

## An Alternative Form of Evaluation That Complies with NCTM's Standards

**T**hree years ago, after hearing about the NCTM's (1989) *Curriculum and Evaluation Standards*, I began emphasizing problem solving, communication, and reasoning in my classroom. I realized I did not have an efficient way to assess students in these three areas. At about the same time, I heard Gary Flebbe and Andy Aiken, two Boulder High School social studies teachers, talk about scored discussions used in their high school history classes and John Zola, another Boulder Valley teacher, talk about scored discussions used in his middle school and high school social studies classes. Zola pointed out several compelling attributes of scored discussions (Zola 1992):

- They are easy to score and do not add to the amount of grading time spent by the teacher.
- They are an alternative form of assessment to traditional paper-and-pencil tests.
- They offer opportunities for success to students with different learning styles.
- They permit students to have greater ownership of their own learning.
- They allow students to learn from each other.

I asked Zola to help me look at ways in which the technique could be adapted to problem solving in mathematics classes.

During my problem-solving scored discussions, a group of three to six students were seated in front of the class to discuss and solve a problem in a given period of time. I have found that for most middle school and high school classes, five minutes is a sufficient amount of time to develop a strategy for solving a problem. I scored the students on the discussion of the problem. Points were assigned according to strategies applied and communication skills exhibited, not on whether a solution was determined. Unlike in an oral presentation in which a student demonstrates the final result of a

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solution method, in a scored discussion the student demonstrates how he or she thinks about mathematics.

When I first tried a scored discussion, I was afraid the students would hate it. I was wrong. Those students in front of the class were trying their best, since they were working in front of their peers. The students in the audience listened intently. I learned more about how the students reasoned than I had by watching them in cooperative groups. Best of all, the approach took no more time than preparing, administering, and grading a short written quiz.

I have used scored discussions in two different ways. First, about twice a week at the beginning of the period, I chose a group to have a scored discussion on one of the challenging problems of the coming night's homework. By participating in, or listening to, the scored discussion, students had a head start on its solution. Almost every student succeeded in solving the problem. Even those students who might otherwise have avoided trying a difficult problem were motivated by their peers' discussion to see if they could determine a solution.

Second, once or twice each semester I devoted a full period to scored discussions, especially if the lesson included such application problems as solving triangles in trigonometry, writing proofs in geometry, or solving distance-rate-time problems in prealgebra. Each group discussed a different problem for five minutes. Then all the problems that had been discussed were assigned as homework.

In my classes, scored discussions were used primarily for assessing problem-solving skills. However, the same technique could be used to discuss any topic appropriate to the course curriculum, such as explaining algorithms or discussing mathematical issues.

### INTRODUCING THE PROCEDURE

The day before the first scored discussion, a practice scored discussion was demonstrated. Every student was given a copy of the evaluation form so

### Individual Evaluation Form

Name _____		Positive	Negative	
1.	Determining a possible strategy to use (3)	_____	1. Not paying attention or distracting others (-2)	_____
2.	Successfully communicating a strategy (3)	_____	2. Interrupting (-2)	_____
3.	Correctly applying a property (2)	_____	3. Making an incorrect application or assumption (-1)	_____
4.	Recognizing misused properties or arithmetic errors (2)	_____	4. Monopolizing (-3)	_____
5.	Drawing another person into the discussion (2)	_____	5. Making a personal attack (-3)	_____
6.	Asking a clarifying question (3)	_____	Total points	_____
7.	Moving the discussion along (1)	_____	Possible points	_____

Fig 1

that each would know the criteria for evaluation. See figure 1.) Three or four students who usually are active discussants in cooperative groups or who just like to be the center of attention were chosen. I then joined the group to discuss a problem. I demonstrated how to make five-point plays by determining a strategy and then drawing someone else into the discussion to apply the suggested strategy. I also demonstrated how to lose points by interrupting or monopolizing. I emphasized that students could score points by thinking aloud and using proper mathematical vocabulary. Not finding "the correct answer" in the allotted time would not hurt the score.

Assigning four students to a group comfortably gives opportunities for each student to contribute a number of times. When using a full period for scored discussions, six students were needed for each group to involve all members of the class in one period.

In addition to choosing challenging problems from the textbook, I used other sources for problems that I copied onto posters or overhead transparencies.

### ROOM ARRANGEMENT

Before students came into the classroom, the desks for the scored discussion were arranged facing each other in the front of the classroom. The desks were placed far apart so that students would have to talk loudly to be heard by others in their group; the hardest problem for students to overcome has been speaking loudly enough to be heard by the entire class. The discussants were seated near the chalkboard so they could demonstrate ideas as they dis-

**Scored discussions were helpful for the tough homework problems**

*I was afraid  
students  
would  
hate it;  
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cussed them. My chair was near the discussants so that I would not miss any points a student might score.

On the day of the scored discussion, the name of each participant was written on the top of one of the tally sheets. See figure 2. Each discussant was assigned the seat that corresponded to the position of her or his name on my tally sheet. The remaining students took their regular seats. To help the student audience remain quiet and attentive I informed them that they could not earn positive points until it was their turn. However, they could earn negative points by distracting the discussants. I reminded them that the problem would be on their homework. Then the problem was displayed. During a full period of scored discussions, each group drew for a problem. One discussant was chosen to read the problem to the class, then the class was asked if they all could hear the reader. Their response gave the discussants a feeling for how loudly they must talk. I took my seat, set my timer for five minutes, and told them to begin. This

command was usually followed by a few seconds of silence while each student was thinking. Once the discussion began, I made a check on my tally sheet every time one of the discussants made a contribution.

### THE ROLE OF THE AUDIENCE

I quit scoring when the timer bell rang, but the discussants finished what they were doing at that moment. The audience could then contribute to the discussion. They could address questions to any of the discussants or make corrections or suggestions. Someone in the audience usually asked a question or offered a strategy that might have been better than the one being used by the discussants. Sometimes students in the audience were so excited about determining the solution that they could hardly keep quiet until the five-minute timer rang. If the problem was solved, then they had one fewer homework problem. After the audience had a chance to contribute, I made any corrections or clarifications that seemed appropriate. Then I

#### TALLY SHEET

LEFT SEAT 1 \_\_\_\_\_  
LEFT SEAT 2 \_\_\_\_\_  
LEFT SEAT 3 \_\_\_\_\_

1. Determining a possible strategy to use (3)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

2. Successfully communicating a strategy (3)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

3. Correctly applying a property (2)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

4. Recognizing misused properties or arithmetic errors (2)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

5. Drawing another person into the discussion (2)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

6. Asking a clarifying question (3)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

7. Moving the discussion along (1)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

RIGHT SEAT 1 \_\_\_\_\_  
RIGHT SEAT 2 \_\_\_\_\_  
RIGHT SEAT 3 \_\_\_\_\_

1. Not paying attention or distracting others (-2)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

2. Interrupting (-2)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

3. Making an incorrect application or assumption (-1)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

4. Monopolizing (-3)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

5. Making a personal attack (-3)

L1 \_\_\_\_\_ R1 \_\_\_\_\_  
L2 \_\_\_\_\_ R2 \_\_\_\_\_  
L3 \_\_\_\_\_ R3 \_\_\_\_\_

Fig. 2

### SAMPLE EVALUATION

<p>LEFT SEAT 1 <u>Lisa</u></p> <p>LEFT SEAT 2 <u>Hans</u></p> <p>1. Determining a possible strategy to use (3)          L1 <u>✓</u> R1 <u>✓</u>          L2 _____ R2 _____</p> <p>2. Successfully communicating a strategy (3)          L1 <u>✓</u> R1 _____          L2 _____ R2 _____</p> <p>3. Correctly applying a property (2)          L1 _____ R1 _____          L2 _____ R2 <u>✓✓</u></p> <p>4. Recognizing misused properties or arithmetic errors (2)          L1 _____ R1 _____          L2 <u>✓</u> R2 _____</p> <p>5. Drawing another person into the discussion (2)          L1 <u>✓</u> R1 _____          L2 _____ R2 _____</p> <p>6. Asking a clarifying question (3)          L1 _____ R1 _____          L2 <u>✓✓</u> R2 <u>✓</u></p> <p>7. Moving the discussion along (1)          L1 _____ R1 <u>✓✓✓</u>          L2 _____ R2 _____</p>	<p>RIGHT SEAT 1 <u>Tom</u></p> <p>RIGHT SEAT 2 <u>Nicole</u></p> <p>1. Not paying attention or distracting others (-2)          L1 _____ R1 _____          L2 _____ R2 _____</p> <p>2. Interrupting (-2)          L1 _____ R1 _____          L2 _____ R2 _____</p> <p>3. Making an incorrect application or assumption (-1)          L1 _____ R1 _____          L2 _____ R2 _____</p> <p>4. Monopolizing (-3)          L1 _____ R1 _____          L2 <u>(Hans corrected his</u> R2 _____  <u>error on page)</u></p> <p>5. Making a personal attack (-3)          L1 _____ R1 _____          L2 _____ R2 _____</p> <p style="text-align: right; margin-top: 10px;"> <i>Totals Lisa 9              Hans 8 - 1 = 7              Tom 6              Nicole 7</i> </p>
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*Students were used to grading of oral reports and papers in other subjects*

Name <u>Tom</u>	
Positive	Negative
<p>1. Determining a possible strategy to use (3) <u>3</u></p> <p>2. Successfully communicating a strategy (3) _____</p> <p>3. Correctly applying a property (2) _____</p> <p>4. Recognizing misused properties or arithmetic errors (2) _____</p> <p>5. Drawing another person into the discussion (2) _____</p> <p>6. Asking a clarifying question (3) _____</p> <p>7. Moving the discussion along (1) <u>3</u></p>	<p>1. Not paying attention or distracting others (-2) _____</p> <p>2. Interrupting (-2) _____</p> <p>3. Making an incorrect application or assumption (-1) _____</p> <p>4. Monopolizing (-3) _____</p> <p>5. Making a personal attack (-3) _____</p> <p>Total points <u>6</u></p> <p>Possible points <u>8</u></p> <p>Score <u>75%</u></p>

Fig 3

either began the lesson or selected the next scored-discussion group.

#### GRADING

The grade was determined by totaling check marks. I have used the highest number of points accumulated by one student in the group as the total possible. Every other student in the group earned a percent of that total. (See figure 3.) More recently, I have predetermined how many points the discussion would be worth and the students have earned their points from that number. Using this method, a particularly good discussion could earn more than the possible points and result in extra credit for the participants. The first time a group participated in a scored discussion, I had allotted ten possible points for the problem.

The next time they participated I raised the number of attainable points to fifteen.

When I first tried a scored discussion, I was concerned whether the students would rebel against such subjective grading. Actually the opposite happened. Because the students were used to having their oral reports and written papers evaluated by English teachers and social studies teachers, this technique seemed no different. Only one student in three years has wanted to argue with me about scoring; however, he also wanted to argue with me about every point he lost on a pencil-and-paper test.

Initially, in all my classes the first couple of groups were uncomfortable, but they began to enjoy the activity. A month into the semester I found that if a few days went by without a scored

discussion, the students requested one. Only two students in three years have never scored a point because they were not willing to participate.

### **BENEFITS OF SCORED DISCUSSION**

I have found several unexpected benefits of scored discussions. One was an opportunity to observe students meeting the curriculum standard on mathematical disposition. I observed which students were excited about mathematics. One of my first discussion groups happened to solve their problem. Rather than quit, they decided to see if they could develop a second strategy to solve the same problem. That endeavor became contagious to the rest of the class. For the rest of the year, every time we developed a new algorithm in class at least five students would try to find a different algorithm to solve the same problem. (Do you know how many ways can be used to find the vertex of a parabola?)

A second benefit was improved discussions in cooperative groups. During the year I first tried this technique, I taught a precalculus class that was "too sophisticated" to work in cooperative groups. If I assigned a group problem, they would put their desks together and then each work independently to find the solution. I tried a full-period scored discussion with them, and they did surprisingly well. A couple of days later they were again required to work on an activity in cooperative groups. Much to my surprise, they worked cooperatively. By seeing the scored discussions, they had learned how to discuss mathematics. This skill can be developed further by encouraging the audience to make suggestions about improving the discussions, as well as the mathematics, at the end of a scored discussion. When a group has had a particularly difficult time with their problem, I have pulled my chair into the group and continued the discussion for several more minutes, modeling how to develop a strategy and how to involve all members of the group in the solution process.

Of course, for me, the main benefit of scored discussions is that the students' grades reflect the experience they have gained in solving problems, reasoning, and communicating in mathematics.

### **REFERENCES**

- National Council of Teachers of Mathematics. *Curriculum and Evaluation Standards for School Mathematics*. Reston, Va.: The Council, 1989.
- Zola, John. "Scored Discussions." *Social Education* 56 February 1992:121-23, 125. □

Diagram 1

NAME \_\_\_\_\_

POSITIVE

- 1. Determining a possible strategy to use. (3) \_\_\_\_\_
- 2. Successful communication of a strategy (3) \_\_\_\_\_
- 3. Correct application of a property. (2) \_\_\_\_\_
- 4. Recognizing misused properties or arithmetic errors. (2) \_\_\_\_\_
- 5. Drawing another person into the discussion. (2) \_\_\_\_\_
- 6. Asking a clarifying question. (3) \_\_\_\_\_
- 7. Moving the discussion along. (1) \_\_\_\_\_

NEGATIVE

- 1. Not paying attention or distracting others. (-2) \_\_\_\_\_
- 2. Interrupting. (-2) \_\_\_\_\_
- 3. Incorrect application or assumption. (-1) \_\_\_\_\_
- 4. Monopolizing. (-3) \_\_\_\_\_
- 5. Personal attack. (-3) \_\_\_\_\_

Total points \_\_\_\_\_

Possible points \_\_\_\_\_