

Figure This!



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Getting to the Point of Assessing Student Work

Source: *Mathematics Assessment – A Practical Handbook*, NCTM, 2000, p.10 - 21

Assessing Conceptual Understanding

Conceptual understanding is an important goal for mathematics instruction. In order for students to develop mathematical power, they must have a deep understanding of mathematics concepts and their relationships.

What are Mathematics Concepts?

Concepts are the building blocks of mathematics. They are the foundation on which mathematical understanding is based. They are the ‘nouns’ of mathematics because they are always objects. One way to think about mathematics concepts is to consider them as a set of objects with a nametag. The picture in **Figure 1** represents the concept of rational numbers.

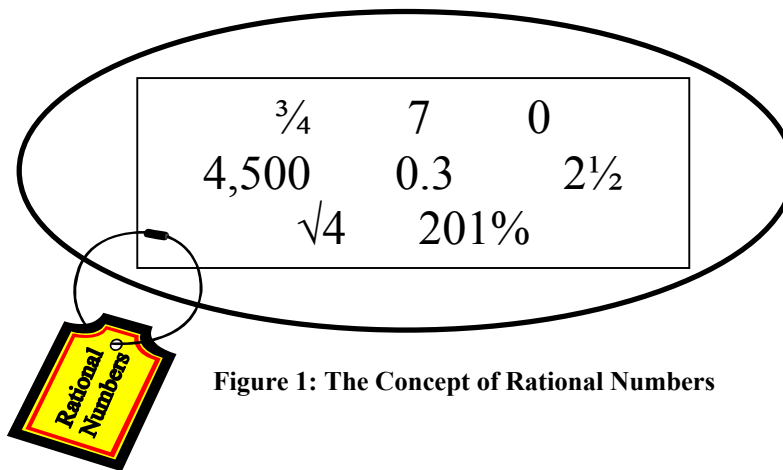


Figure 1: The Concept of Rational Numbers

How Do I Assess Conceptual Understanding?

To assess students’ understanding of mathematics concepts, we might ask them to –

- ✓ Describe concepts in their own words.
- ✓ Identify or give examples and non-examples of concepts.
- ✓ Use concepts correctly in a variety of situations.

Tasks designed to assess understanding can vary – from focusing narrowly on the concepts to focusing on the way in which concepts are used. Assessment tasks that focus primarily on the mathematical concepts give students a chance to apply a concept in a new situation, to reformulate it, and to express it in their own terms. These tasks probe the understanding of an idea. They are usually:

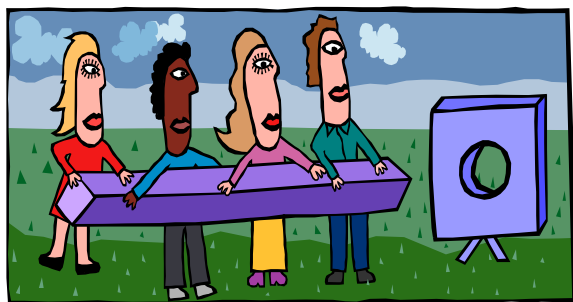
- ⌘ Nonroutine
- ⌘ Short
- ⌘ Based upon reconstruction, rather than memorization
- ⌘ Cast in a context
- ⌘ Focused on representation and explanation of the solution



How do I Assess Relationships Among Concepts?

Concepts rarely appear in isolation. Mathematics is built on relationships and connections. Therefore, it is important that our students develop an understanding of the relationships among important concepts.

Assessing Mathematical Skills



What are mathematical skills?

Skill development is an important part of doing mathematics. To solve problems, students must be able to perform mathematics skills correctly. If concepts are the *nouns* of mathematics, then skills are the *verbs*. They are the procedures that enable students to perform mathematical tasks. For example, the middle school mathematics curriculum contains many mathematical skills. Listed below are some of the important skills.

Middle School Mathematical Skills

- ✍ Compute with rational numbers and integers
- ✍ Estimate quantities, computation and measurements
- ✍ Measure objects with appropriate tools
- ✍ Graph data
- ✍ Find probabilities
- ✍ Solve equations
- ✍ Use formulas

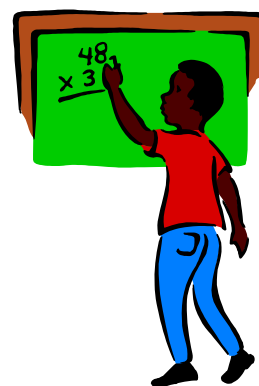
How Do I assess Mathematical Skills?

To assess proficiency with mathematical skills, we might ask our students to –

- ✓ Perform the skill accurately and consistently.
- ✓ Explain how and why the skill works.
- ✓ Use the skill in a variety of situations.

Assessing skills, like assessing concepts, can focus narrowly on the skill itself or more broadly on how and why the skill is used. Tasks used to assess skills often have the following similar characteristics. An assessment task that focuses primarily on mathematical skills gives students a chance to apply a well-practiced and important procedure or algorithm. These tasks are usually:

- ⌘ Routine
- ⌘ Short
- ⌘ Based on recalling a well-known procedure
- ⌘ Cast in a simple context or no context at all
- ⌘ Focused on a single correct answer



Assessing Mathematics Problem Solving

According to the NCTM Standards, problem solving is the essence of mathematical power. To be successful, students must not only have a clear understanding of mathematics concepts, but they must also be proficient with mathematical skills. And, most important, they must be able to reason mathematically.

What is Mathematics Problem Solving?

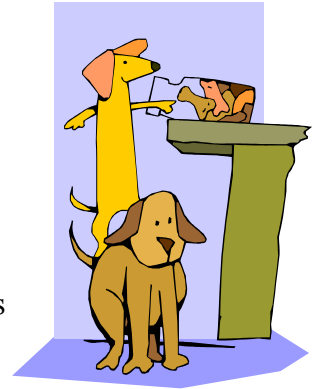
Mathematics problem solving has been defined in many ways. The definition presented is by Charles and Lester (1982).

A problem is a situation or task for which —

- ↳ The person confronting the tasks wants to or needs to find a solution.
- ↳ The person has no readily available procedure for finding a solution.
- ↳ The person makes an attempt to find a solution.
- ↳ A variety of solution routes may be appropriate for solving the problem.

In summary, the three requirements of problem solving are desire, barrier, and effort. This view of problem solving allows us to include many mathematics tasks as problems – from simple word problems to extended investigations.

One way to think about how mathematics problems are different from one another is through their degrees of “openness”.



Closed Task: Task with one correct answer and one route to arriving at that answer.

Open-Middled Task: Task with one correct answer but many routes to arriving at that answer.

Open-Ended Task: Task with several correct answers and many routes to arriving at those answers.



Questions and Answers about the District-wide Mathematics Assessments in Grades 2, 4, 6, 7, & 8

Q What is the purpose of the performance-based mathematics assessments?

A In a standards based educational system, formative assessments are the key to informing teachers whether their students are meeting the standards. In 2000, APS adopted new mathematics standards and teachers are being asked to implement those standards. In an attempt to support schools and teachers, APS has developed a comprehensive assessment system that includes performance-based assessments that are specifically aligned to the current mathematics standards. The performance assessments provide the teachers with insights about what their students know about key mathematical ideas and inform teachers about the instructional needs of their students.

Q Where can I find resource material to support the mathematics content in the assessments?

A There are a number of places teachers can go to obtain information about performance-based mathematics assessments: RDA published two resources for teachers during the 2000–01 and 2001–02 school years; the *Mathematics Task Bank* and the monthly mathematics tip sheet *Figure This!* The task bank and tip sheets were distributed to each school as a teacher resource. The task bank has tasks for grades K – 8 and includes a resource list for teachers. This year RDA will continue to add performance tasks to the task bank. Tasks will be distributed quarterly; each quarter schools will receive 3 tasks, one for each grade band (K-2, 3-5, 6-8). The tip sheet will again be distributed on a monthly basis to schools and will provide teachers with support information about the mathematics assessments.