

DESIGNING SIMULATIONS FOR ELICITING STUDENT THINKING: IS IT POSSIBLE TO DESIGN A COMPREHENSIVE STUDENT PROFILE?

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PME-NA • St. Louis, MO • November 17, 2019



The research reported here was supported by the National Science Foundation, through a grant to the University of Michigan. The opinions, findings, and recommendations expressed are those of the authors and do not represent views of the National Science Foundation.



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BACKGROUND

We conduct research on:

- the design of simulations (approaches to design, how different design features impact performance)
- the enactment of simulations (challenges of standardization in interactive contexts, training materials that would support others in using simulations)
- the capabilities that preservice teachers have with eliciting and interpreting student thinking and how such capabilities change over time
- the connections between skill with teaching practices and knowledge of content

WHY DO WE USE SIMULATIONS?

Simulations are approximations of practice that can be used for both assessing and supporting ongoing learning.

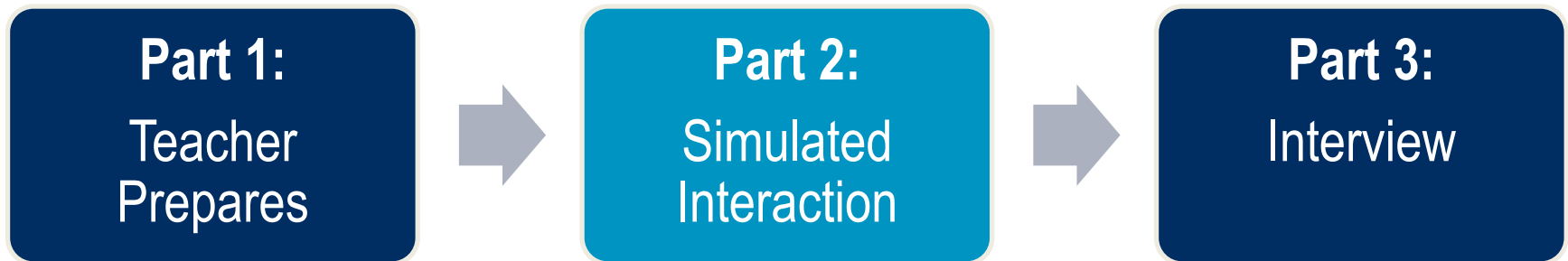
Simulations:

- engage participants in authentic demands of practice
- strategically hold still some elements of the practice-based situation
- are common in many professional fields
- can provide information that is difficult to access in the context of classroom practice

WHAT DO WE MEAN BY SIMULATIONS?

Our simulations:

- are designed around a specific piece of student work
- involve a teacher educator taking on the role of a student
- include a detailed student profile to support standardization of the student
- consist of three parts (eliciting takes place in Part 2)



A SAMPLE SIMULATION



Which fraction is greater: $\frac{3}{7}$ or $\frac{2}{5}$

$$\frac{3}{7} = \frac{6}{14} \quad \frac{2}{5} = \frac{6}{15}$$

$$\frac{6}{14} > \frac{6}{15}$$

$$\text{So: } \frac{3}{7} > \frac{2}{5}$$

TWO QUESTIONS WE'VE EXPLORED

1. How well does the student profile cover the range of questions that preservice teachers (PSTs) ask during the simulation?
 - Investigating the match between the student profile design and questions actually posed by PSTs
2. How standardized are “student” responses during the simulation?
 - Investigating the match between the student profile design and enacted “student” responses

WHY DOES IT MATTER TO HAVE A COMPREHENSIVE STUDENT PROFILE?

- We use simulations as a regular part of our teacher education program for both assessment and learning opportunities
 - Want to make sure that all PSTs will actually encounter the designed scenario
 - Want to make sure that PSTs have opportunities to do similar eliciting work (e.g., ensure the student doesn't "give away" more than is elicited)
- Need to support teacher educators to enact the student role consistently and reliably
 - Interest in growing the use of simulations beyond our project
 - Need to know that simulation designs can be reliably recreated by other teacher educators

STUDY DATA

- Context:
 - We administered the same simulation assessment in April 2016 and April 2017
 - This was a regular program assessment at the end of Year 1 of 2 in an undergraduate elementary TE program
- Participants:
 - 36 elementary PSTs
 - 4 teacher educators from other institutions trained to carry out the role of the “student”

STRUCTURE OF THE STUDENT PROFILE

Student Work

*Mathematics task
presented to the student:*

Which fraction
is greater:
 $\frac{3}{7}$ or $\frac{2}{5}$

$$\frac{3}{7} = \frac{6}{14} \quad \frac{2}{5} = \frac{6}{15}$$
$$\frac{6}{14} > \frac{6}{15}$$

So: $\frac{3}{7} > \frac{2}{5}$

Sections of the Student Profile

- General guidance describing:
 - The student's process
 - The student's understanding of key ideas underlying the process
 - General "ways of being"
- Specific scripted responses to anticipated questions

GENERAL GUIDANCE

$$\frac{3}{7} = \frac{6}{14} \quad \frac{2}{5} = \frac{6}{15}$$
$$\frac{6}{14} > \frac{6}{15}$$

So: $\frac{3}{7} > \frac{2}{5}$

- **The student's process:** The student is using the common numerator method to compare fractions.
 - To determine which numerator to use, the student finds the least common multiple of the numerators of the original fractions.
 - The student generates equivalent fractions by multiplying the numerator and denominator of each fraction by the same number.
 - Once equivalent fractions with common numerators have been found, the student compares the denominators to determine which fraction is larger.

GENERAL GUIDANCE

$$\frac{3}{7} = \frac{6}{14} \quad \frac{2}{5} = \frac{6}{15}$$
$$\frac{6}{14} > \frac{6}{15}$$

So: $\frac{3}{7} > \frac{2}{5}$

- **The student's understanding of the ideas involved in the problem/process:**
 - The student knows you have to multiply (or divide) the numerator and denominator by the same number to generate an equivalent fraction but does not understand why that process works.
 - Once the student has common numerators, the student understands that when you have the same number of pieces, you can use the denominator to determine which fraction has larger pieces and therefore which fraction is larger.

GENERAL GUIDANCE

$$\frac{3}{7} = \frac{6}{14} \quad \frac{2}{5} = \frac{6}{15}$$
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So: $\frac{3}{7} > \frac{2}{5}$

- **Other information about the student's thinking, language, and orientation in this scenario:** The student knows of other strategies for comparing fractions, but the student thinks that the common numerator methods works best with the given example.
- **The student's way of being:** The standardized student gives the least amount of information that is still responsive to the PST's question.

$$\frac{3}{7} = \frac{6}{14} \quad \frac{2}{5} = \frac{6}{15}$$

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SCRIPTED RESPONSES

PST prompt	Response
What did you do first?"	"I wanted to change the fractions so that there would be something in common."
Asks about how 6 was identified as the common numerator	"I wanted the numerator to be 6 because it was the least common multiple."
"Why can you compare fractions by comparing the denominators when the numerators are the same?"	"When you make the numerators the same it means you have the same number of parts so all you need to think about is how big the parts are."
"Why is 6/14 greater than 6/15?"	"Fourteenths are larger than fifteenths."

TRAINING FOR THE “STUDENT”

- Teacher educators taking on the role of the student received the complete student profile document in advance (could take the time to read through it, could also reference it during and after the training)
- 2 hours of training that includes:
 - Discussion of video examples
 - Discussion of common questions
 - Multiple opportunities to practice enacting the student role

METHODS OF ANALYSIS

- Examined video records of 36 simulations
- Using Studiocode © software, we parsed videos of simulations into “instances” containing a question posed by a PST and the “student’s” response
- Each instance assigned one of three codes:

Scripted response available	No scripted response, but guidance available	Guidance not available
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- Two coders independently coded each video; disagreements were discussed to reach consensus

CODING SCHEME

Code	Definition	Example
Scripted response available	A scripted response exists in the student role protocol that could be used to respond to the question posed by the PSTs	PST: “Why is $6/14$ greater than $6/15$?” Student: “Fourteenths are larger than fifteenths.”

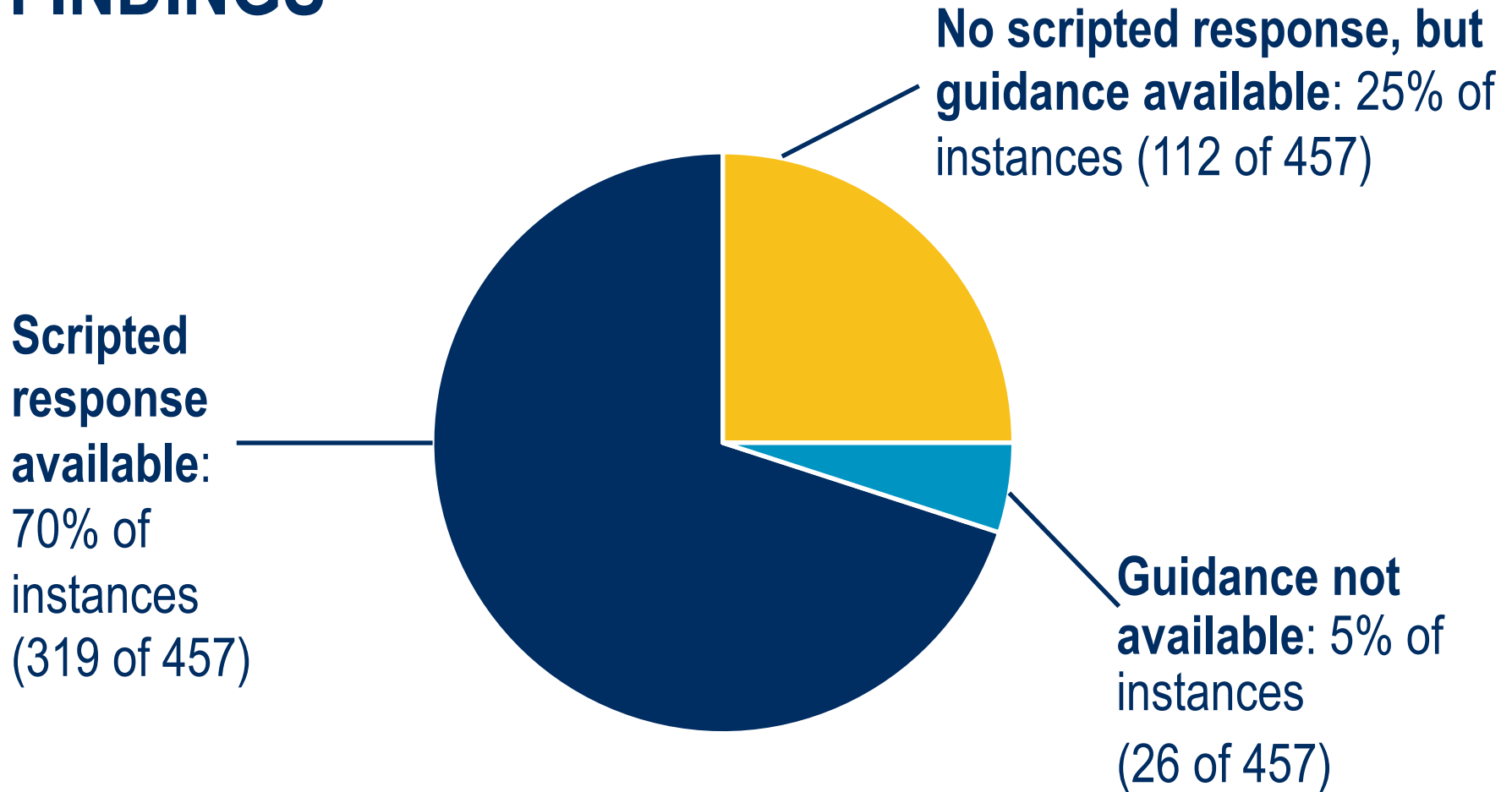
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No scripted response, but guidance available	No scripted response exists in the student role protocol that could be directly used to respond to the question posed by the PST; however, the general guidance provides information about the student thinking that might be used in response	PST asks student to compare $3/4$ and $4/5$. Student applies the same process to new numbers.

CODING SCHEME

Code	Definition	Example
Scripted response available	A scripted response exists in the student role protocol that could be used to respond to the question posed by the PSTs	PST: “Why is $\frac{6}{14}$ greater than $\frac{6}{15}$?” Student: “Fourteenths are larger than fifteenths.”
No scripted response, but guidance available	No scripted response exists in the student role protocol that could be directly used to respond to the question posed by the PST; however, the general guidance provides information about the student thinking that might be used in response	PST asks student to compare $\frac{3}{4}$ and $\frac{4}{5}$. Student applies the same process to new numbers.
Guidance not available	There is no scripted response in the student profile that can be used to respond to the PST’s question and no guidance for responding to the student is available in the general guidance section	PST: How do you feel about fractions? Are fractions hard for you? Student: I feel okay about fractions.

FINDINGS



CONCLUSIONS

- The student profile provided some form of guidance for 95% of instances. This suggests:
 - It is possible to design a comprehensive student profile.
 - It is still necessary to have a live simulated student.
- We have also explored fidelity of implementation of the student profile using this same data set; results suggest a high degree of fidelity (in preparation).

LIMITATIONS AND FUTURE DIRECTIONS

- Findings are limited to the range of questions posed by PSTs at one university at one point in time (following coursework that emphasizes eliciting and interpreting student thinking).
- Additional research is needed to explore the extent to which the student profile provides sufficient guidance for questions posed by PSTs more broadly and by PSTs at different stages in teacher education.