

GENERATING A FOLLOW-UP PROBLEM TO CONFIRM STUDENT THINKING AND UNDERSTANDING: WHAT CAN PRESERVICE TEACHERS DO?

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BACKGROUND

- **Posing an additional problem:** Posing an additional problem to confirm or learn more about student thinking is a strategic move that teachers can make when eliciting student thinking.
 - Teachers need to attend to critical features in tasks to strategically choose what to maintain and what to vary in order to meet particular goals (e.g., posing an additional problem to confirm a student's process).
 - It draws upon mathematical knowledge for teaching (Ball, Hoover, & Phelps, 2008)
- **Simulation:** A situation that represents a context of practice with fidelity and elicits authentic professional work. Used in the preparation of professionals in other fields. Focus on the doing of teaching while standardizing important contextual factors that impact both teaching and ability to appraise its quality.

RESEARCH FOCUS

- What skills do preservice teachers have with generating a follow-up problem to confirm a particular student's thinking?
- What rationales do preservice teachers articulate for the follow-up problem that they generated?

METHODS

- **Participants:** 39 preservice teachers in three cohorts in a two-year elementary teacher preparation program: pre-admission (Pre-admits), beginning of year 1, and beginning of year 2.
- **Simulation assessment:** Preservice teachers interact with a simulated student.

Student Role Protocol to Standardize the Assessment

The student's process: Uses marked squares to find the number of squares in one row and then skip counts by that number (Battista et al., 1998).

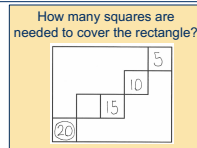
The student understands: Not all of the individual unit squares need to be marked to determine the number of squares needed to cover the rectangle.

- Analyzed the follow-up problems and articulations focusing on:
 - To what degree the follow-up problem confirms the particular student's thinking;
 - Mathematical features of the follow-up problem;
 - Rationale for maintaining or changing certain features in the original task

SIMULATION ASSESSMENT

Preservice teachers engage in three parts:

- **Preparation:** Preparing for an interaction with a standardized student about a specific piece of student work.
- **Simulation:**
 - Eliciting and probing the standardized student's thinking to understand the steps taken and the student's understanding of the key mathematical ideas.
 - The standardized student will solve an additional problem during the simulation, if they are asked to do so.
- **Interview:**
 - If a preservice teacher asked the student to solve an additional problem during the simulation:
 - Why did you choose to pose a problem?
 - Why did you choose to pose **that** problem?
 - Preservice teachers are asked to pose a follow-up problem to confirm student thinking, and articulate "How would the problem confirm the student's process?"



FINDINGS

- 79.5% of study participants generated a follow-up problem that could be used to fully confirm the student process.
- Only 3 preservice teachers posed a follow-up problem during the simulation, one of these problems could be used to fully confirm the student's process.
- Preservice teachers changed features of the original task in four ways to confirm the student's process or to see if the student would use the same process on an extension problem:
 - Changed the dimensions of the rectangle (Fig.1)
 - Added gaps between squares (Fig.2)
 - Created composite shapes (Fig.3)
 - Changed the orientation of the rectangle or diagonal of squares (Fig.4)

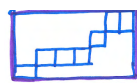


Fig.1



Fig.2



Fig.3

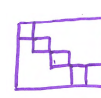


Fig.4

FINDINGS

- **Articulating rationales for maintaining or changing the features of the original task:**
 - 69% of the preservice teachers focused on confirming one core step of the student's process: counting by rows.
 - "I put two squares in the same column. I want to see if the student can still count by rows."
 - Other steps of the student's process that preservice teachers intended to learn about:
 - Whether the student would continue to skip count when the row does not have 5 unit squares
 - "I feel that 5 is easy, but counting by 4 is harder and needs more thinking."
 - Whether the orientation or path of squares affects the student's ability to count by rows
 - "I put the square here (left top) to see if the student will still know to record the sum in this box. Because the box is on the right (in the original problem), which is easy to record the sum when you count from left to right."
 - Whether gaps between squares matter
 - "All connected are easy to count. I wanted to see if the student can do the same with spaces."
 - Whether the strategy can be adjusted to account for changes in rows (e.g., composite shapes).
 - "I will see if the student will see how many squares make up each row. It will be interesting to see if they would notice the differences of squares (3x3 on top of 5x2). See if they will go 'there is 3 plus 3 plus 3 and then the rows are 5.' Or if they will go '3, 3, 3, 3, 3.'"
- While only 27% of Pre-admits provided a plausible rationale which was aligned with the changes that they made, 73% of beginning of Year 2 preservice teachers were able to do so.

CONCLUSIONS

- Many preservice teachers are able to generate follow-up problems for a particular purpose (e.g., fully confirm student process), but they do not always generate them when eliciting and probing student thinking.
- Most preservice teachers focused on confirming one core step of the student's process by either maintaining or changing some features of the original problem. These changes sometimes resulted in an easier or more difficult problem.
- Further studies might examine skill in generating follow-up problem for a range of content or instructional experiences that support the development of such capabilities.

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