

Evolving Mathematics Classroom Assessment Cultures

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A review of literature indicated that there has been a shift in mathematics classroom assessment practice. In the advocated assessment alternatives, mathematics teachers and their students are expected to undergo a cyclical assessment process. This assessment process typically consists of five stages that are planning, designing, implementing, marking, and reporting. As a consequence of this recent demand, traditional mathematics assessment culture is greatly challenged in tandem with the change of roles expected of teachers and students within this assessment process. Hence, this paper is a review reflecting upon the changing cultures of mathematics classroom assessment.

Mathematics Classroom Assessment

Classroom assessment may involve a range of activities; from a teacher's informal observations to a final examination that he or she hands out, and from students' self-reflection to group works with a task on peer-assessment. For the purpose of this paper, classroom assessments are limited to the formal assessments that go through a cyclical process of planning, designing, implementing, marking, and reporting (Figure 1). In addition, students and their mathematics classroom teacher(s) are simultaneously considered as the participants of assessment process. Although typically classroom teacher(s) are perceived to have control over this assessment process, recent literatures have advocated that students also have an important role at different stages of the assessment process (e.g. Black & Wiliam, 1998a; Watt, 2005).



Figure 1: Assessment process

Review of recent literature indicates that a shift in the assessment paradigm has been advocated globally (e.g., An, 2004; Black & Wiliam, 1998a). This advocacy has led to modifications in classroom assessment practices from traditional testing to assessment alternatives that is integrated within teaching and learning processes. However, there are also reports indicating that in reality, mathematics classroom assessment has remained, for the most part, unchanged (Kaur, 2005; Watt, 2005). The question to ask then “is there an assessment culture that has been so deeply rooted within mathematics tradition of teaching and learning that hampers the assessment practice to be reformed?”

Mathematics Classroom Assessment Culture

Two major factors have influenced the reformation in mathematics curriculum throughout most parts of the world; first, the increasing use of technology, and second, the advent of new

learning theories in mathematics (Leung, 2008). According to Cunningham (1998), a critical characteristic for most educational reform agendas is related to accountability, which in practice suggests more testings and/or different assessments techniques (Cunningham, 1998). Hence, there has been a strong advocacy towards shifting assessment paradigm and thus, changing the assessment practice (e.g., Black & Wiliam, 1998a; Brookhart, 2004; Earl, 2003).

These reformations may mean changing an assessment culture that students and teachers are familiar with. One of the explanations listed in the Merriam-Webster Online Dictionary (2009) on 'culture' is "the set of values, conventions, or social practices associated with a particular field, activity, or societal characteristic." What values, conventions, or practices did students and teachers share in the traditional mathematics assessment culture? What values, conventions, or practices do they need to change in the new classroom assessment culture? Are teachers and students fully responsible to be the agents of change in order to materialise the advocated assessment practice?

This paper presents a reflection at the different stages of an assessment process that is directly related to classroom assessment culture. The different stages, beginning with planning stage in the assessment process are as shown in Figure 1. As noted earlier, the traditional assessment culture suggests that classroom teachers are perceived to have the absolute control over this assessment process. Nevertheless, recent literature strongly advocated students' active role, especially in the last three stages of the assessment process. This advocacy demands some shift in teachers' pre-eminence position, while simultaneously empowers students with further responsibilities over their learning progress. The following paragraphs will contain some components that exist in each stage of the assessment process which may be correlated to assessment culture.

First Stage: Planning

One of the considerations that teachers need to be aware of at the planning stage is the assessment purpose(s). From Scriven's early work (1967) to an extensive review conducted by Black and Wiliam (1998) a decade ago and more recent proposal such as by Earl (2003), a discourse on purposes of assessment has been deliberated on the current understanding of assessment purposes.

According to Leung (2008), China is the first country in the world (A.D. 587) introducing an examination system as an assessment method for selection purpose. He also noted that forms of national examination appeared in Europe only started in the nineteenth century (Leung, 2008). Hence, it is not surprising that the traditional purpose of assessment was to serve summative functions. An excerpt below depicts this scenario:

Historically, classroom assessment has been the hurdle that students needed to overcome to show they were ready for the next stage. It occurred at the end of instruction ... and was a symbol of completion and a comment on the adequacy of learning. The substance of learning was much less important than teachers' collective judgments about their students' learning potential, as demonstrated in routine classroom tests and exams. This approach to assessment generated the currency (i.e., grades) that students (and their parents) used in the educational marketplace.

(Hargreaves, Earl, & Schmidt, 2002, p. 76, emphasis added)

Since traditional assessment culture is concerned with serving the summative purposes, the grades churned after the examination was always the end of assessment process. However, some scholars argued that assessments can, and should, be used to serve formative purposes as well. Therefore, an assessment process (Figure 1) is typically considered cyclical, that is to ensure that formative purpose can be further served. Hence, teachers need to be capable of using information from prior assessment processes, especially from the reporting stage (Figure 1), as a diagnostic tool, to improve the next cycle of assessment processes at

this planning stage. In addition, formative purpose can also be achieved when assessments are planned and designed to be used *as* learning (Earl, 2003) and *for* learning (Black & Wiliam, 1998a). How do teachers, who generally control the classroom assessment planning, modify their values, conventions, or assessment practices in ensuring that formative and summative purposes are served?

A mathematics teacher I met commented that all ‘new ideas’ are recycled ‘old ideas’. She and her colleagues believed that they have always conducted assessments for formative purposes in addition to summative purposes. However, they felt that ‘formalising’ (clarified as recording and reporting students’ continuous progress) formative assessment has been the real challenge. Clearly, this situation indicates a traditional mathematics assessment culture that teachers conduct informal assessment to serve formative purpose. Meanwhile, examination or testings, typically perceived as an objective way of assessing students (Watt, 2005), are more valid for summative purposes. In addition, it is only recently that many educational authorities acknowledge the importance of serving formative purposes (e.g., Australian Association of Mathematics Teachers, 2008; National Council of Teachers of Mathematics, 1995). Even China with its long tradition of examination culture (Leung, 2008) has acknowledged the importance of assessments that serve formative purposes (An, 2004).

Second Stage: Designing

At this stage, there are at least two dimensions that one can investigate about designing an assessment: first, criteria and standards, and second, contents of assessment. In discussing both of these dimensions, the former relates to communication between teacher and their students, while the later concerns on the quality of assessment design.

First, setting up relevant criteria and establishing assessment standards (Natriello, 1987) have to begin with teachers considering what were decided in the planning stage. According to Sadler (1998), highly competent teachers bring a deep knowledge and appropriate standards to the assessment task. However, this knowledge may exist in an unarticulated form (Sadler, 1998). Stiggins (2002) argues informing students of those learning goals has to start early in the teaching and learning process. He also stresses that teachers’ understanding and ability to articulate the achievement targets (criteria and standards) that their students are expected to aim for during instruction is crucial in preparing for assessment (Stiggins, 2002). In other words, hidden or arbitrary assessment criteria and standards are not acceptable as part of the new assessment culture. Clear communication between teachers and students on the appropriate criteria and standards is crucial (see McMillan, 2000; Sadler, 1987). This communication also indicates the intertwined nature between assessment, pedagogy and curriculum.

Lack in communicating these criteria and standards to students may hamper learners from recognizing the value inherent in the assessment task which will impede them from becoming engaged in the assessment process (Van Manen, 1999). Students’ disengagement, typically manifest by being passive learners (see Black & Wiliam, 1998b), will not enable the assessment to serve formative purposes effectively (e.g., Hargreaves et al., 2002; Wiliam, 2007b). In addition, ambiguous assessment criteria can negatively influence learners in what is learned (Wiggins, 1998), as students may focus on learning areas that are not necessarily important, or of value, to teachers and/or students.

Second, with regards to assessment content, typically in a form of questions or assessment tasks (Natriello, 1987), teachers communicate the kind of activities and learning outcomes that they value (Clarke, 1987). Unfortunately, it seems that the culture of designing assessment value lower thinking order of Bloom’s taxonomy. In an extensive review of the trends of mathematics teaching and learning research, Niss (2007) found that frequently assessment instruments hold limited scope of the content and assess low level competencies

(p. 1304). In a comparative study on mathematics assessment and teaching practice among 14 year old students in the USA, England and Wales, Firestone, Winter, and Fitz (2000) found that many of the tests were not well-written, and typically focused on repetition of learned procedures using small sets of problems. In a professional development study conducted in New South Wales, Pegg and Panizzon (2004) highlighted that participating teachers become aware of “how limiting many of their questions were in providing insight into the degree of understanding held by students” (p. 441). To that note, an excerpt of a teacher’s comment (below) summarises the importance of designing assessment with the right content and in the correct manner:

I would think the students were doing really well, but it’s only because of the limited nature of the questions I asked. Other times I had thought I had been asking a question on a certain thing, but in reality it had been a question that had targeted something completely different.

(Pegg & Panizzon, 2004, p. 442).

In short, the teachers, who are responsible for this assessment design stage, have to become aware of the two fold culture adjustments in the assessment process. First, teachers are expected to communicate the criteria and standards of assessment to their students clearly. This communication is expected to be intertwined throughout teaching and learning process. This step should ease students’ engagement, especially in the next three stages of the assessment process. Students’ engagement is among the conventions of the new assessment practices (see de Lange, 2000; McMillan, 2000; Shepard, 2000). Second, teachers are expected to design assessment content that assess *relational understanding*, which is about knowing what to do and why (Skemp, 1976). Relational understanding is evident when students are being *successful* in mathematics learning.

Third Stage: Implementing

According to Clarke (1987), successful mathematics students are able “to devise problem-solving strategies; to identify conceptual similarities in different situations; to assess the relevance of different procedures to applied contexts; to work productively with others, co-ordinating individual efforts to achieve a group goal” (p. 8). Based on Clarke’s description, varied forms of assessment methods necessarily need to be implemented in the new assessment culture. It has been argued that traditional tests alone, typically containing multiple choice items, short and medium answer problem, has a limited capacity to inculcate and assess the above criteria of being mathematically successful students (McMillan, 2000; Pegg & Panizzon, 2004, Volante, 2004). Yet many studies shown that mathematics teachers often rely more heavily, or exclusively, on the written approaches, typically via testing (e.g., Firestone, Winter, & Fitz, 2000; Ohlsen, 2007; Watt, 2005).

In traditional assessment practice, the convention is that teachers are invigilators at the implementation stage of assessment, while students sit quietly responding to written questions or tasks individually. However, in recent years, literature has advocated assessment practice, especially when alternative assessment methods are utilised, that there is a change in the role of teacher-student and student-student. For example, an oral assessment approach, such as project presentation or group work, necessitates dialogues during the implementation stage of assessment. Clarke (1987) claims that meaningful dialogues encourage reflection on learning which simultaneously recognises students’ contributions as valuable. An extensive study on small-group discussions in mathematics classrooms of over 1000 high school students conducted by Fiori and colleagues (2004) found that “student discussions frequently emulate discussions among professional mathematicians, thus creating authentic engagement experiences for the students” (p. 7). Such group discussions can be used to assess students’

understanding and can at least serve formative purposes (e.g., Black & Wiliam, 1998b; Clarke, 1987; Sadler, 1998; Stiggins, 2007).

In short, there are two most significant changes in the classroom assessment culture during the implementation stage. First, the new assessment culture recognises the various assessment methods that can, and should, be implemented as opposed to conducting traditional testings alone (e.g., Clarke, Goos, & Morony, 2007). However, it is not about implementing more assessments or tests, rather about varying the assessment techniques (Watt, 2005). Second, the implementation of various assessment strategies suggests modified roles for teachers and students. Assessments are no longer presented as the teacher's prerogative and students' active participation at this stage of assessment are expected (Department of Education and Early Childhood Development, 2006b).

Fourth Stage: Marking

Similar to the implementation stage, the change in role for teachers and students is evident in the new assessment culture at the marking stage. In the past, typically teachers did the marking of tests (Earl, 2003) and eventually provided the students with their grades (Clarke, 1987). The traditional view of a teacher as the expert of the subject matter justifies the unidirectional practice of teacher-as-assessor. Hence, Natriello (1987) proposed that instead of teachers directly marking the work, they could sample work and appraise the performance based on the pre-determined criteria and standards. The collected samples can become valuable exemplars for analysis.

During the marking stage, teachers have two major roles in the new assessment culture. First, there is a teachers' role in analysing students' work (Chapuis & Stiggins, 2002) and providing feedback to the students. According to Stiggins (2002), teachers' frequent descriptive feedback as opposed to judgmental feedback for students, are useful to provide students with specific insights as to how to improve. In agreement with Stiggins (2002), Wiliam (2007a) claims that feedback must contain implicit or explicit recipe for future actions, where feedback can show what the student has learned, which areas are still weak, and how to go about improving those weaknesses. Second role for teachers in the new assessment culture is in reflecting on students' work that may help them improve their future teaching approaches. Teachers' reflections are necessary catalysts for teachers' professional growth (e.g., Clarke & Hollingsworth, 2002) and skills in self-assessment to improve their practice (e.g., Ross & Bruce, 2007).

In the traditional assessment culture, students are generally not expected to participate in the marking process. In fact, this stage is generally considered alien to the students. However, in the new assessment culture, students have two major roles during the marking stage. Both roles are known as peer-assessor and self-assessor on their learning process (Elwood & Klenowski, 2002). According to Stiggins (2002), students engaged in regular self-assessment during the marking stage of assessment, with criteria and standards held constant, will be able to watch their progress over time, and thus feel in charge of their own success.

At the same time, an awareness to the positive and negative kinds of feedback is also crucial. In his review, Wiliam (2007b) discusses some issues with respect to feedback by providing examples of positive and negative impacts of feedback. For instance, the positive effect of feedback is when it is used to encourage students to be engaged in meaningful activity which can be profound in their learning. Meanwhile, an example of the negative effect of feedback can occur when there is miscommunication, such as when there is the existence of inconsistencies between students' and teachers' use and understanding of mathematics notations (Wiliam, 2007b).

The above description depicts the view of new mathematics assessment culture. Both teachers and students are expected to take an active role to mark, analyse, and reflect on the

assessment to improve teaching and learning process. Marking stage is no longer limited as teachers' prerogative especially when assessment is meant to serve formative purposes. Thus, in order for assessment to serve formative purposes, it is necessary for students and teachers to provide and receive feedback (Elwood & Klenowski, 2002).

Fifth Stage: Reporting

In the final stage of the assessment process, it is generally expected that teachers will report on students' achievements. In doing so, Shepard (2000) claims that teachers need to be able to make a systematic analysis and appropriate inference on the available evidence or data. As Natriello (1987) proposed, the final stage of this process is to monitor the outcomes of students' performance which helps teachers to establish or re-establish purposes of assessment at the first stage for the next cycle. Teachers are to assess if the purpose of assessment has been satisfactorily reached in the last cycle, as well as to inform what needs to be done for the next cycle. Yet, although marking is usually conscientious, the outcome of this process is rarely reported and used to guide how work can be improved (Black & Wiliam, 1998a).

Watson (2006) stresses the importance of teachers' ability in interpreting evidence based on the informal assessments to make 'professional judgment'. She questions the implications for students when teachers' awareness and assessment practice lack appropriate judgements. However, McMillan (2000) states that assessment is inherently based on professional judgement, which is true in both formal and informal assessments.

In addition, the new culture of assessment practice encourages students' involvement in interpreting and communicating with their teacher and their families about their achievement status and improvement (Stiggins, 2002). Students' engagement in reporting their own achievement allows them to monitor their own learning progress, through using tools such as 'developmental achievement maps' (Griffin, 1990) which can be utilised as a guide for teachers and students to seek ways to enhance the teaching and learning process. This claim is backed by literature (e.g., Clarke, 1996; Earl, 2003), and acknowledged by educational authorities and professional bodies (e.g., AAMT, 2002; DEECD, 2006b).

Indeed, the five stages in this assessment process: planning, designing, implementing, marking and reporting the assessment results, are oversimplified. But an overview of the assessment process has been presented using these stages here to demonstrate the assessment culture prior and after the new culture been advocated.

Significance in Understanding the Assessment Cultures

According to Wiggins and McTighe (2005), the failure to transfer learning is evident in many areas but is most striking in mathematics where students face difficulty in applying knowledge into meaningful problem solving skills. It is clear that the curriculum documentation in many states emphasise mathematical processes (Clarke, Goos, & Morony, 2007; Watt, 2005) which demand relational understanding. It is also evident that such a curriculum demands suitable pedagogical approaches (e.g., Ball & Bass, 2000; Piccolo, 2008) to be in place. Eventually, it is imperative to assess if the students have learned as what has been taught. Their attainment in the learning process, that is the achieved curriculum, should not only be assessed for summative purpose. Rather, formative assessments should also be employed to enhance students' meaningful learning and to attain relational understanding. This advocacy demands a shift in assessment paradigm and consequently in assessment practice. Awareness and acknowledgement in the differences between the old and new mathematics assessment cultures can be the first few steps in reforming assessment practice.

Yet, how do mathematics teachers, as professional practitioners of classroom assessments, modify their own classroom assessment culture?

Leung (2008) provided a table summarising major users and possible purposes of assessment information. According to him, theoretically students may use the assessment information to self-improve by adjusting their focus and mode of learning, leading to more efficient learning. Similarly, teachers may use the assessment information to self-improve by reflecting on how effective their teaching has been and in what ways will the assessment information potentially lead to improvement in the teaching practices (Leung, 2008, p. 985). It appears that self-improvement may be one of the societal features shared between students and their teachers in how they might use assessment information.

Conclusions

Similar to many other areas of educational reformations, a review of literature indicates that assessment paradigm is undergoing a shift. Shifting one's assessment paradigm denotes challenging his/her prior beliefs of the culture. There was a Malay idiom which is directly translated as, "Let death be onto a child, but never the culture", indicate the potential strength in clinging to an old tradition. Although it can be difficult to change assessment practice, it can be tougher to shift an assessment paradigm that is deeply rooted in traditional culture.

The advocated changes of assessment practice will impact on at least five areas within the assessment process: 1. Planning for formative use of assessment as opposed to limiting it to summative purposes, 2. Communicating assessment criteria and standards clearly, and improving the quality of assessment content, 3. Changing students' and teachers' role, especially during the implementation of alternative assessment methods, 4. Sharing responsibilities in marking and providing feedbacks between teachers and students, and 5. Interpreting, reflecting, and reporting results of assessment are again shared between teachers and students.

One of the areas in assessment that is affected in the paradigm shift is on the place for classroom assessment. According to Hargreaves, Earl, & Schmidt (2002), classroom assessment is very much intertwined with the teaching and learning process. It can be difficult to untangle classroom assessment from instruction (Khatti & Kane, 1995). Therefore, based on the advocated assessment reform, classroom assessment is no longer limited to a place at the end of the education row.

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