Assessing Pre-service Teachers' Enacted Mathematics Teaching Practice Through Simulations

Timothy A. Boerst, Meghan M. Shaughnessy, Laurie Sleep, Deborah Loewenberg Ball

University of Michigan

National Council of Teachers of Mathematics
April 24, 2012

SCHOOL OF EDUCATION UNIVERSITY OF MICHIGAN

Overview

1. Framing
2. An eliciting and interpreting assessment
3. Assessing pre-service teachers' eliciting performance
4. Assessing pre-service teachers' interpreting performance
5. Benefits and challenges of assessment simulations of enacted practice

1. Framing

Assessment in teacher education

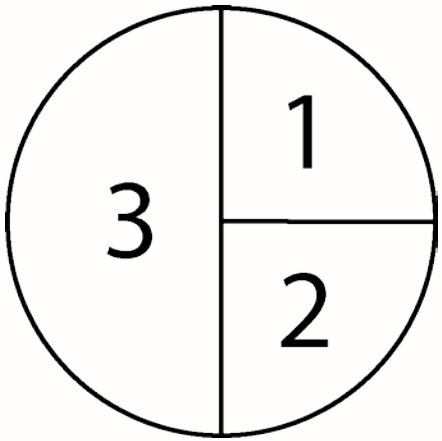
- Call for teacher education that focuses more directly on specific practices of teaching (Ball & Forzani, 2009; Grossman et al., 2009; Lampert & Graziani, 2009)
- Current assessment in teacher education
- Common assessments:
  - Develop elaborate lesson plans or units
  - Write detailed reflections on teaching or observations of students
  - Compile a portfolio that includes artifacts such as student work
  - Observations in practicum and student teaching
- Methods offer information about how pre-service teachers think about teaching
- Limited evidence of pre-service teachers' skill with enactment of specific teaching practices
- Need for assessments that evaluate the enactment of practice – "assessments of enacted practice"

Assessments of enacted practice

- Based on actual performance, appropriate to the practice being assessed
- Entail, capture, and enable the appraisal of the doing of teaching
- Conducted in a variety of settings, depending on the practice: real classrooms, in "performance centers", through simulations; some live and some scored through records of practice

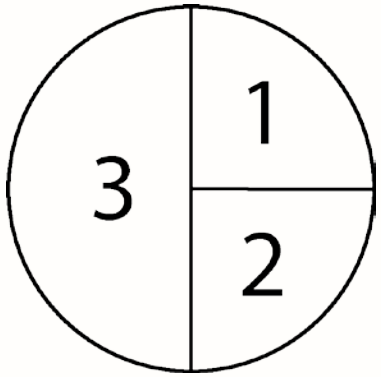
Context of video

- 4th grade probability lesson
- Introduction to a spinner experiment



Question: When you spin the spinner, is any number more likely to come up than any other number? Why do you think so?

Video



Discussion

- What components of eliciting and interpreting might we look for in an assessment of pre-service teachers' skill with respect to these practices?
- Components of proficient practice may include:
  - Being purposeful and strategic with questions
  - Focusing on pertinent mathematics
  - Demonstrating understanding and use of students' ideas
  - Using appropriate tone and manner

Benefits of assessing enactment

- Focuses design and enactment of learning opportunities on the doing of teaching
- Conveys that teaching practice "counts"
- Strengthens the connection to student learning by focusing on high-leverage practices and assessing pre-service teachers' skills with those

Challenges of assessing enactment

- Articulating the specific practices to be assessed
- Developing assessment tasks that can elicit the intended practice(s)
- Ensuring fairness with respect to what is being appraised and the teaching contexts in which it is appraised
- Constructing criteria that address the complexities in teaching and evaluating practice
- Creating assessment tasks, tools, and contexts that are efficient and sustainable
- Understanding whether performance in a particular instance of teaching practice will generalize to other performances

Context for our work

- Redesigning teacher education at UM
  - High-leverage teaching practices
  - Content knowledge for teaching
  - Professional ethics
- Designing assessments of enacted practice for math methods courses that include a variety of:
  - High-leverage practices
  - Contexts
  - Forms
  - Purposes

Challenges of assessing enactment in "real" contexts

- Ensuring fairness with respect to:
  - What is being appraised
  - The teaching contexts in which it is appraised
- Creating assessment tasks, tools, and contexts that are:
  - Targeted and tailored to key mathematics
  - Reliably used by a range of assessors
  - Usable at scale

How might these challenges be managed in the design of assessments of practice?

Assessing enactment in simulations

Assessments of enacted practice:

- Based on actual performance, appropriate to the practice being assessed
- Entail, capture, and enable the appraisal of the doing of teaching

Simulations can be used that:

- Occur outside of a "real" context of practice, which allows for standardization
- Fix content, student responses, and/or resources that are variable in "real" contexts
- Include essential conditions for enacting the practice being assessed

2. An eliciting and interpreting student thinking assessment

Eliciting and interpreting assessment

Context

- **Focus:** eliciting and interpreting student thinking with particular mathematics content
- **Timing*:*** happening mid-program; after significant course-work that includes a focus on eliciting and interpreting student thinking

Assessment overview

A pre-service teacher:

- Interacts with a "standardized student" about a sample of student work
- Responds to a series of follow-up questions to ascertain:
  - Her/his interpretation of the student's thinking
  - Her/his hypothesis about how the student would perform on a similar task

How is evidence of practice obtained?

The pre-service teacher:

1. **Analyzes students' work on fraction tasks**

Example task

A student is trying to solve the addition problem: $\frac{2}{3}+\frac{1}{5}$

The student writes: $\frac{2}{3}+\frac{1}{5}=\frac{3}{8}$

a) Find the correct answer

b) Describe the steps the student likely took to reach his/her answer

c) Provide a brief mathematical explanation as to why the student's method is not mathematically valid

How is evidence of practice obtained?

The pre-service teacher:

1. Analyzes students' work on fraction tasks
2. **Prepares for an interaction with a standardized student about one piece of student work**

Your goal is to elicit and probe to find out both what the "student" did to produce the answer as well as why she performed the particular steps.

$$9\frac{2}{10}$$
$$-\ 6\frac{7}{10}$$
$$2\frac{5}{10}$$

Correct answer, unclear basis

$$9\frac{2}{10} = 8 + \frac{2}{10} + \frac{10}{10} = 8\frac{12}{10}$$
$$8\frac{12}{10} - 6\frac{7}{10} = 2\frac{5}{10}$$

Valid method

$$9 - 6 = 2$$
$$\frac{2}{10} - \frac{7}{10} = \frac{5}{10}$$

Basic facts errors & subtracting up

$$\begin{array}{r} 8\ 12 \\ \cancel{9}\ \frac{2}{10} \\ -\ 6\frac{7}{10} \\ \hline 2\frac{5}{10} \end{array}$$

Overgeneralizing

How is evidence of practice obtained?

The pre-service teacher:

1. Analyzes students' work on fraction tasks
2. Prepares for an interaction with a standardized student about one piece of student work
3. **Probes the standardized student's thinking to understand the steps she took as well as why she performed the particular steps**

A Standardized Student

Developed response guidelines focused on:

- What the student was thinking such as
  - Overgeneralized the standard algorithm for whole number subtraction
- General orientations towards responses such as
  - Talk procedurally
  - Give the least amount of information that is still responsive to the question
- Responses to anticipated questions such as
  - "So tell me what you did" - restate the problem and answer




How is evidence of practice obtained?

The pre-service teacher:

1. Analyzes students' work on fraction tasks
2. Prepares for an interaction with a standardized student about one piece of student work
3. Probes the standardized student's thinking to understand the steps she took as well as why she performed the particular steps
4. **Responds to questions about her/his interpretation of the student's thinking, including predicting the student's response on a similar task**

Questions

a) Briefly describe what was learned about the student's thinking

b) Predict how the student would solve a similar problem

$$\begin{array}{r} 7\frac{1}{9} \\ -\ 2\frac{4}{9} \\ \hline \end{array}$$

c) Explain prediction using evidence from the interview

3. Analysis and discussion of pre-service teachers' eliciting performances

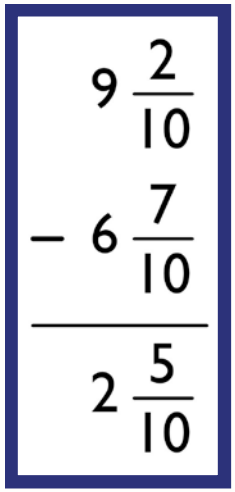
What is being assessed about the eliciting?

Evaluate whether the pre-service teacher:

- Launched the interaction with a question that was neutral, open, and focused on student thinking
- Elicited the specific steps of the student's process
- Attended to the student's ideas in follow-up questions
- Used appropriate tone and manner

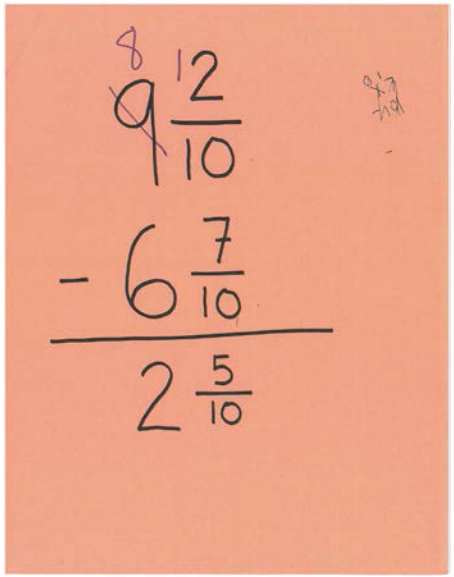
Not assessed:

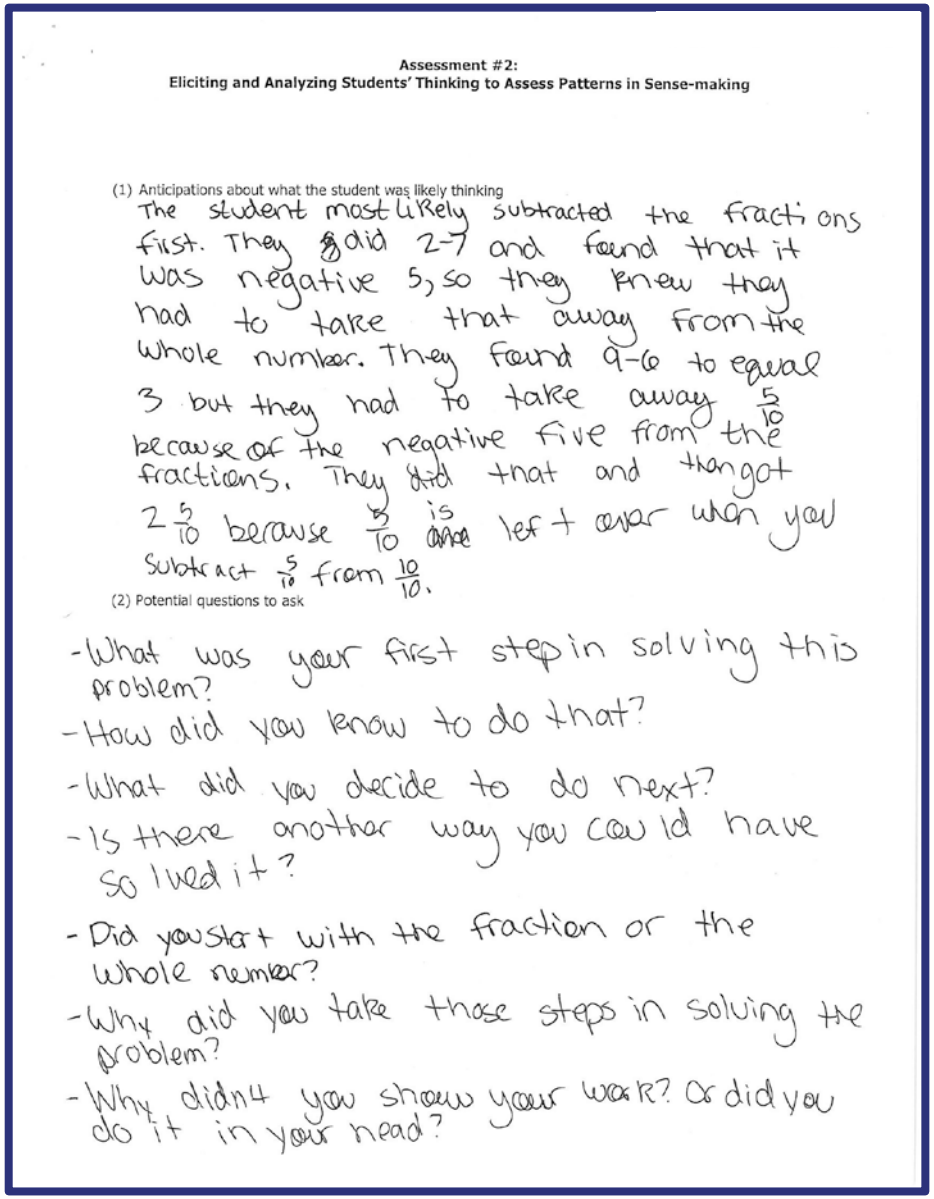
- Established an environment in which the student was comfortable sharing his/her thinking
- Monitored the rest of the class while working with an individual student



Use the scoring tool to appraise the pre-service teacher's eliciting.

An eliciting performance #1





Assessment #2:
Eliciting and Analyzing Students' Thinking to Assess Patterns in Sense-making

(1) Anticipations about what the student was likely thinking

The student most likely subtracted the fractions first. They did 2-7 and found that it was negative 5, so they knew they had to take that away from the whole number. They found 9-6 to equal 3 but they had to take away $\frac{5}{10}$ because of the negative five from the fractions. They did that and then got $2\frac{5}{10}$ because $\frac{5}{10}$ is left over when you subtract $\frac{5}{10}$ from $\frac{10}{10}$.

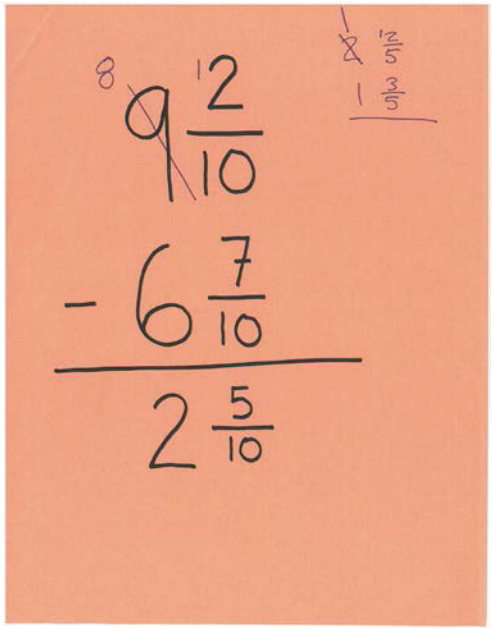
(2) Potential questions to ask

- What was your first step in solving this problem?
- How did you know to do that?
- What did you decide to do next?
- Is there another way you could have solved it?
- Did you start with the fraction or the whole number?
- Why did you take those steps in solving the problem?
- Why didn't you show your work? Or did you do it in your head?

Discussion question

- What questions do you have about the task, the scoring tool, or the context of the assessment?

Another eliciting performance



Focal questions

- What aspects of teaching practice are observable in the assessment?
- How do the two performances differ?

On the note cards provided at your table, please comment on the following question:

- How might the assessment be modified to better capture the intended practice?

4. Analysis and discussion of pre-service teachers' interpreting performance

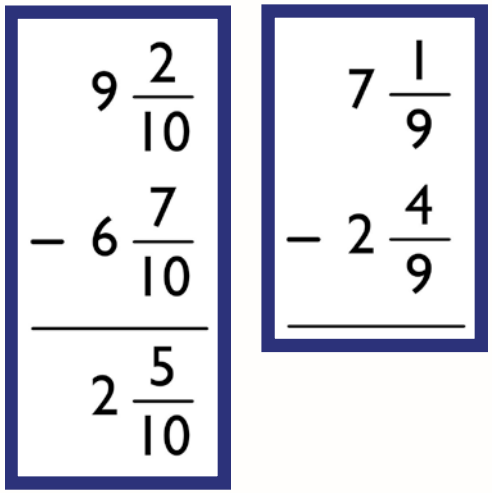
What is being assessed about interpreting?

Evaluate whether the pre-service teacher:

- Described accurately the elicited method
- Anticipated accurately the student's response to a similar problem
- Justified her/his anticipation with evidence from the video

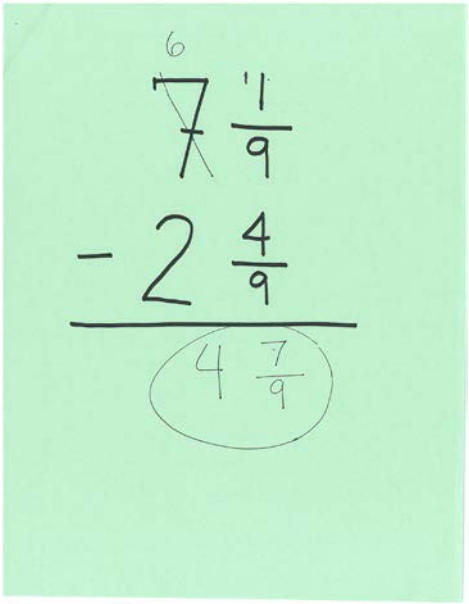
Not assessed

- Linked the interpretation to subsequent instruction or other purposes
- Interpretation of performance across multiple tasks



Use the scoring tool to appraise the pre-service teacher's interpretation.

Another interpreting performance



Focal questions

- What aspects of teaching practice are observable in this part of the assessment?

On the note cards provided at your table, please comment on the following question:

- How might the assessment be modified to better capture the intended practice?

4. Conclusions

Next steps

- Refining the logistics associated with simulations of enacted practice
- Harnessing the potential of assessments as opportunities for teacher educators' learning
- Developing "assessment prototypes" as a way to generate versions that address different patterns of student thinking and mathematics topics/strands
- Assuring through validation work that performance on the assessment simulation corresponds to performance in "real" teaching contexts

Conclusions

- Teacher education needs to assess the enactment of specific teaching practices.
- Because designing assessments of enacted practice has a number of inherent challenges, assessment simulations provide an important tool for assessing enacted practice.