REFEREED ARTICLE

Formative Assessment: Strategies for a High School Mathematics Class

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Abstract

Formative assessment has become a focus of classroom teachers as a quick method to assess students' progress in their classrooms. For students to be prepared for summative assessments, it is important to separate the traditional forms of summative assessment from the everyday practice and feedback that is formative assessment. Mathematics teachers can modify current classroom processes to meet the qualities of true formative assessment and, in the process, improve student learning through engagement.

In the beginning of this author's career as a high school mathematics teacher, there was little discussion about the differences between formative and summative assessment. The focus of assessment was the accumulation of marks, and there was little mention of assessment as a learning tool (Black & Wiliam, 1998). The collection of student achievement data seemed obvious: teach a lesson, give some questions, mark all questions, and record a cumulative mark. In this model, assessment and evaluation was focused on ranking and sorting students from the highest to the lowest achiever, which resulted in some students succeeding and others falling into failure (Stiggins, 2006). Black and Wiliam's (1998) ground-breaking assessment research has caused many educators worldwide to re-evaluate their assessment methods. Adoption of their assessment practices has not been an overnight process or overnight success. This situation raises two key questions: (1) what are the differences between formative and summative assessment? and (2) what are the strategies of formative assessment that can be implemented in a high school mathematics class?

Defining Formative Assessment

Before implementing formative assessment strategies in the classroom, it is important to define clearly the difference between formative and summative assessment. Both formative and summative assessments are required for a course to have balanced assessment ("Summative and Formative Assessment", 2011). Formative assessment is the "formal and informal processes teachers and students use to gather evidence for the purpose of improving learning" (Chappuis, 2009, p. 5). These assessments occur while learning is going on, and the goal is for the teacher to adjust the teaching and the student to adjust the learning, based on the results (Stiggins et al., 2006). From a mathematics perspective, formative assessment can be used to identify "what students understand, what they are struggling with, and whether a child might need additional diagnostic testing" (Koellner et al., 2011, p. 49). In contrast, summative assessments are "assessments that provide evidence of student achievement for the purpose of making a judgement about student competence or program effectiveness (Chappuis, 2009, p. 5). These assessments are given occasionally, usually at the end of a unit, term, or course, in order to determine what the student knows at that time (Garrison & Ehringhaus, 2012). Summative assessment is used to assign grades, to give a student's standing in the course. It happens after the teaching has been completed, which is often too late for the teacher to make an adjustment to his or her teaching techniques (Stull et al., 2011). The major difference between formative and summative assessment is the use of the results in the classroom. Formative assessments are tools to make student learning better, and summative assessments are measuring devices to determine what learning has occurred.

Strategies for Formative Assessment

Once a clear understanding of formative assessment is reached, a teacher can begin to implement specific formative strategies into the classroom. The strategies of formative assessment that a teacher uses in his or her classroom encourages better learning and understanding (Chappuis, 2009). Many of the strategies already used in the classroom can be adapted to be used as formative assessment. The utilization of the results of the assessment is what will distinguish these activities as formative. Formative assessment in the mathematics classroom encourages students to become active participants in their own learning, and this participation enables quality learning in the form of "considering, proposing, testing and applying mathematics concepts" (Jones et al., 2012, p. 172). Four strategies that can be implemented into a mathematics classroom include good questioning, providing feedback, setting examples of desired work, and self-assessment (Stiggins et al., 2006). The author has chosen the four strategies listed above to implement in her high school mathematics classes, and the students have accepted these new practices in their daily routine.

The strategy of asking good questions will help teachers to lead students through their learning, as opposed to dictating the learning that is to take place. Asking good questions seems like an obvious expectation of all teachers in any classroom, yet many times this practice has been ineffective in promoting student learning (Davis & McGowen, 2007). In mathematics, there is a need for a deeper understanding of simple procedures that are combined to form more difficult concepts (Black et al., 2004). It is important to create questions that will help students to link simple concepts such as adding, multiplying or factoring, to more complex strategies such as finding the maximum height of a projectile at a certain time. Often when a question is asked to students in a classroom setting, one of two things happens: either the brightest student answers the question right away, or there is silence which is quickly filled by the teacher who provides the answers (Davis & McGowen, 2007). Taking the time to create good questions will engage students in their own learning, and the responses provided by the students also help the teacher to determine the level of understanding from the students.

A number of different strategies can be used to improve questioning in the classroom. To develop good questioning practices, the teacher needs to take the time to create questions that push student answers beyond recall (Garrison & Ehringhaus, 2007). Teachers must also give students time to formulate an answer for themselves, rather than getting it from the teacher or another student (Black et al., 2004). After asking a question, it is important to take a step back and be content with the silence that may follow. To be effective, good questioning strategies should be integrated directly in a lesson, instead of being a stand-alone activity (Garrison & Ehringhaus, 2007). The author has used good questioning strategies in her classroom to engage students in what they are learning by asking one or two "big questions" (Black et al., 2004, p. 12) about the topic to be discussed in that class, before the lesson has begun. This strategy encourages the students to discuss what they already know about the topic. This discussion is an important part of being involved in their learning (Black & Wiliam, 1998). A change to the classroom dialogue can be an effective form of formative assessment, but to occur, a teacher needs to examine the imperfection of past practices and spend time refining questions and practices to encourage the desired discussion.

Setting out clear learning expectations and demonstrating what acceptable work for student submission looks like is another strategy in formative assessment. Often, students are not provided with samples of the type of work a teacher is expecting. When given the opportunity to see ahead of time the work that is expected from them, students have a clear understanding of the teacher's expectations (Chappuis, 2009). An important strategy in formative assessment is to take the time to work with students, in order to identify what good learning looks like by providing samples of student work that is both strong and weak. In this author's experience with the grade 9-12 Manitoba mathematics curriculum, the need to demonstrate to students a clear expectation of work has become important. Students are being asked, more than ever, to

communicate mathematically and they are being asked to explain in words what their mathematical calculations mean (Manitoba Education, Citizenship and Youth, 2009). To help students understand what a quality response to an explanation question might look like, the author has developed a set of examples that demonstrate a full-marks response, a part-marks response, and a no-marks response. These examples alone are not enough information for students. Students need to be involved in the discussion process of why each sample would receive which grade. Provided with a clear idea of what the teacher's expectations are, as well as setting their own expectations for what a strong answer might look like, only continues to strengthen the students' involvement in the assessment process.

Providing students with comprehensive feedback, rather than just a final grade, will improve student learning by focusing students on the learning outcomes, rather than a final mark. Sharing feedback with the students is a key component to formative assessment (Garrison & Ehringhaus, 2007). The results of providing students with feedback include making clear the areas that require improvement and drawing attention to the outcomes that have been successfully achieved (Stull et al., 2011). Providing feedback to students is a far more effective way of improving student learning. A review of the research on feedback used in the classroom has found "improved performance in 60% of the studies" (Black et al., 2004, p. 18). Feedback in mathematics is traditionally accompanied by a grade and often "purely formative feedback is rare" (Havnes et al., 2012, p. 23). For feedback to be effective, it should not be combined with a grade, as students will not focus on comments when grades are also provided (Black et al., 2004). The sharing of feedback from teacher to student through unmarked assignments is a difficult strategy to implement in the classroom because it takes time on the teacher's part to provide consistent feedback, and it takes time for students to accept feedback instead of a mark. Assigning a grade to a completed assignment is a natural process for most teachers, and for students grades have long been the main motivation for completing an assignment (O'Connor & Wormeil, 2011). To be successful in using feedback in the classroom, teachers need to become practised in producing comments that give clear and insightful information about the students' progress, and students need to be given the opportunity to respond to that feedback.

Using self-assessment in the classroom can not only be a valuable form of formative assessment, but can also help the teacher to stay on top of student progress. If students can understand the criteria set out in front of them, and can determine what they need to do to be successful, they can achieve the learning goals set out for them. Using self-assessment in the classroom is an important part of student learning (Black et al., 2004). A suggested strategy to implement self-assessment in the classroom is a system of traffic lights: "red, yellow, green" (Black et al., 2004, p. 14). This strategy has been used in two ways in the author's mathematics classroom: as a way of self-assessing homework and as a review before a summative assessment. For the purpose of homework checks, students are asked to evaluate how they feel that they progressed through the assigned questions, using red to represent no understanding, yellow to represent a general understanding but with assistance required, and green representing complete understanding of the concept. The students who have recorded a red require immediate intervention before moving on to the next topic, and the students who have recorded yellow are monitored, and provided assistance when necessary. For the purpose of preparing for summative assessments, students are given a red, yellow, and green math block. As questions are presented for review, students are asked to reflect on their level of understanding of the concept being reviewed. As the teacher circulates throughout the classroom, his or her attention can be focused on the students who are presenting red or yellow. Self-assessment is an important skill for a teacher to develop with his or her students, but it can also be used as a simple, time-saving strategy during homework review or test preparation.

Conclusion

Through reflection and investigation, teachers can implement a system of formative assessment in their own classroom. After establishing the content of the course, teachers need to spend time organizing strategies for assessing student progress. The goal, as the teacher, should be to find a balance between formative and summative assessments in the classroom. To be successful, formative assessments must involve cooperation between the teacher and the students, and its purpose is to identify to both student and teacher where the learning should go from there. Formative assessment should not be an isolated event in the classroom. It should be integrated in everyday classroom life. Students should use formative assessment to prepare for the summative assessments that will take place in the course. Within formative assessment there lies flexibility for teachers to give the strong students the praise and support that they desire, while building the confidence of the struggling student. A number of strategies can be used to implement formative assessment into the high school mathematics classroom. Teachers need to find a balance of activities that work for them and their students. The strategies suggested in this paper have worked in the author's mathematics classroom, and new strategies are continually experimented with as the author's comfort with formative assessment grows.

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