Assessment of Mathematical Understanding  
Especially as it Relates to CMP

Introduction

Assessment has become a very “hot” topic in education circles lately. Or at least, it is talked about more often and with more passion. Teachers are being judged on their students’ performance, based on assessment scores. It is the assessment by which we are judged. The reauthorization of ESEA and the ‘No Child Left Behind’ act shows the public’s (or is it the politician’s?) faith in standardized tests as a school improvement instrument. But I also know that the once-a-year test can not provide continuous information about student achievement. The traditional assessments of computation exercises, short answer questions, and word problems will not suffice any more. Typically, standardized tests measure factual knowledge, not conceptual understanding. I believe that conceptual understanding is not only what students know, but what they can do with what they know. Assessments are varied from teacher to teacher, district to district, and state to state. I did an informal survey with some of my colleagues, asking them their reasons for assessing students, and the results varied greatly. I am interested in assessment and alternative assessments in order to help further my students’ understanding of mathematical concepts. I strongly believe that the purpose of assessment to inform my instruction, which in turn will further my students understanding.
Background

According to the National Council of Teachers of Mathematics Principles and Standards 2000 Assessment Principle, “assessment should support the learning of important mathematics and furnish useful information to both teachers and students.” Assessment should be designed to “maximize student learning” and “support the learning of important mathematics and furnish useful information to both teachers and students.”

The National Education Association suggests that assessment is a “continuous flow of evidence that can only be provided by classroom assessment.” (NEA, 2003) Balanced assessments can actually promote student learning and achievement. “To maximize student success, assessment must be seen as an instructional tool for use while learning is occurring, and as an accountability tool to determine if learning has occurred.” (NEA, 2003)

The 1995 NCTM Standards acknowledged that assessment should:

1. Reflect the mathematics that students show they know and what they are able to do.
2. Enhance mathematics learning.
3. Promote equity.
4. Be an open process.
5. Promote valid inference.
6. Be a coherent process.

The Assessment Model from NCTM (2000) includes four phases of the assessment process includes planning, gathering, interpreting, and using data. The table below shows how each phase influences the next.

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NEA (2003) lists four various forms of achievement.

1. mastery of content knowledge
2. the use of that knowledge to reason and solve problems
3. mastery of performance skills
4. the ability to create products that meet standards of quality

The classroom achievement targets (NEA, 2003) include:

1. What do my students need to know and understand to be ready to demonstrate that they have met a standard? What are the knowledge foundations?
2. What patterns of reasoning must my student be in control of in order to be successful?
3. What performance skills must students have mastered prior?

“Assessment and feedback are crucial to help people learn.” (NRC, 2002) Assessment should happen continuously, but not intrusively, as a continual part of instruction. Assessment provides information about the level of understanding that students are reaching. Assessment must “test deep understanding rather than surface knowledge.” (NRC, 2002)

Results from an informal survey about why teachers assess students were varied. Some teachers assess students to promote student accountability. It provides a “motivation when they care about their grades” said one particular science teacher. Another stated that the reason they assess students is to “test their knowledge” about a certain subject. One teacher mentioned that she assesses students to “see where they are so she will know where to go.”

Students build mastery over time. Assessment is a day-to-day journey in which a student demonstrates their competence. Black and William (1998) found student achievement when classroom assessment is managed effectively. “Improved classroom (formative) assessments
helps low achievers more than other students and so reduces the range of achievement while raising achievement overall.” Achievement gains are maximized when teachers increase the accuracy of classroom assessments, provide students with frequent feedback and involve students in assessment, record keeping and communication.

According to AAHE, “assessment works best when it is ongoing not episodic.” It is an ongoing process whose power is cumulative. We should monitor progress toward intended goals in a spirit on continuous improvement.

Performance assessment gives teachers immediate feedback about students’ mathematical strengths and weaknesses. (NCTM, 1995) One of the uses of the information acquired through assessment is to make instructional decisions. “To maximize the instructional value of assessment, teachers need to move beyond a superficial ‘right or wrong’ analysis of tasks to a focus on how students are thinking about the tasks.” (NCTM, 2000) Efforts should be made to identify insights on which further progress can be made rather than concentrate on errors.

Precis

Assessment in the CMP curriculum is an “extension of the learning process, as well as an opportunity to check what students can do.” Assessment is multidimensional, and gives students many ways to demonstrate how they are doing. “Assessment should be more than merely a test at the end of instruction to see how students perform under special conditions; rather it should be an integral part of instruction that inform and guide teachers as they make instructional decisions.” (NCTM, 2000) Assessment should enhance student learning, and by making it an integral part of classroom practice, can improve student learning. One of the uses of the
information acquired through assessment is to make instructional decisions. Assessment should be “an ongoing part of the classroom activities, not an interruption.”

**Development**

As a teacher, I am always assessing my students understanding. As I walk around the room, looking at their work, listening to their discussion, asking them questions, I am informally assessing what they know and understand. I believe that walking around is one of the best and most effective ways to informally assess student understanding. It is immediate, and the student can receive feedback instantaneously. I can observe students without interfering, or I can actively engage group members in conversation.

In my career, I have also depended on formal assessments. These have been in the form of homework assignments, quizzes, tests, midterms and end-of-year tests. As a result of more research, I am continually reassessing my students and my instruction in order to help my students develop that deeper conceptual understanding.

According to the Assessment Model from NCTM (2000), the four phases of assessment matches the Connected Mathematics Project (CMP) curriculum. The teacher must plan for assessment. This is a critical stage in which the teacher is continually assessing student learning and understanding. Daily assessments are an essential component as she monitors the student. I have never believed in “teaching to the test” but I do believe in assessing what we teach. As I plan my instruction, I am also planning for the assessment. Gathering is focused on the student as he responds to both informal and formal assessments. Informal assessment could be in the form of verbal questions and answers, or written assignments. Through the student responses, I can then move to the next stage of Interpreting. I must interpret those responses and the
information that I gather in order to assess whether that student understands the concept presented. Using that information, I can then offer feedback (which is critical) and make decisions about the class lessons. This comes back to the Planning stage.

The classroom achievement targets suggested by NEA (2003) agree with the need for appropriate assessment. The knowledge foundation that my students need to have in order to demonstrate that they have met a particular standard or objective is critical. This is just the beginning of my planning. I must also know what patterns of reasoning my students must be in control of in order to be successful. This is a tremendous task, and one that takes much planning and examination. I admit that this is one that I still need to work on. I need continual practice at developing a knowledge package. This also relates to the next target. Students must become proficient at certain performance skills in order to achieve at the next level. Only through assessment can I know if they have mastered those skills.

CMP is effective in the use of assessments. CMP attempts to “capture the broad perspectives of mathematics by collecting data in three dimensions of student learning:

1. Content knowledge
2. Mathematical dispositions
3. Work habits”

Content knowledge, according to CMP, is what a student knows and is able to do. Mathematical dispositions indicate that a student is confident, and able to reflect upon his own learning and monitor his own learning. This is control! Assessment of work habits show that students are able to persevere, contribute to group tasks, and follow the task to completion.

CMP provides a variety of checkpoints, surveys of knowledge, and observations as assessment of understanding. Checkpoints are daily work, notebooks, and mathematical reflections. These give the students and teachers opportunities to check for understanding at key
points. Surveys of knowledge include check-ups, quizzes, tests, and projects, which provide a broad view of student understanding. Observation gives numerous opportunities to assess students understanding during group work and class discussions. This is an important part of the assessment process, giving students an opportunity to verbalize their understanding in a less formal way.

When teachers are tuned in to the assessments of their students, they are more apt to know what the students are learning and why. We can make instructional decisions based on our assessments. Assessments should be aligned with our instructional goals. Student learning is enhanced because the tasks used in assessment convey a message to the students that the work has value.

Formal assessments provide only one viewpoint. These may give an unsure picture of a student’s understanding. Instead we should use open-ended questions, constructed-response tasks, selected-response items, performance tasks, observations, conversations, journals, and portfolios.

Application

We must not ignore the state and national tests. When we teach for understanding, students will be prepared for those tests. Students who do not test well will have more opportunities to demonstrate their understanding. We have “trained” our students, and maybe ourselves, to see the world of mathematics as points and right or wrong answers. As a teacher, my responsibility with assessment is to identify, teach, and assess the achievement targets that support student success, and enable students to grow to a place to demonstrate that they have met the state standards. Through the CMP curriculum, I believe that assessment is embedded in each
investigation. It is ongoing, and continual, and an integral part of every problem. It is my responsibility to ask the kind of questions that will illicit responses giving my students an opportunity to prove their mathematical understanding. As stated in NCTM (2000), “assessment should be more than merely a test at the end of instruction to see how students perform under special conditions; rather it should be an integral part of instruction that informs and guides teachers as they make instructional decisions.”
Bibliography


