

Data and Method:

We distributed 24 worksheets to an 8th grade pre-algebra class. Students worked on Item #3 and Item #4.

The following is a table that summarizes the scores of the 24 worksheets for Item #3 that assessed students' understanding about lines of symmetry. The top row “#” indicates each student and bottom row “Sc” indicates the score.

Item #3 Analysis

Table of list of students numbered 1-24 and corresponding score labeled “Sc”

| # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Sc | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 4 | 2 | 4 | 3 |

General Misconceptions:

From reviewing the student responses, I noticed that many students did not draw the correct line of symmetry (part three)--many of them did not show an attempt of drawing the line of symmetry. I am not sure if this was because students were unsure if there was a correct line of symmetry or if they misread the question. Therefore, this could be either a procedural or conceptual error: conceptual error for students who do not understand symmetry and procedural error for students who did not read the problem. All students provided an explanation in their answer. Shape C appeared to be the problem that students struggled the most.

There were a wide array of student explanations to the reason why they thought Adam drew the correct or incorrect line of symmetry. Some students used words to describe each shape by saying that the shape is “congruent,” “equivalent,” “even,” “equal,” or “unequal.” Other students described how if the line was folded, the sides would or would not match up. As a result of the variety of student explanations, I mainly looked for whether or not students' explanations accurately matched up with their yes or no answer to why Adam's solution was a line of symmetry or not; I was lenient with students' vocabulary when they used “even” or “equal” instead of “congruent.”

Score Classification: Solutions, multiple representations, errors, procedural vs conceptual

I modified the rubric to be more concrete while trying to be as fair as possible. An important part of the problem was for students to demonstrate their understanding by drawing the correct line of symmetry, in which more than half of the students did not. Students who did not attempt to draw or drew incorrect lines of symmetry fell under the 2-point score.

4-Point Score

- ⤴ Out of the 24 students, 3 students scored a 4. These student demonstrated a solid understanding of lines of symmetry with a straightforward explanation to why each shape had a correct or incorrect line of symmetry by stating that the sides are not congruent or folding on the line did not “match up.” The students had the correct responses for all three shapes and drew the correct lines of symmetry for Shape A and Shape C. One student did not give a very concrete argument saying that “the sides are equal or sides are unequal.” However, by drawing in the correct line of symmetry for Shape C, the student accurately justified their explanation of what they meant by “unequal” and “equal” so I gave them a 4.

3-Point Score

- ⤴ 4 students scored a 3. These students answered line of symmetry correctly with some minor errors; these three students were of the few that drew lines of symmetry to justify their answer.

They drew the correct line of symmetry for Shape A, but did not draw in the correct line of symmetry for Shape C. Their explanations demonstrated an understanding about symmetry, some stronger than others. Student 24 gave a vague explanation about symmetry in saying “right spot” and “not right spot” but he drew in the correct line of symmetry for Shape A and had all correct answers circled, showing some understanding of symmetry. Student 16 justified their explanations well but did not draw the correct line of symmetry for Shape C, resulting in the score of a 3 since they needed correct line of symmetry drawn for all three shapes based on the rubric.

2-Point Score

- ⤴ 17 students scored a 2. The majority of the class received a score of 2 because they did not finish the problem in drawing the correct line of symmetry when they answered “no” to whether or not Adam had the correct line of symmetry. Many of these students provided an explanation but did not justify their explanation by drawing the correct line of symmetry. Drawing the correct line of symmetry would better demonstrate the students' understanding of lines of symmetry.

1-Point Score

- ⤴ 1 student received a score of 1. This student gave a flawed explanation for Shapes B, C. For Shape C, they said “because the rotation” and said that the line of symmetry was correct; this demonstrated the students' limited understanding of symmetry.

0-Point Score

- ⤴ No students received a score of 0 because all attempted and showed work on the worksheet.

Item #4 Analysis

Table of list of students numbered 1-24 and corresponding score labeled “Sc”

| # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Sc | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 1 | 2 | 0 | 2 | 3 | 3 | 3 |

General Misconceptions:

Many students seemed to have not understood the entirety of the problem, sending the grey piece to an open area instead of the black piece because the teacher related it to the game of tetris. This misconception could be either procedural or conceptual based on the misinterpretation on the task or lack of understanding about transformations. Many students did not use all of the terms when describing the transformations: translation, rotation, reflections; instead, they used words such as “flip” and “slide.” Therefore, I changed the rubric so that if students demonstrated understanding of the transformations even though they did not use all three words in their description, they could still score at least a 3. Students were not specific when they were talking about the transformations, such as “move down until it reaches, as opposed to “translate 5 units down.” Students who specified more concretely in their description such as “rotate it to the right and then down 5” received a higher score than those who said “move down.”

Score Classification: Solutions, multiple representations, errors, procedural vs conceptual

I modified the rubric to best fit whether or not students understood transformations. Students who did not use the transformation terms, but demonstrated their understanding still could score at least a 3 if they justified their description through providing a picture. To take procedural error into account, the changing of the rubric also allowed leeway for students who did not follow all of the objectives such as fit the grey piece to black piece but showed understanding of transformations to score higher than a 2.

4-Point Score:

- ⤴ 1 student scored a 4. This student gave a step by step description that demonstrated their

knowledge of transformations even though they did not use all three terms. Their picture and explanation, however, showed that they understood transformations through a clear description and they justified their explanation through their drawing. Unlike those who scored a “3” this student provided the number of steps one should move.

3-Point Score:

- ⤴ I gave the score of 3 to 6 students. These students demonstrated understanding of transformations through their descriptions and drawings but had slight misconceptions about the objective of the problem. Two of the students moved the grey piece to an open area as opposed to the black area. Overall, these students talked about moving the piece but did not talk about how many steps. For instance, Student 22 used all three transformations in their description, but was not specific in regards to how many steps needs to be translated. Therefore they were not very accurate in their step by step description. Other example descriptions of those who scored a three included “slide down until fit, bring it down, etc.”

2-Point Score:

- ⤴ I gave the score of 2 to 6 students. These students demonstrated some understanding of transformations. But had very weak descriptions and weak or no drawings to support their description. Some did not take direction into account, saying “over” instead of referring to left or right, and their picture did not justify their description. One student who wrote a good description did not draw to sketches to justify their work, resulted in a 2 based on the rubric. I debated whether or not this student received a 2 or 3, but because they did not justify their work by drawing the moves, they did not fully demonstrate their understanding of transformations.

1-Point Score:

- ⤴ 10 students received a 1. These students showed limited understanding of transformations. Some students did put in a good amount of effort, but their descriptions were not specific and they did not use at least one transformation. Like the scores of 2, some did not take into account direction, saying “scoot and go down.” Other students did not draw a picture. One student responded that “you can unconnect them and drag each side down.” The student showed a limited understanding of translation and rotation, but their reasoning was not clear.

0-Point Score:

- ⤴ 1 student received a score of 0 because they did not attempt the problem, drawing a big question mark.

Sidenote: I think a meaningful form of assessment of this activity for students to assess on their own work is to have a partner try and follow the steps of their written description in part two and see whether or not they were able to fit the grey piece into the black area.

Rubric #3 Students Responses and Scoring– With Modifications

- 4:** A **4-point** response includes all of the following components:
- ⤴ Provides clear explanation of why line is correct or incorrect
 - ⤴ Demonstrates understanding of lines of symmetry by circling or underlining
 - ⤴ No for Shape A
 - ⤴ Yes for Shape B
 - ⤴ No for Shape C.
 - ⤴ Draws Correct line of Symmetry for Shape A, B, C
- 3:** A **3-point** response includes the following:
- ⤴ Demonstrates understanding of lines of symmetry by circling or underlining
 - ⤴ No for Shape A
 - ⤴ Yes for Shape B
 - ⤴ No for Shape C.
 - ⤴ Draws Correct line of Symmetry for at least 1 shape (either Shape A or Shape C)
 - ⤴ Provides an explanation of why line is correct or incorrect with missing minor part of justification
- 2:** A **2-point** response includes the following or similar:
- ⤴ Demonstrates some understanding of lines of symmetry by circling or underlining yes or no for at least 2 shapes correctly
 - ⤴ Does not draw correct line of symmetry for 2/3 shapes
 - ⤴ Provides no or incorrect explanation
- 1:** A **1-point** response includes the following or similar:
- ⤴ Demonstrates limited understanding of lines of symmetry
 - ⤴ Provides no explanation of reason for symmetry
- 0:** A **0-point** response shows little or no understanding of the task

Rubric #4 Students Responses and Scoring– With Modifications

- 4:** A **4-point** response includes all of the following components:
- ⤴ Demonstrates solid understanding of transformations
 - ⤴ Provides a step by step description of moves using at least one transformation
 - ⤴ Draws moves in the diagram that can be justified by the description.
 - ⤴ Student demonstrates understanding of the objective of the problem by following given guidelines
 - ⤴ Moves do not move piece off the board or overlap other pieces
 - ⤴ Description of moving grey piece fits the black area.
- 3:** A **3-point** response includes the following:
- ⤴ Demonstrates understanding of transformations
 - ⤴ Student understands transformations but shows misinterpretation of the objectives of the problem:
 - ⤴ Fits grey piece into open area instead of black area.
 - ⤴ Provides a step by step description of moves using at least one transformation
- 2:** A **2-point** response includes the following or similar:
- ⤴ Demonstrates partial understanding of the objectives.
 - ⤴ Provides vague explanation of the steps without using transformation terms.
- AND/ OR

⤴ Provides inaccurate or no sketch that somewhat supports description

1: A **1-point** response includes the following or similar:

- ⤴ Demonstrates limited understanding of the objectives and definition of the types of transformations.
- ⤴ Attempts to move shapes, but overlaps and moves piece off the board
- ⤴ Description of the directions does not include at least one transformation.
- ⤴ No or inaccurate drawing

0: A **0-point** response shows little or no understanding of the task