as it was still in its transition to switch from English to mother tongue as the medium of instruction for its mathematics classes.

#### *Planning the Lesson*

Table 1 shows the composition of the members of the Lesson Study Groups (LSGs) in each school. The lessons were mainly planned by the teachers with the assistance of academics from RECSAM and the Teacher Institute who took on the roles of external advisors.

In School A and C, the LSG group members taught mathematics at different year levels while in School B, the LSG members of each group taught the same year level. This was possible as there were eight classes in each of the year level in School B. Each of the groups met twice to plan the lesson together with the external advisors and the LSG were allowed to choose the topics for the research lesson. All the members of the groups had agreed that the focus of the planning was to emphasize student-centered lessons and mathematical thinking. The learning outcomes were chosen by the teachers and were picked out from the national curriculum. The topics and the learning outcomes selected are shown in Table 2. It was observed that the experience of the teachers was an important factor in the group discussions during lesson planning. The opinions of the experienced teachers were well accepted and served to guide the direction of the lesson planning discussion. For example, in the LSG from School A, the Head of the mathematics panel in the school pointed out the students in the class were weak in recalling the multiplication tables. This led the group to focus on ideas and activities that

would help the students understand and remember the multiplication tables during the planning of the lesson.

The research lessons were then conducted once the teachers agreed on the lesson plans.

Table 1  
*Composition of the Lesson Study Groups*

School	Lesson Study group	No. of teachers	Experience of teachers
A	Year 4	3	Head of mathematics panel (20 years) Two teachers (5 to 10 years)
B	Year 1	8	Two teachers (1 to 5 years) Three teachers (6 to 10 years) Three teachers (more than 10 years)
	Year 2	7	One teacher (less than 5 years) Three teachers (6 to 10 years) Three teachers (more than 20 years)
	Year 3	8	Five teachers (Less than one year) One teacher (less than 5 years) Two teachers (more than 20 years)
C	Year 3	3	one teacher (5 years experience) two teachers (8-10 years experience)

Table 2  
*Subject Matter of the Research Lessons*



School	Lesson Study Group	Topic	Learning Outcomes
A	Year 4	Whole Numbers	Multiply up to six-digit numbers with a one-digit numbers
B	Year 1	Money	Recognize coins and notes of Malaysian currency and their values.
	Year 2	Length	1. Use the vocabulary related to length in practical 2. Compare the lengths of two objects by direct comparison 3. Say out the lengths of any objects by relating them to non-standard measuring units.
	Year 3	Fractions	1. Recognize one whole, one half, one quarter and three quarters. 2. Say fractions, parts, one whole, one half, one quarter and three quarters in context. 3. Read fractions, parts, one whole, one half, one quarter and three quarters in context.
C	Year 3	Fractions	1. Recognize one whole, one half, one quarter and three quarters. 2. Say fractions, parts, one whole, one half, one quarter and three quarters in context.

*Flow of the Research Lessons*

All the lessons typically started with set inductions which were aimed at introducing the lesson and setting the mood for the lesson. The lessons were then followed by the development of the targeted concept. The teachers would first explain the mathematical concepts through student activities which were then reinforced through further activities. All the LSGs were encouraged to attempt new activities to help the students mathematize, but the teachers seemed reluctant to include such activities. Thus even though the lessons planned were activity-oriented, the involved more deductive approaches rather encourage than inductive thinking. There was no activity which required the students to work through activities to arrive at concepts by themselves through reasoning and discussion. The main reason cited by the teachers was that this was not stated as a learning outcome in the curriculum and was thus beyond what they were required to teach. All the lessons prepared by the LSGs ended with the conclusion to the lessons where teacher discussed the concepts the students had learnt during the lesson.

*A snapshot of one lesson.* The snapshot is taken from the lesson of the LSG group in School B which chose the topic on fractions. A brief description of the lesson flow is shown in Table 3. The learning outcomes of the lesson were to recognize, say and read fractions, parts, one whole, one half, one quarter and three quarters in context.

Table 3  
*Flow of Lesson on the Topic of Fractions*

	Activities
Set induction	Demonstration through role play – two students divide 4 sweets between themselves. Is it fair?
Development 1	Group work – groups provided with colored paper of different shapes, teacher explains with an example of a round shape, cuts it into two equal halves, students identifies as “one-half”, “one out of two parts”. Teacher explains the concept of one whole, number of different parts; explains one-quarter, student writes $\frac{1}{4}$ on the board, teacher explains the terms “numerator”, “denominator”
Development 2	Group work: students to arrange cutouts into a rectangle 
Development 3	Teacher discusses the concepts of fractions using the cutouts of the students from the development 2. A few students called to write the fractions indicated on the board. 

Development 4 Group work: students given paper strips and were asked to fold and shade the fractions



Closure Teacher discusses the meaning of fractions and gives out worksheet for students to complete.

### Assessment

During the post-lesson discussion the teachers explicitly stated that the main modes of assessment that they had used were 1) worksheets given out at the end of the lesson, and 2) professional noticing which includes observations of the students while they were working on the tasks, and questions that the teachers posed during the lesson tasks. It was observed that worksheets were used in all the lessons to assess student learning. During the post-lesson discussions it also became clear that all the teachers were fully aware that they were continually assessing the students through all the activities during the lesson.

*The worksheets.* Figure 1 shows the worksheet given at the end of the lesson on fractions. The worksheets for the other lessons were similarly given to test whether the students had achieved the learning outcomes as stated in the lesson plan.

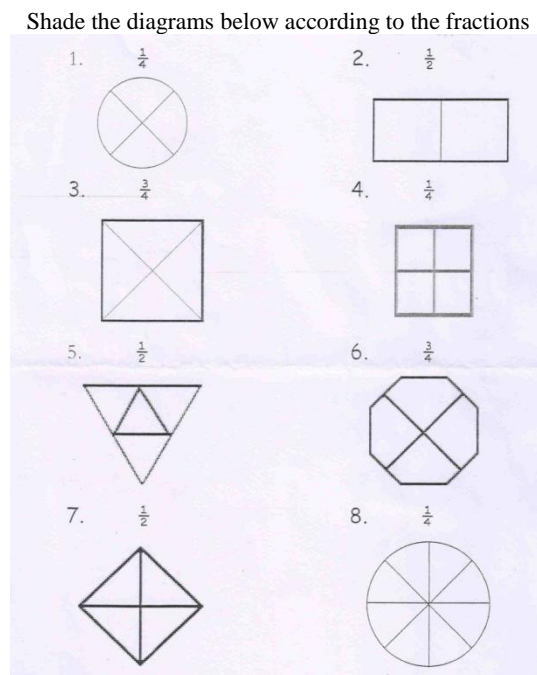


Figure 1. The end-of lesson worksheet on fractions.

## Discussion

### *Modes of Assessment in the Classroom*

It was apparent from the lesson observations and the post lesson discussions that the teachers were aware of the aims of the lessons and the assessment procedures. In all the lessons, worksheets were given at the end of the lesson. The importance attached to the use of worksheets shows its indirect link to the examinations. It could be a form of training that the teachers intend to provide the students so that they are prepared to answer similar questions that appear in school tests. Another common mode of assessment used by the teachers was through observations and questioning while the students were carrying out the tasks. The general observation is that the students were assessed both formatively through observations and the answers to teacher's questions, and summatively through the worksheets. The assessment methods used also seemed to be an integral part of the lesson and grew out of the activities the teachers had planned to achieve student understanding.

### *Teacher Professional Noticing*

One of the most general forms of assessment that was used in the lessons was through the teacher observing and asking questions during the activities. This form of assessment, commonly called noticing, is the most common assessment activity carried out by the teachers. Competence in classroom noticing is closely linked to the experience of the teachers; the more experience the teachers are, the more elaborate is his or her ability to notice (Jacobs, Lamb & Philipp, 2010). Noticing is difficult to quantify explicitly. However, through the Lesson Study approach, the noticing ability of the teachers became more apparent and explicit through the post-lesson comments offered by the other observing teachers of the LSG. Given that class sizes often reach 40 students, it would be difficult to notice all the specific instances of student learning and student difficulties. With the extra pairs of eyes of the group members, more instances of student response were thus able to be perceived and discussed. What is often missed by the teacher could then be picked up by the other observing teachers. Discussion of these instances during the post lesson discussion was made explicitly known to the teacher and this would add on to his or her experience. This strategy that enhances professional noticing could possibly be the most important role and an added advantage of Lesson Study in improving assessment in the classroom.

### *Subject Matter and Learning Outcomes*

Various quarters have raised the issue that there is an overemphasis on examinations and that the public examinations influence the way teachers teach in Malaysia (Cheah, 2010; Lim, 2010). The observations from the five lessons in this project, however, showed that there is only an indirect influence of the examinations on classroom lessons. The first and primary concern of the LSGs was on achieving the learning outcomes as stipulated in the curriculum and not on how the students would perform in the public examinations. The teachers wanted the students to understand the mathematical concepts which they hoped to achieve through classroom activities and group tasks. However, it was also found that the teachers seemed rather reluctant to include learning outcomes that are beyond what is documented in the curriculum even when they felt that the activities were related and interesting. This could perhaps be the reason why the teachers hesitate to include mathematical tasks that involve students creating or discovering

mathematical concepts. While the tasks planned were hands-on and student-centered, they were mainly focused on helping the students understand the mathematical concepts that were taught. The focus was on the teacher explaining the mathematical concepts through student activities and not on student discovering the concepts to be learnt. This falls short of the ultimate aim of mathematical thinking. Learning mathematics is not just confined to learning the mathematical formulas and concepts as stated in the textbooks but also to create mathematical ideas that are relevant to the students. Only when students are nurtured to acquire the affective knowledge of creating mathematics, will they be empowered to know the power of mathematical knowledge.

### *Shifting the Focus towards Mathematical Thinking*

*Start with the lower primary.* Teachers often cite the need to “complete the syllabus” and “prepare for the examinations” as the most common reasons why tasks that help build creativity are not included in their lessons. It is noted that all the lessons observed in this project involved classes in the lower primary (Year 1 to Year 4). This could be one reason why the teachers did not give much direct focus on the public examinations when planning the lessons, as could be generally expected. This raises the prospect that it could be more practical for teachers in the lower primary rather than those from the upper secondary to make an effort to include mathematical thinking tasks in the lessons. Given that public examinations are high-stakes and of great importance, then a good place to start to de-emphasize examinations would be in the lower primary. Instead, emphasis in the lower primary can be given to understanding and creative thinking. By Year 5 and Year 6, teachers can then begin to include programs to prepare the students for the UPSR public examination. It therefore seems logical and practical that this would be easier approach to prepare the mindset of the teachers for change.

*Availability of teaching materials.* One important factor that would encourage teachers to include more activities on mathematizing is the availability of teaching materials that are also matched to the curriculum. While there are many teaching materials available on the internet, most of these are not contextualized to the Malaysian culture. Further, teachers would be required to match these materials to the national curriculum. If these contextualized teaching materials are made readily available it would greatly facilitate teachers using them in the classroom. As at present there is a lack of such materials available to the teachers and this could possibly hinder the teachers from attempting to include mathematical thinking as a prime focus of classroom teaching.

*Lesson Study.* The teachers in the LSGs view Lesson Study positively as a professional development approach through which they are able to learn and further cultivate and nurture their teaching skills. The more experienced teachers however were also more aware that the Lesson Study approach requires more time to implement and were thus hesitant to agree to its adoption as a formal activity of the teachers. However, the teachers were also quick to point out that they have learnt a lot from their peers in the LSGs and were confident that they had improved in their teaching.

## **Conclusion**

Contrary to what is often claimed by teachers that teaching methods are greatly influenced by the public examinations, the methods and modes of assessment used by the teachers in this study showed only a faint and indirect link to the examinations. In planning the lessons, the



teachers were more concerned that the learning outcomes as stipulated in the curriculum were followed closely. The teachers were also very concerned about the students' understanding of the mathematical concepts as was evident in the various teaching activities that were planned. It was seen that each activity was planned to help the students understand the mathematical concepts. What seemed lacking, however, is the use of student inductive thinking to arrive at the mathematical concepts. The direction of student thinking was teacher directed and there was very little exploration on the part of the students.

Assessment of student learning during the activities was through the teachers' professional noticing and through discourse, mainly through the use of questions and answers. The ability to notice and to assess student learning depends very much on experience (Jacobs, Lamb & Philipp, 2010). It is in this area that Lesson Study could play a major role in helping novice teachers explicitly learn to assess students while they are on task.

The use of worksheets at the end of every lesson is perhaps some indication of teachers' perception that there must be a pencil and paper form of summative assessment. A possible reason for this perception is that worksheets provide a more objective evaluation of student performance and thus present a means of quantifying student learning that would facilitate easier reporting. The use of worksheets is also perhaps an indication of the indirect link that classroom assessment has with the public examinations since both these form of assessment provides objective quantitative methods of evaluating student performance.

The observations from this project show that the Lesson Study approach provides a viable practice towards improving classroom assessment. Through post lesson discussions teachers become aware of their strengths and weaknesses. Through the observers comments, the teachers are able to see what they might have failed to notice and thus provide a window through which lessons can be improved

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