STUDENT PERCEPTION OF MATH CONTENT IN AN EDUCATIONAL VIDEO GAME

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This study has two purposes: 1) To determine whether students see the connection between solving levels in an educational video game and solving problems on a math test, and 2) To determine whether student explanations of how they arrived at their answers support the two main misconceptions identified through data mining of game log data.

1 STUDY DESIGN

Students were given a context, played a series of four educational games on fractions, and then took a posttest. After the posttest, 666 students in 22 urban and suburban 4th grade math classes were given a short questionnaire which asked students:

1. To identify the fraction represented in the game image in Figure 1 and explain how they got the answer;
2. To identify the fraction represented in the number line image in Figure 1 and explain how they got the answer; and
3. To decide whether the images in the first and second questions were the same or different, and explain why they thought so.

![Figure 1: Game and Number Line Representations of the Same Problem (Identifying A/B)](image)

2 DO STUDENTS SEE THE CONNECTION?

Figure 2 shows that significantly more of the students stated that the questions were the same than stated that the questions were different (p < .001).

Explanations of why the representations were the same or different were either based on conceptual similarity/dissimilarity (71% of explanations) or similarity/dissimilarity of answers they had given about the diagrams represented (29% of explanations).

Students whose explanations were based on conceptual similarity/dissimilarity were significantly more likely (p < .001) to say the questions were the same than students whose explanations were based on answer similarity/dissimilarity (84% and 65%, respectively).

![Figure 2: Student Explanations for Why the Questions Were the Same or Different](image)

3 SAMPLE STUDENT EXPLANATIONS

Same Because They Had the Same Answers

"Because they have the same denominator and numerator."

Same Because They Are Conceptually the Same

"Because the sign is the 'V' and the cat is the 'X'."

"They both have the same numerator of quarters and the numerator and the fraction are also in the same place."

"Because one is in a game number line and one is a regular number line."

Different Because They Had Different Answers

"Because the answers are different."

Different Because They Are Conceptually Different

"Question 1 is a fraction and Question 2 is a mixed number."

"Because one is on a number line and the other isn't."

"Because they are in different parts."

![Figure 3: Student Explanations for Why the Questions Were the Same](image)

4 IS SEEING THE CONNECTION RELATED TO PERFORMANCE?

There was a significant difference in the percentage of students who saw the connection (p < .001) between students who correctly identified the fraction represented in both images and students who incorrectly identified one or both fractions. While 85% of the students who got both answers correct stated that the two questions were the same, only 83% of students who got one or both answers incorrect stated that the two questions were the same.

However, as indicated by the bar portion of the first bar in Figure 3, 47% of students who said the questions were the same based on concept similarity actually gave different answers to the two questions. Additionally, 11% of students who said the questions were the same based on answer similarity actually gave different answers to the two questions.

![Figure 4: Breakdown of Common Errors and Student Explanations for Those Errors](image)

5 STUDENT MISCONCEPTIONS

Figure 4 shows that more than half the students (58%) made errors, 39% of errors were partitioning errors and 19% were unitizing errors. While most explanations were vague (e.g., "It counted" or "Because"), 35% of the students who made partitioning errors specifically explained that they counted bars (rather than spaces) and 55% of students who made unitizing errors specifically explained that they counted all the way to the end rather than stopping at the end of the unit.

![Figure 5: Student Answers to Why the Questions Were the Same](image)

6 SUMMARY

- 76% of students said the questions were the same.
- 71% of explanations for the similarity/dissimilarity were conceptual.
- Students who gave conceptual explanations were significantly more likely to say the questions were the same (p < .001).
- Students who got both answers correct were significantly more likely to say the questions were the same (p < .001).
- 39% of students who said the questions were the same gave different answers.
- 58% of students made errors (39% of errors were partitioning, 19% were unitizing).
- 35% of students who made partitioning errors said they counted bars.
- 52% of students who made unitizing errors said they counted all the way to the end.

Takeaway 1: Most students saw the connection between solving levels in an educational video game and solving problems on a math test, but some students thought the problems represented different concepts.

Takeaway 2: While most student explanations for how they arrived at their answers were not very informative, a number of students whose responses were coded as exemplifying one of the two main misconceptions we had identified gave an explanation that matched our expectations.