Dimension 9: Assessment

Assessment in mathematics education has changed significantly. More comprehensive than before, it includes gathering information about a broader range of learning — the ability to reason and solve problems, the ability to communicate mathematically, the ability to apply concepts and skills, as well as the ability to recall and use various facts and procedures. Since the range of information gathered is more encompassing, additional assessment strategies and tools are needed. Perhaps the most significant change that is occurring is in how the assessment data is being used. Teachers are interested in discovering what students have learned and in using that information to alter instructional approaches.

PURPOSE OF ASSESSMENT

There are three "types" of assessment to consider, each serving a different purpose.

Diagnostic assessment is used to determine what students already know and can do, before formal instruction begins. In this way, it helps inform instruction by indicating to the teacher how and where to begin.

Formative assessment takes place during the learning in an ongoing manner. One of its purposes is to provide students with constructive feedback during the learning process. It also provides teachers with information to further shape instruction.

Formative assessment has a profound effect on student learning.

Summative assessment involves assessment of any learning that has occurred after a specified period of time, such as at the end of a sequence of lessons, a unit, or a term. Summative assessment requires the teacher to examine a larger sample or collection of student work gathered over time and to determine, at a given point in time, what overall evaluation (level, mark, or letter grade) best summarizes that individual student's achievement. Teachers must ensure that they have included a wide enough range of tasks to provide a valid sample of evidence. Teachers are accountable and must be able to explain their summative assessment and related evaluation practices.

Diagnostic and formative assessment are sometimes referred to as "assessment for learning," while summative assessment is "assessment of learning."

ASSESSMENT STRATEGIES

Effective assessment includes a variety of assessment strategies. Sometimes students respond better to certain assessment strategies. Certainly some strategies are better suited for assessing mathematical content, while others are much more appropriate for assessing mathematical processes. For example, if the teacher is assessing whether students know their basic facts, a simple written quiz might be used. Whereas, if the teacher is interested in assessing problem solving and communication, an open-ended performance task would be more appropriate.

ASSESSMENT STRATEGIES

- performance tasks
- projects
- journals
- observations
- interviews
- homework
- tests and quizzes
- portfolios (which include many of the above)

Evaluation Tools

Evaluation tools help the teacher determine what overall value to place on student work that has been collected for assessment. Teachers have an assortment of evaluation tools to choose from, depending on what is appropriate for a particular task.

A scoring guide outlines a suggested assignment of points, or marks, for various aspects of a piece of work. For example, a scoring guide can be developed for a question that asks a student to list three factors of 12, and then three multiples. The guide would indicate whether students get 1, 2, or 3 marks for each part of the question.

EVALUATION TOOLS

- scoring guides
- rubrics
- anecdotal comments

A rubric is a guide for assigning a particular score to a level of performance on a student task that allows for a wide range of performance. Often, the guide is descriptive. A rubric may be used to evaluate work on a rich task, a portfolio, or a performance task. It is a valuable exercise for teachers within a school to work collaboratively on the development and interpretation of shared rubrics. This consistency in teacher expectations helps students to make better sense of what is important. Sometimes parents and teachers are initially uncomfortable with rubrics in mathematics; they still think of math as a subject where you get points for getting things right or wrong and have difficulty with labels like "superior," or "level 4." But experience with rubrics over time usually dissipates this concern.

Rubrics can be task-specific or generic. Here is a sample generic problem-solving rubric that could be used to evaluate the solution to any problem.

Generic Problem Solving Rubric

Level 1	Level 2	Level 3	Level 4
Understand • is unable to restate the problem	**Understand** • has difficulty restating the problem	**Understand** • restates the problem	**Understand** • rephrases the problem in own words
Make a plan • struggles to model the problem	**Make a plan** • models part of the problem	**Make a plan** • models the problem correctly	**Make a plan** • models the problem in an efficient or creative way
Carry out the plan/ Look back • solution is seriously flawed due to major errors in procedures; gives up if plan does not work	**Carry out the plan/ Look back** • solution is faulty due to several errors in procedures; hesitant to change plan	**Carry out the plan/ Look back** • solution is correct, though there may be minor procedural errors; revises the plan as necessary	**Carry out the plan/ Look back** • solution is correct and there are few, if any, errors in procedures; flexible about the plan and revises it as necessary
Communicate • provides an incomplete explanation of the results that is unclear and/or imprecise	**Communicate** • provides a partial explanation of the results that is somewhat clear and precise	**Communicate** • provides a complete, clear, and precise explanation of the results	**Communicate** • provides a thorough, clear, and insightful explanation of the results

Sometimes teachers will choose to provide **anecdotal feedback**; that is, using comments without any "score." These anecdotal comments are useful feedback for students, but can also be kept by the teacher to include in her or his bank of assessment information for each student. At other times, the teacher will simply note that work has been done and provide verbal feedback without keeping a permanent record.

Self-assessment

When a student completes an assessment task and is unable to determine how well he or she has done, something is wrong. Whether it is through examples or descriptions, students need to know how to look at their own work and assess themselves. This allows them to self-monitor their strategies and thinking processes and improve on their performance the next time. Having students complete selected tasks, and then working with them to examine and analyze their solutions using one or more of the tools provided—a printed solution, sample student responses, a rubric—enables them to take increasing responsibility for monitoring their own learning.

Assessment is truly effective when students no longer require the teacher to tell them what quality work looks like.

Manipulatives and Technology

Teachers should provide access to whatever manipulatives or technology are appropriate to enable students to be successful on the assessment tasks. If manipulatives or technology were used during the teaching phase of the learning process, then they should also be available for any related assessment. If the focus of the assessment is on problem solving and not calculation competence, calculators should be made available.

TRANSPARENCY

Teachers should be transparent with students about what evaluation criteria will be used in their assessments. It is important that students understand what is expected of them. This can be done in different ways. For example, providing a rubric or a checklist of what should be included in a solution (such as the communication checklist shown in the margin), or providing the rubric or checklist that the teacher will use, re-stated in student-friendly language. The teacher can also involve students in creating the checklist or rubric. It is in knowing what is valued that students have the best opportunity to achieve it.

As well, the results of assessment should be clearly communicated to students as this is useful in assisting students to assess their own learning. For this to occur, the feedback that students receive must be specific and anecdotal, as opposed to a simple score. For formative assessment to improve student achievement, teachers need to carefully plan opportunities to provide feedback to their students.

COMMUNICATION CHECKLIST

A checklist such as this helps students understand what is expected:

- Did you show the right amount of detail?
- Did you use math language?
- Did you show all your steps and put them in order?
- Did you explain your thinking?
- Did you include a diagram?

HOW THE ADMINISTRATOR CAN SUPPORT THE TEACHER

The administrator can help the teacher in this dimension by

- working with teachers to ensure that assessment data provides a true picture of student achievement for a summative assessment
- ensuring teachers include a variety of assessment strategies in their short- and long-range plans
- encouraging teachers to plan together to promote a more consistent approach to assessment across the grades and within the school
- encouraging and supporting professional development activities that focus on assessment in mathematics

PRIMECONNECT

- PRIME Developmental Maps
- *Guide to Using the Developmental Map*
- *Diagnostic Tools*
- *Background and Strategies*

The main purpose of the first three components listed above is to help teachers with formative assessment that will inform and help differentiate instruction for each strand in mathematics.

The *Background and Strategies* book contains general information about assessment in mathematics.

(See page vii.)

LINKING THE NCTM PRINCIPLES AND STANDARDS

This dimension links to *Assessment* by using assessment to support learning and to provide useful information to students (see page 4 in Section 1).