

8

Remodelling Math Lessons

When elementary school students are asked the question, "There are 75 sheep in the field and 5 sheep dogs, how old is the shepherd?", four out of five students add, subtract, multiply, or divide to get an answer. And the more math they've had, the greater this tendency. Studies of math learning demonstrate that much of the time students don't really know what they are doing when they manipulate mathematical concepts.

As Alan Schoenfeld and others have pointed out, most students are not learning to think mathematically. They are learning to blindly follow directions, to rotely manipulate figures, to "mindlessly" do what they think they're supposed to do. The solution is to switch from formula-based instruction to problem-based instruction, making sure the problems come from real life situations and that they require mathematical thinking. Even primary grade students can begin to discover important mathematical concepts. For example, by figuring out how to answer the question, "How many paper clips would it take to make a chain from here to the principal's office?", even young children (as soon as they run out of paper clips) can begin to deeply grasp the nature of proportional thinking.

Although we have provided only two math lessons, we hope that they will help you begin to see how to help students make the connection between mathematical concepts and the real world. Remember, critical thinking in math is self-directed mathematical thinking. It is reflective, self-correcting, and based on a genuine understanding of math concepts. When students begin to learn to think mathematically, they have begun to acquire powerful tools for making sense of the world.

Bar Graph

(1st Grade)

by Anne J. Harris, Jefferson Elementary
School, Cloverdale, CA

Objectives of the remodelled lesson

The students will:

- participate in making a bar graph as a group and independently
- analyze and evaluate the bar graph
- discuss the values underlying their choices of television shows
- decide how important each of the values is to them and make their own bar graph to communicate this
- deeply probe the usefulness of bar graphs and when it is good to use them

Original Lesson Plan

Abstract

Students make a "shoe graph" by lining up their shoes in different categories (such as tie shoes, buckles, and slip-ons). They then "read" the "graph" and examine a bar graph in their text showing visitors to a class over a week. They answer the following questions: How many visited on Monday? Wednesday? Circle the day with the most visitors.

Critique

The sole objective of this lesson is to complete a bar graph. The assignment also asks students to interpret some of the data, but more questioning can be done here to infuse critical thinking into the lesson.

editors' note: The example of how many visitors came to class over a week is weak because it lacks purpose. To understand bar graphs, one must understand their usefulness. Therefore, students should compare different ways of presenting data, such as verbally and in a bar graph.

Strategies used to remodel

S-9 developing confidence in reason

S-1 thinking independently

S-15 developing criteria for evaluation: clarifying values and standards

S-17 questioning deeply: raising and pursuing root or significant questions

Remodelled Lesson Plan s-9

In addition to the original lesson, I would ask the students “Would the graph always work the same? How could it change? Would it be the same for our room?” Predict, then check the answer to that question by making a graph for the class. **S-1**

To foster insights into mechanical skills, I would ask the children why we would want to know this information? Where else do people use graphs? Why? **S-1**

editors’ note: We suggest the class collect data that is either a topic of interest to them or a tie-in to another subject they are studying, and then translate their data into a bar graph.

One example could be to make a graph of the class’ favorite TV shows. After doing the shoe bar graph in the original, the teacher could take down nominations from the class and have students count the hands for each show mentioned, while keeping a list on the board. Next, the teacher could set up the bar graph on the board, thinking aloud through the process and explaining how to mark off the scale, etc. Students could come to the board and fill in a bar. (Instead of a “show graph”, this lesson could begin with a “kid graph”. Students could stand in lines representing their favorite shows, notice which lines are shortest and longest, and count and record the numbers before the teacher illustrates the bar graph with the same data.)

After graphing, the students can discuss the results, read the graph, and give reasons for their choice of shows. To have students begin to see the purpose of graphing, the class could compare the list of TV shows and numbers to the graph. “Look at the list with its numbers and the bar graph. Which way of showing the data makes it easier to see which is the most popular show? Why?”

“Why is this your favorite show? Does anyone have a different reason for preferring this show? Given these reasons, why is this such a popular show? Why is this less popular?” The teacher could help the students make the values underlying their preferences explicit. **S-15**

One way to allow students (or groups of students) to produce their own bar graphs would be to have them copy this list of values and rank each value on a scale of 1 to 10. They can then take those written lists and make a bar graph showing their rankings of the values. (The same purpose could be served by having the class poll another class, say a fifth grade class about *their* favorite shows.) The class can share and discuss the graphs.

To have the class more deeply explore the function of the graphs. “Why do we sometimes use graphs to communicate, instead of just writing our findings in words or in a table? When is a graph more helpful? When would this way be better? That way? Why?” **S-17**

Word Problems

(3rd Grade)

by Mandy Ryan and Barbara Morrow,
Greensboro Public Schools,
Greensboro, NC

Objectives of the remodelled lesson

The students will:

- clarify their understanding of math functions to solve story problems
- distinguish relevant from irrelevant information in word problems
- work independently by creating their own word problems

Standard Approach

Students read story problems and translate them into number problems in order to solve them.

Critique

The standard approach is passive in its involvement of students, requiring no independent thinking, and the students are only asked to demonstrate surface knowledge — the recall of basic facts. In addition, students get bogged down in nonessential facts.

Strategies used to remodel

S-31 distinguishing relevant from irrelevant facts

S-1 thinking independently

Remodelled Lesson Plan

The teacher will begin the lesson with a review of the four math processes: addition, subtraction, multiplication, and division. Then have students model each process. For example, the teacher could put the problem "4-1=___" on the board, and ask students for ideas on how to demonstrate this problem using their classmates. (Four students stand together, then one walks away.) Continue to do this while increasing the difficulty of the problem each time. (The teacher will also reinforce ideas with visual aids on the board.)

Then, she will elicit applications for "real life" situations and help students discriminate between the important facts in the problem and the unimportant facts. For example, "Twenty-three students came to school, two went home sick before lunch and three went to the bathroom after lunch. How many stu-

dents were at school at the end of the day?" The teacher should ask which facts in the situation are important to figuring out the answer and why. **S-31**

Then reverse the process by giving the students the number problem first. Ask them to create a story problem which will demonstrate the functions given. Let them do this verbally while the teacher models and reinforces the problem visually. Then have them create story problems independently. **S-1** As closure, one child will read a story problem to another while that child solves it.

"Be aware of the hidden curriculum in all schools. If teachers ask only factual questions that test memory and recall, students assume that this is the most important aspect of learning. If principals spend more time focusing on administrative concerns, discipline, or standardized test scores, teachers also assume these aspects of school are the most important."

*Greensboro Handbook,
Greensboro Public Schools
Reasoning and Writing Project*

“Teachers need time to reflect upon and discuss ideas, they need opportunities to try out and practice new strategies, to begin to change their own attitudes and behaviors in order to change those of their students, to observe themselves and their colleagues — and then they need more time to reflect upon and internalize these concepts.”

*Greensboro Handbook,
Greensboro Public Schools
Reasoning and Writing Project*