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Pupil Self-Assessment In Mathematics: A Viable Alternative Assessment Strategy?

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Abstract

Pupil self-assessment as an alternative assessment strategy was tried out in two Primary 3 classes as part of an ongoing research project on integrating “new” assessment strategies in mathematics. The pupils were involved in judging the extent to which they have learnt and in thinking back to and reporting on their experiences of learning mathematics. They engaged in the self-assessment tasks where appropriate during the daily lesson. This paper describes briefly the self-assessment project and highlights some preliminary findings from classroom observation notes and pupil responses to the tasks. Pupil self-assessment can be a viable source of assessment information for improving learning and teaching. The challenges faced and questions raised are presented.

Introduction

This paper reports on an ongoing study of pupil self-assessment in two Primary 3 mathematics classes. The study is part of a research project (Mathematics Assessment Project or MAP*) inquiring into the integration of “new” assessment strategies in mathematics teaching in a selection of Singapore schools. Current assessment rethink calls for a shift from the so-called “traditional” ways of testing students to “alternative” means of assessing them. Fan (2003) argues in support of the “newer” assessment strategies (e.g., use of portfolios, project work, or journals). He describes the traditional assessment of students as time-limited, venue-limited and tool-limited, narrowly focussed on knowledge attainment and overly concerned with marks and grades. Rather, student assessment should play an expanded role in the service of learning. It should just be as important to assess and develop pupil attitudes and dispositions that are favourable to mathematics, as to assess pupil knowledge and skills in mathematics. An assessment strategy that supports student learning should recognise that the inherently multifaceted nature of the learning demands a variety of information to guide the process. To the extent that pupils are to take responsibility for their own learning (i.e., pupils as active participants of learning), self-assessment is integral to it.

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Why Pupil Self-Assessment In Mathematics

A conception of student assessment that has been cited widely is given by in the *Assessment Standards for School Mathematics* (NCTM, 1995). Assessment is “the process of gathering evidence about student’s knowledge of, ability to use, and disposition toward mathematics and of making inferences from that evidence for a variety of purposes” (p. 3).

“Disposition,” according to the *Assessment Standards*, refers to interest and appreciation students show for mathematics and the tendency with which they think, act and react positively toward mathematics. Desirable dispositions would include working with confidence, curiosity, perseverance, flexibility, inventiveness and reflectivity, when doing mathematics. The “traditional” approach assessment as we know it (e.g., a once-off written test at a specific time and place) would be inadequate to the task of providing information to help students develop positive dispositions toward mathematics. There may be a role and place for student self-assessment in fulfilling this educational goal.

A related reason for advocating the use of pupil self-assessment lies in its potential in fostering desired attitudes and developing metacognitive awareness. The Singapore Mathematics Curriculum’s (MOE, 2001) primary aim is to enable students to develop their ability to solve mathematics problems. To this end, the curriculum framework identifies five essential and interrelated elements in mathematics learning – *concepts, skills, processes, attitudes* and *metacognition*. The attitudinal component refers to pupils enjoying doing mathematics, persevering in seeking solutions to mathematics problems, appreciating the power and beauty of mathematics, and confident with things mathematical. The metacognitive component seeks to instil the habits of constant and conscious monitoring of one’s own effort in carrying out mathematical tasks, in searching for alternative pathways to completing the tasks, and in evaluating the solutions. The emphasis on the “self” or the look inward, in the conceptualisation of metacognition, should be best served by the use of self-assessment as an assessment strategy. The present study attempts to identify and clarify the self-assessment concepts, methods and strategies that would support teachers in fostering desirable attitudes, promoting positive dispositions and developing metacognitive awareness in pupils.

Another argument for the use of self-assessment is that assessment as part of the learning process implied the information it gathered should feedback to inform the learner. Edward Thorndike (Driscoll, 2004) made this point when reformulating his law of practice in the 1930s. In self-assessment, it is the process rather than the outcome (pupils’ responses) that is assumed to bring about learning, possibly in feeding-back to the learner to enable re-learning, in making aware the desirable dispositional effect, or in developing metacognitive skills. How might these be achieved? The present study set out to explore ways of attaining these aims.

Self-assessment is argued to be able to provide information on how pupils view their own performance, on pupil attitudes, feelings, opinions, views, and so on toward mathematics and its learning. Most importantly, self-assessment would provide information that cannot be obtained elsewhere, namely, the pupil’s own “voice” on his or her experience of mathematics learning, and not one that is imposed by the teachers or any other outsiders. How should a teacher make use of his or her pupils’ expressed views and feelings about their own learning? Will there be breaches of confidentiality?

Finally, the study aims to augment the relatively small knowledge-base for alternative assessment strategies to support the local mathematics curriculum. In Singapore, the *Assessment Guide to Primary School Mathematics* (MOE, 2004) recognises the role of assessment methods other than the so-called “traditional” written tests. The *Guide* points out that assessment should be “an integral component of the teaching and learning process” (p.7) whose main purpose is the improvement of teaching and learning. The same document provides guidelines to a generous selection of “alternative” assessment methods: journal writing, classroom observation with teacher-pupil conferencing, portfolios and self-assessment. However, the notion of self-assessment would warrant fuller specification for an increase in its use in higher-stakes decisions. The term appears to be variously defined in the literature for alternative assessment (e.g., McCoombs, 1997; McDonald, 2002). As a working definition, self-assessment is said to start when pupils undertake to reflect, judge and then report (spoken or written) on their own behaviour or performance. To facilitate this process, pupils are asked to respond to specially designed questions or statements on certain aspects of their experience, feeling or behaviour associated with their learning of mathematics. Their responses are assumed to be able to tap the attitudinal, dispositional, or metacognitive dimensions of mathematics learning. The present study examines the extent to which the elements in self-assessment correspond to facets of these dimensions.

Overview Of The Study

The Mathematics Assessment Project (MAP) – investigating two broad research questions:

1. What are the effects of using “alternative” assessment approaches in mathematics on students’ achievement – cognitive and affective?
2. How can the new assessment strategies be effectively embedded in classroom teaching?

MAP explores four “new” assessment approaches in a selection of primary and secondary schools in Singapore. They are:

- Project-based assessment
- Communication-based assessment: Written (journal-writing) and oral (presentations)
- Performance-based assessment
- Pupil self-assessment

This paper focuses on the last of the alternative assessment approaches. In this study, two classes of Primary 3 pupils engaged in teacher-designed self-assessment activities, and a third serves as “control”. The activities are:

- Self-evaluation activity (topic-based; focus on pupil assessing their learning of a topic)
- Self-reflection activity (task-based; focus on pupils monitoring their own efforts in solving a problem)
- Self-constructed questions activity (pupils making up mathematics tasks or problems at the end of a learning segment, e.g., topic).

The sections following present some of the self-assessment tasks designed by the teacher and highlight some preliminary thoughts on (a) pupils’ written responses to these tasks, (b) teacher’s observations of the pupils as they engaged in the tasks and notes from talking with the pupils, and (c) records of non-participant observations

SAMPLE PUPILS' RESPONSES AND COMMENTS

A. An example of a topic self-evaluation sheet (Fig. 1)

Dear Pupil: This topic: Money was taught two weeks ago.
Think about your experience of learning this topic.

Complete this self-assessment sheet so that I can know
better how you have learned and how I can help you.

(A) Circle your answer.

- | | | | |
|--|--------------------------------------|-------------------------------------|---|
| 1. This topic was easy | <input checked="" type="radio"/> Yes | <input type="radio"/> No | <input type="radio"/> Not Sure |
| 2. I enjoyed learning this topic | <input checked="" type="radio"/> Yes | <input type="radio"/> No | <input type="radio"/> Not Sure |
| 3. I had difficulty with this topic | <input type="radio"/> Yes | <input checked="" type="radio"/> No | <input type="radio"/> Not Sure |
| 4. I feel I was quite lost with this topic | <input type="radio"/> Yes | <input type="radio"/> No | <input checked="" type="radio"/> Not Sure |
| 5. I am confident about this topic | <input type="radio"/> Yes | <input type="radio"/> No | <input checked="" type="radio"/> Not Sure |

Is there any help you like me to give to you? (tick your answer)

1.	Show me how to convert dollars to cents or cents to dollars.	No
2.	Show me how to make up \$1.00 with 1/5/10/20/50 cents coins.	No
3.	Show me how to make up \$10.00 with 1/5/10/20/50 cents and 1/2/5/ dollars.	No
4.	Show me how to make up \$100.00 with 1/5/10/20/50 cents and 1/2/5/10 dollars.	No
5.	Teach me how to do working for money.	No

(C) Is there anything else about this topic that you wish to tell me?

1.	It is interesting.	Yes
2.	It is boring.	No
3.	I find it useful.	Yes
4.	I don't find it useful.	No
5.	I am able to teach it to someone else.	Yes
6.	I love to do sums on money.	Yes
7.	I hate to do sums on money.	No
8.	I think there are too many exercises on money.	Yes
9.	I think there is just enough exercises on money.	Not sure
10.	I think there is not enough exercises on money.	Not sure

In this particular self-evaluation sheet, there is some degree of consistency in the pupil's responses (see especially the responses to the third section). One of the research concerns was that the Primary 3 pupils would be too young to be able to respond in a meaningful way

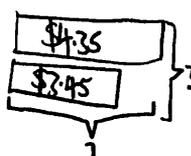
to activity of self-assessment. We will examine more pupils' responses to determine if their responses can indeed be interpreted.

B. An example of self-reflection task (Fig. 2)

For this activity, pupils first worked at the solving the given problem. The teacher then presented the solution(s) and the pupils "marked" their own work. Once done, they "think back" to their experiences of solving the problem and responded to the self-reflection prompts.

1. You have tried to do the mathematics task given below

Mary bought a bottle of milk and a packet of sweets. She gave the cashier \$10 and received \$4.35 change. The packet of sweets cost \$3.45. How much did the bottle of milk cost?



the bottle of milk cost \$2.20

$$\$4.35 + \$3.45 = \$7.80$$

$$\$10.00 - \$7.80 = \$2.20$$

\$4.35
+ \$3.45
\$7.80
\$10.00
- 7.80
\$ 2.20

2. After doing the given task, I think (Please tick the sentences that describe what happened when you did this task)

- I was able to do the work.
- I did not understand the question.
- I was able to the working but not the model drawing.
- I understood the question but got wrong answers.
- I can explain how to solve this task to someone else
- The task was easier than I thought it would be.
- The task was harder than I though it would be.
- If I try a similar task like this next time, I will have confidence to solve it.

Figure 2. Pupil A's self-reflection

Although this particular pupil had given the correct solution, he or she was aware of the difficulty in drawing the model diagram. The "model" (diagram) drawn by the pupil is incorrect, in the local understanding of the meaning of model-drawing.

In the next example (below), it is interesting to note here that the pupil enjoyed the task anyway. To that pupil, the problem was solved rather easily and so his or her expression of confidence in solving similar problems. But that was prior to checking his or her solution against the teacher's. After checking against the teacher's solution, the pupil attempted to isolate his or her reasons for the mistake. Here again it appears that the particular pupil's responses may be interpreted.

C. Examples of summary sheet

A summary of the pupils' responses for the class was made (see Tables 1 & 2). The summary tables of pupil self-assessment of their learning for a topic are another source of information to guide teaching and learning. It complements the feedback teachers get from marking the exercises and homework set. The summary figures for items in Table 1 suggest a semblance of consistency in the pupils' responses. In Table 2, it was clear that about half of the class would

Table 1. Summary of Pupils' Responses - General

	Items	Yes	No	Not Sure
1.	This topic was easy.	27	0	13
2.	I enjoyed learning this topic.	36	0	4
3.	I had difficulty with this topic.	4	21	12
4.	I feel I was quite lost with this topic.	7	23	7
5.	I am confident about this topic.	18	7	12

Three pupils did not answer items 3, 4 and 5.

Table 2. Summary of Pupils' Responses - Specific Learning Objectives

Items	No. of students
1. Teach me how to convert from cm to m.	6
2. Teach me how to convert from m to cm.	6
3. Teach me how to measure length.	5
4. Teach me how to add length.	4
5. Teach me how to subtract length.	10
6. Teach me how to multiply length.	16
7. Teach me how to divide length.	23
8. Teach me how to do problem sums on length.	12
9. Others.	4

Sample Teacher's Observations

The pupils were initially very excited about the tasks. Three sessions later, the self-evaluation activity appeared to have lost its novelty and might even be a chore to the pupils (judging by the "groans" and not-again's). By a show of hands, about three-quarters of the pupils asked for help of some kind (e.g., asking for the meaning of terms used) in answering the self-reflection questions, and about half did not think it was a useful tool to help them learn their mathematics better.

The teacher noted that pupils who had reflected in their self-evaluation sheets that they were careless in their tasks, were still careless when doing their sums and in solving word problems. In comparing the pupils self-assessments against test scores, the teacher found that pupils who had indicated in the topical self-reflection sheets that they understood the topic and have no difficulty with doing the exercises therein. These pupils somehow performed poorly in the end-of-topic test and the end-of-semester tests. This raised the question of the

“dependability” of the pupils’ self-assessment of their own understanding and mastery of a topic.

A final point to note concerns, not unexpectedly, the huge challenge to find enough time from within the already crowded teacher-schedule to craft the pupil self-assessment tasks and to derive maximum benefit from the pupils’ responses. The self-assessment tasks had to be suitable and varied enough for the pupils to do meaningful self-reflection as well as to sustain their interest. Being new to such tasks, this took time. Looking through the pupils’ responses for better follow-up action on teaching or learning took up time too. This was because it was not always clear if pupils were responding properly or if they really understood what was asked of them in the tasks.

Discussion And Conclusion

The preliminary observations above showed up practical as well as conceptual issues. A number of pupils required help in completing the self-assessment tasks. While this is likely to be an issue of language demand for young pupils as well as a matter of initial unfamiliarity with the tasks, it could also indicate that self-assessment is beyond pupils at that age (around 8 years). This would seem so if one assumes that the child needs to have gone far beyond being egocentric to being metacognitive. This difficulty the pupils have with the self-assessment tasks would question the viability of using self-assessment with young pupils. Also, their struggle with language may well mean that language is an inseparable component of self-assessment. Whether the pupils would need less assistance in completing the tasks, given more time and regular exposure to self-assessment activities, is a practical question the study sets out to answer.

There was some degree of consistency within a pupil’s responses to the self-assessment task. Yet the teacher noted an apparent discrepancy: poor test performance from the very pupils who reported no difficulty with a topic. Also, the pupils who were aware that they were careless when working out the sums or in identifying the correct information from word problems, continued to be careless in subsequent work. These observations suggest that it is one thing to be “being aware” of the status of one’s learning and another to actually act accordingly to one’s knowledge of that situation. Different skills are called for in working computationally and in performing well in tests.

Another interpretation of the observation of mismatch between test performance and pupils’ self-reports of mastery is that the pupils were giving socially desirable answers when asked if they had understood the lesson or had difficulty in learning. The threat to a pupil of the consequences of self-assessment can be real (e.g., parents informed). What will an honest disclosure of one’s failure of learn bring about? Other questions raised are “How should a teacher use this privileged information?” and “What does it mean to a young pupil to accept or recognise his or her failure to learn?” Will recognising self-assessment as a legitimate sociomathematical norm (Yackel & Cobb, 1996) alleviate the threat?

From the perspective of the participant observer, the pupils took to the self-assessment activities as they would any other teacher-directed activity. To them, the self-evaluation sheets to be filled up were no different from the other worksheets they would meet in a daily lesson. Taken on a positive note, the observation that the pupils did not see anything special

about the activity could mean that self-assessment activities (where well-designed) could be readily “integrated” or “infused” into the daily lesson. That is, for pupils at this age, such a practice could be readily established as a sociomathematical norm.

Also noted was that half of the pupils did not see the self-assessment activities useful to the learning of mathematics. This questions the assumption that self-assessments of such kind would benefit pupils. For that matter, what a teacher sees as important or helpful to the learning of mathematics may be at odds with that which pupils consider as helpful to them in their learning of mathematics.

The role of “self” in pupil self-assessment needs further elaboration, especially where it concerns the question of whether a pupil will initiate self-assessment on his or her own or will make it a habit of the mind. That is, will and how will the pupil begin to gather information to *make inferences about his or her own learning (as highlighted in definition of assessment by the Assessment Standards)?* Finally, will self-assessment encourage metacognitive awareness and implant positive attitude and dispositions towards mathematics *in the long run?*

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