INTERPRETING STUDENTS’ THINKING:
PRESERVICE TEACHERS’ INFERENCES AND
THEIR USE OF SUPPORTING EVIDENCE

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TAKING STOCK, AND TAKING RESPONSIBILITY
TAKING STOCK, AND TAKING RESPONSIBILITY

Skillful teaching is powerful. Unskillful teaching is dangerous.

Many, many children are being taught by underprepared beginning teachers.

Skillful teaching can be taught and learned.
ORIENTING PROFESSIONAL PREPARATION TO OUR STUDENTS

- Teaching should be oriented to the prior knowledge and skills of learners, at any level or any context
- This is just as true of teacher education
- Knowing what preservice teachers already believe, are inclined to do, and patterns can help make professional education more effective
CONSIDERING ONE TEACHING PRACTICE: INTERPRETING STUDENT THINKING

Characterizing what a student thinks based on evidence from the student’s words, actions, or writing

- Making qualified claims about valued outcomes that can be used as the basis for future action
- Using evidence to generate and test claims
- Matching the scope and nature of the claim to the amount and type of information available
- Actively working to prevent bias or distortion
- Developing or using appropriate criteria to focus or inform judgments

(Developed drawing on Stiggins, 2001)
FOCUSING ON INTERPRETING FROM THE BEGINNING OF TEACHER EDUCATION

Early attention to interpreting student thinking is crucial, because:

- People are likely to develop ways of doing this in everyday life
- Figuring out what students think is foundational to teaching
- Errors in focus, scope and/or evidence are likely to result in teaching that is less supportive of student learning
ASSESSING THE INTERPRETING OF PRESERVICE TEACHERS

Many methods can and have been used to assess the interpretive skill of preservice teachers, including:

- Analyzing written cases
- Applying rubrics to student work samples
- Scrutinizing classroom video
- Conducting student thinking interviews
- Producing a reflective essay based on an observation
USING STANDARDIZED SIMULATIONS TO ASSESS INTERPRETING

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

Simulations:
- Are commonly used in many professional fields
- Place authentic, practice-based demands on a participant
- Purposefully suspend or standardize some elements of the practice-based situation
- Can provide insights that are not possible or practical to determine in real-life professional contexts
SETTING THE STAGE FOR ELICITING AND INTERPRETING

The preservice teacher:

1. Prepares for an interaction with a standardized student about one piece of student work

Your goal is to elicit and probe to find out what the “student” did to produce the answer as well as the way in which the student understands the steps that were performed.

Correct answer, alternative algorithm, degree of understanding is unclear
SETTING THE STAGE FOR ELICITING AND INTERPRETING

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Your goal is to elicit and probe to find out what the “student” did to produce the answer as well as the way in which the student understands the steps that were performed.

How can the difference between the two numbers be re-established?

\[
\begin{array}{c}
784 \\
-315 \\
\hline
469
\end{array}
\]

Correct answer, alternative algorithm, degree of understanding is unclear
SETTING THE STAGE FOR ELICITING AND INTERPRETING

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HOW IS EVIDENCE OF ELICITING SKILLS AND MKT OBTAINED?

The preservice teacher:
1. Prepares for an interaction with a standardized student about one piece of student work
2. Interacts with the student to probes the standardized student’s thinking

A Standardized Student
Developed response guidelines focused on:

- What the student is thinking such as
  - Uses a method not conventional in the U.S. (but that is standard in many European and South American countries)
  - Applies the method correctly and has conceptual understanding of the procedure
- General orientations towards responses such as
  - Talk about digits in columns in terms of the place value of the column (e.g., 14 ones)
  - Give the least amount of information that is still responsive to the question
- Responses to anticipated questions
ELICITING STUDENT THINKING: VIEWING FOCUS

What opportunities exist to assess the preservice teacher’s skill with eliciting and mathematical knowledge for teaching?
ELICITING A STUDENT’S THINKING
ELICITING STUDENT THINKING: VIEWING FOCUS

What opportunities exist to assess the preservice teacher’s skill with eliciting and mathematical knowledge for teaching?

- Probes mathematics that is crucial for understanding the method
  - Does the student understand why adding 10 ones to the minuend and 1 ten to the subtrahend results in the same difference?
- Poses an additional task that is useful for confirming the student’s method

\[ \begin{array}{c}
14 \\
- 3215 \\
\hline
469
\end{array} \]

\[ \begin{array}{c}
13 \\
- 2376 \\
\hline
427
\end{array} \]
HOW IS EVIDENCE OF INTERPRETATION?

The teaching intern:
1. Prepares for an interaction with a standardized student about one piece of student work
2. Interacts with the student to probes the standardized student’s thinking
3. Responds to questions about her/his interpretation of the student’s thinking, including predicting the student’s response on a similar task

Interviewing about interpretations
Preservice teachers are asked to
- Summarize the student’s process
- Indicate what the student does and does not understand about the process
- Anticipate how the student would solve a similar problem
- Provide interpretations of understandings that are at the core of the process

761
- 342
INITIAL SKILL IN INTERPRETING STUDENT THINKING

Context:

- Simulation assessment (23 preservice teachers)
- Data collected during the first week of the teacher education program

Analyzing the nature and prevalence of interpretations:

- Focusing on mathematical process used by the student
- Focusing on the student’s understanding of the process
- Anticipating method and understanding of work on a similar problem
- Marshalling available evidence to support claims
SOME TYPES OF INTERPRETATIONS

Elicited information from interaction with “student”
SOME TYPES OF INTERPRETATIONS

- Elicited information from interaction with “student”
- Interpretations of “student’s” process and understanding
SOME TYPES OF INTERPRETATIONS

Elicited information from interaction with “student”

Evidence-based Interpretations

Interpretations of “student’s” process and understanding
PREVALENCE OF INTERPRETATIONS

0% (no preservice teachers)

50% (half of preservice teachers)

100% (all preservice teachers)

Describes the process (87%)
PREVALENCE OF INTERPRETATIONS

Based on your interaction with the student, how do you think the student would solve this problem if the student used the same process?

96% of preservice teachers correctly anticipated the student’s process.
PREVALENCE OF INTERPRETATIONS

0% (no preservice teachers)
50% (half of preservice teachers)
100% (all preservice teachers)

Anticipates the process (96%)
Describes the process (87%)
SOME TYPES OF INTERPRETATIONS

- Elicited information from interaction with “student”
- Core process and understanding
- Peripheral process and understanding

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PREVALENCE OF INTERPRETATIONS

0% (no preservice teachers)
50% (half of preservice teachers)
100% (all preservice teachers)

Indicates “core” understanding with evidence (4%)
PREVALENCE OF INTERPRETATIONS

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>(no preservice teachers)</td>
</tr>
<tr>
<td>50%</td>
<td>half of preservice teachers</td>
</tr>
<tr>
<td>100%</td>
<td>(all preservice teachers)</td>
</tr>
</tbody>
</table>

Indicates peripheral understanding with evidence (43%)
PREVALENCE OF INTERPRETATIONS

0% (no preservice teachers)

50% (half of preservice teachers)

100% (all preservice teachers)

Indicates understanding incorrectly (22%)
PREVALENCE OF INTERPRETATIONS

0%  (no preservice teachers)
50%  (half of preservice teachers)
100%  (all preservice teachers)

Indicates peripheral understanding with evidence (43%)
Indicates understanding incorrectly (22%)
Indicates “core” understanding with evidence (4%)
Anticipates the process (96%)
Describes the process (87%)
Indicates “core” understanding without evidence (22%)
PREVALENCE OF INTERPRETATIONS

What would the student understand about this [points to the little 5]?
PREVALENCE OF INTERPRETATIONS

Recognizes the need for more information before anticipating understanding (4%)

Anticipates understanding incorrectly* (35%)

Anticipates understanding with evidence (56%)

0% (no preservice teachers)

50% (half of teachers)

100% (all preservice teachers)

Understanding of digit values

96% of interns elicited evidence of understanding of digit values

* includes incorrect claims and making a claim without having gathered evidence
PREVALENCE OF INTERPRETATIONS

Why does the student change both the top and bottom numbers?
PREVALENCE OF INTERPRETATIONS

Recognizes the need for more information before anticipating understanding (4%)

0% (no preservice teachers)

Anticipates understanding correctly* (35%)

50% (half of teachers)

Anticipates understanding with evidence (56%)

100% (all preservice teachers)

Anticipates understanding with evidence (4%)

Recognizes the need for more information before anticipating understanding (30%)

Anticipates understanding incorrectly* (61%)

Understanding of compensation 30% of interns elicited evidence of understanding of compensation

Understanding of digit values 96% of interns elicited evidence of understanding of digit values

* includes incorrect claims and making a claim without having gathered evidence

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WHAT CAN BE LEARNED FROM THE SKILLS THAT NOVICES BRING?

This small study of preservice teachers at the outset of their TE experiences illustrates that:

1. Preservice teachers can use written work and interaction with a “student” as the basis for:
   a) Later describing the student’s process
   b) Anticipating the application of the process to a similar case

2. Preservice teachers may experience more challenges in interpreting a “student’s” understanding, such as:
   a) Identifying core components of understanding in need of attention
   b) Using evidence to support claims about understanding
   c) Remembering information that could be used as evidence for claims about core components of understanding
IMPLICATIONS FOR MATHEMATICS TEACHER EDUCATION

When teacher education is focused on the practice of teaching, we need:

- Information about the skills with teaching practices that novices bring to teacher education
- Ways of using such information to inform teacher education design
- Ways of thinking about how teaching practices are defined AND connected
- To better understand how the mathematical knowledge of teachers plays into interpreting students’ mathematical processes and students’ understanding of those processes