What Are Good Questions?

There are three main features of good questions.

- They require more than remembering a fact or reproducing a skill.
- Students can learn by answering the questions, and the teacher learns about each student from the attempt.
- There may be several acceptable answers.

More Than Remembering

A particular grade 6 student, Jane, had just finished a unit on measurement where she had been asked to calculate area and perimeter from diagrams of rectangles with the dimensions marked. She was able to complete these correctly, and the teacher assumed from this that Jane understood the concepts of area and
perimeter. However, when she was asked the following good question she claimed that she could not do it because there was not enough information given. *I want to make a garden in the shape of a rectangle. I have 30 meters of fence for my garden. What might be the area of the garden?*

To find an answer to this Jane needed to think about the constraints that a perimeter of 30 meters places on the lengths of the sides of the rectangle, as well as thinking about the area. She needed to use higher order reasoning skills since she had to consider the relationship of area and perimeter to find possible whole number answers that could range from 14 x 1 ($14m^2$) to 7 x 8 ($56m^2$). This certainly required her to do more than remember a fact or reproduce a skill. It required comprehension of the task, application of the concepts and appropriate skills, and analysis and some synthesis of the two major concepts involved.

Through further probing, this question allowed the teacher to see that Jane had little appreciation of perimeter as the distance around a region, and no

concept of area as covering. She had learned to answer routine exercises without fully understanding the concepts.

Another example of closed questions commonly found in textbooks is from the topic of averages. A typical question looks something like *What is the average of 6, 7, 5, 8, and 4?* This mainly requires students to recall a technique. That is, add the numbers and divide by how many there are—in this case five. However, if this question was rephrased in the form of a good question it would look something like *The average of five numbers is 6.What might the numbers be?* or *After five games, the goalie had averaged blocking six goals per game. What might be the number of goals he blocked in each game?*

These questions require a different level of thinking and a different type of understanding of the topic of averages to be able to give an answer. Students need to comprehend and analyze the task. They must have a clear idea of the concept of average and either use the principle that the scores are evenly placed about the average or that the total of the scores is 30 (that is, 5 x 6) as the basis of their response. It most definitely requires more than remembering.

Students Learn By Answering the Question and Teachers Learn from the Students' Attempts

Good questions are particularly suitable for this because they have the potential to make children more aware of what they do know and what they do not know. That is, students can become aware of where their understanding is incomplete. The earlier question about area and perimeter showed that by thinking about area and perimeter together the student is made aware of the fact that the area can change even though the perimeter is fixed. The very act of trying to complete the question can help children gain a better understanding of the concepts involved. The manner in which some children went about answering the following question illustrates this point.

> John and Maria each measured the length of the basketball court. John said that it was 25 yardsticks long, and Maria said that it was 24 ½ yardsticks long. How could this happen?

Some fifth- and sixth-grade students were asked to discuss this question in groups. They suggested a variety of plausible explanations and were then asked to suggest what they need to think about when measuring length. Their list included the need to:

- agree on levels of accuracy
- agree on where to start and finish, and the importance of starting at the zero on the yardstick
- avoid overlap at the ends of the yardsticks
- avoid spaces between the yardsticks
- measure the shortest distance in a straight line.

By answering the question the students established for themselves these essential aspects of measurement, and thus learned by doing the task.

As we have discussed, the way students respond to good questions can also show the teacher if they understand the concept and can give a clear indication of where further work is needed. If Jane's teacher had not presented her with the good question she would have thought Jane totally understood the concepts of area and perimeter. In the above example, the teacher could see that the children did understand how to use an instrument to measure accurately. Thus we can see that good questions are useful as assessment tools, too.

Several Acceptable Answers

Many of the questions teachers ask, especially during mathematics lessons, have only one correct answer. Such questions are perfectly acceptable, but there are many other questions that have more than one possible answer and teachers should make a point of asking these, too. Each of the good questions that we have already looked at has several possible answers. Because of this, these questions foster higher level thinking because they encourage students to

develop their problem-solving expertise at the same time as they are acquiring mathematical skills.

There are different levels of sophistication at which individual students might respond. It is characteristic of such good questions that each student can make a valid response that reflects the extent of their understanding. Since correct answers can be given at a number of levels, such tasks are particularly appropriate for mixed ability classes. Students who respond quickly at a superficial level can be asked to look for alternative or more general solutions. Other students will recognize these alternatives and search for a general solution.

If we think back to the earlier question on the area of the garden, there is a range of acceptable whole number answers (14 x 1, 13 x 2, 12 x 3 . . . 8 x 7). Students could be asked to find the largest or smallest garden possible. They could be asked to describe all possible rectangles. Other students will be interested in exploring answers other than those that involve only whole numbers, for example, 12.5m x 2.5m. It is the openness of the task that provides this richness. The existence of several acceptable answers stimulates the higher level thinking and the problem solving.

In this article, we have looked more closely at the three features that categorize good questions. We have seen that the quality of learning is related both to the tasks given to students and to the quality of questions the teacher asks. Students can learn mathematics better if they work on questions or tasks that require more than recall of information, and from which they can learn by the act of answering the question, and that allow for a range of possible answers.

Good questions possess these features and therefore should be regarded as an important teaching tool for teachers to develop.