Teacher Observation to Evaluate Mathematics Achievement

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There are a plethora of assessment techniques that can be used in evaluating student achievement in mathematics. Each method has its pros and cons; however, some methods do a more comprehensive job than others.

Too frequently, mandated tests are the focus in the educational literature on evaluation. Mandated tests are given once a year and then in selected grade levels. Also, feedback from these tests does not provide information on specific errors made by learners (to be used for remedial purposes). The most frequently used assessment procedure should be teacher observation. Teacher observation can be used continuously in the classroom, and the teacher can immediately diagnose and remedy difficulties faced by students.

How might teacher observation of students help in mathematics teaching and learning?

Assessing Mathematical Progress

Teachers of mathematics must have a good knowledge of the subject matter, as well as of teaching methodology, to do quality work in observing learner progress. These matters need to be uppermost in the teacher's mind when observing. The teacher should consider the following questions about student behaviour:

- Is the student on task and engaged in learning?
- Does the learner show interest in mathematics (rather than being bored)?
- What specifically does the student not understand in an ongoing activity?
- How might this student best understand how to remedy the deficiency?
- What do individual learners need as background information in order to attach meaning to the ensuing learning experience?
- Does the student's learning style favour individual or cooperative endeavours?
- Does the student reflect on past mathematical experiences?

Assignments in mathematics should make provisions for individual differences. Students have different ability and interest levels, and they need to make sequential progress. The teacher may notice that a sequence is not working when students fail to make continuous progress. Assignments should be clear and relevant, and adequate prerequisite information must precede each new process being emphasized. There is a zone of proximal development (Vygotsky 1986) for each student; thus, a student may have a current achievement level in adding negative numbers, for example, and the ensuing learnings require multiplication of negative numbers. With small steps and meaningful experiences, the teacher can help the learner bridge the gap.

Vygotsky (1986) stresses the importance of students mediating experiences through language, such as discussions in large or small groups. This might, too, involve peer-mediated discussion groups. Teacher observation of student participation in discussions should include the following considerations (Ediger and Rao 2001):

- Meaningful mathematical learnings are being developed.
- All are participating, but no one is dominating the activity.
- Ideas are circulating among the participants.
- Enthusiasm for learning is in evidence.
- Ideas are being expressed with clarity.
- In-depth discussions are being stressed.
- Optimal achievement is a focal point for each student.

What might a mathematics teacher observe specifically about "meaningful mathematical learnings"?

What is accomplished must make sense to the student. Thus, if a student is unable to come up with the correct answer to a set of three two-place numerals with carrying, what might be some possibilities for error? The teacher needs to evaluate if the learner understands the concept of addition. The student may even need to use markers to show the sum of two addends. A place value chart with ones and tens columns might well help the learner to attach meaning to adding two- and then three-digit numerals. If meaning is lacking for the student, then it is very difficult to proceed to more complex learnings, such as regrouping from the ones to the tens column. Understanding place value is very important here. Problems might even arise in terms of writing numerals legibly for ease of comprehension. Once student understanding is in evidence, the use of technology (such as handheld calculators/computers) can truly make subject-matter learnings interesting and challenging (Ediger 2006a).

Keeping Anecdotal Records and Using Student Portfolios

Teacher observations may and should be recorded. Unless a careful system of record-keeping is involved, observations can be forgotten or modified. Each record should contain vital data and be written clearly. The observer can then review patterns of student behaviour in mathematics. By recording specific errors, the teacher can diagnose and remediate students' difficulties in the sequence. For example, if a student has problems with reducing fractions to lowest terms, he or she may not be able to understand factoring. Or in dividing fractions, the learner may not attach meaning to the process of inverting the divisor and then emphasizing the operation of multiplication.

Portfolios can be an excellent way for students to demonstrate their progress over time, in ongoing lessons and units of study. The contents (chosen by the student with teacher guidance) should be a representative sampling of the learner's completed work in mathematics. The time period can be a semester or the entire school year. A student's portfolio can contain the following items, among others (Ediger 2006b):

- Student solutions to problems from the textbook
- Completed worksheets
- Student drawings of geometrical figures
- Graphs, charts and tables of data from ongoing lessons and units of study
- Printout of the student's test results
- Student self-evaluation of his or her progress, using criteria agreed upon by the student and the teacher

The portfolios should be viewed and discussed in parent–teacher conferences. Coming up with agreed-upon ways of helping a student achieve should be a goal of the conference. The home and the school need to work together for the good of the learner. Independent evaluators may also assess portfolio contents for the purposes of noting student progress and ensuring teacher accountability.

In assessing the portfolio, the following questions should be considered:

- How might the teacher guide the learner in attaining as optimally as possible?
- Which objectives need to be stressed specifically?
- What kinds of learning opportunities will help the student achieve these objectives?
- What should be done to help the student reflect on his or her progress and monitor himself or herself adequately?
- How can the student be motivated more thoroughly to develop an inward desire to learn?
- How might the student become more conscientious about careful proofreading?

Portfolios provide feedback to the teacher on how to help students overcome selected problems and continuously progress in mathematics. Decisions may then be made about large group, small group and individual student endeavours. The teacher must use the feedback wisely in order to provide for individual differences among learners (see National Council of Teachers of Mathematics 1989).

Improving the Classroom Environment

The classroom environment is highly significant in improving mathematical achievement. Through observation, the teacher can determine what environmental factors are hindering student achievement and progress. For example, when students are distracted from attending to a lesson, their sequential learnings are disrupted and they lose out on specific and major ideas. On-task behaviour is very important.

Sometimes students are rude about points presented in a discussion. This hinders the free flow of ideas. Rules for discussions should be set up, such as all students should participate but no one should dominate, interrupting others should be avoided, respect for others and their ideas should be demonstrated, and active participation is important.

Steen (2007, 12) writes the following:

> Experience shows that many students fail to master important mathematical topics. What's missing from traditional instruction is sufficient emphasis on three important ingredients: communication, connections, and contexts.
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> Colleges expect students to communicate effectively with people from different backgrounds and with different expertise and to synthesize skills from multiple areas. Employers expect the same things. They emphasize that formal knowledge is not, by itself, sufficient to deal with today's challenges. Instead of looking primarily for technical skills, today's business leaders talk more about teamwork and adaptability. Interviewers examine candidates' ability to synthesize information, make sound assumptions, capitalize on ambiguity, and explain their reasoning. They seek graduates who can interpret data as well as calculate with it and who can communicate effectively about quantitative topics.
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> To meet these demands of college and work, K–12 students need extensive practice expressing verbally the quantitative meanings of both problems and solutions. They need to be able to write fluently in complete sentences and coherent paragraphs; to explain the meaning of data, tables, graphs, and formulas; and to express the relationships among the different representations.

In Closing

The demands of today's workplace require increased proficiency in mathematics, which means that mathematics achievement in the elementary, middle school and high school years is essential. Mathematics teachers need to help each student achieve optimally, and strategies must be developed to guide learner progress.

The basics should be taught in problem-solving experiences. However, with some students, essential content may be taught more systematically. The psychology of learning must be stressed in teaching and learning situations. This includes making learnings interesting and meaningful, as well as purposeful. The learning style of the individual student should also be considered. Thus, students should learn in cooperative settings, as well as individually. The student must be guided to make connections between what is acquired in the school setting and what is needed in society, in order to establish relevance.

All these strategies can be facilitated and assessed through teacher observation.

References

Ediger, M. 2006a. "Writing in the Mathematics Curriculum." *Journal of Instructional Psychology* 33, no 2 (June): 120–23.

———. 2006b. "Testing Versus Portfolios to Assess Achievement." *OASCD Journal* 13, no 1: 31–32.

Ediger, M, and D B Rao. 2001. *Teaching Mathematics Successfully.* New Delhi, India: Discovery.

National Council of Teachers of Mathematics (NCTM). 1989. *Curriculum and Evaluation Standards for School Mathematics.* Reston, Va: NCTM.

Steen, L A. 2007. "How Mathematics Counts." *Educational Leadership* 65, no 3 (November): 8–14.

Vygotsky, L S. 1986. *Thought and Language.* Rev ed. Cambridge, Mass: MIT Press.

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