ASSESSING THE USE OF CONTENT KNOWLEDGE IN PRACTICE IN AN ELEMENTARY TEACHER EDUCATION PROGRAM

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THE CHALLENGE

- Beginning teachers need to develop skills and knowledge for responsible entry-level teaching.
- Students, parents, and schools need beginning teachers who are ready for classroom practice.
- Policymakers and critics demand rigorous assessments of early career teachers' effectiveness.
- The profession needs to establish appropriate means for verifying beginning teachers' skills and knowledge.

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WHAT DO ASSESSMENTS OF INTERNS' CAPABILITIES NEED TO BE LIKE?

- Assess entry-level practice: Actual skills and knowledge for <u>doing</u> teaching
- Provide information about interns' development and about instructional needs
- Be useful to interns and program instructors, and also demonstrate professional accountability and rigor to external stakeholders
- Use time efficiently and resources wisely

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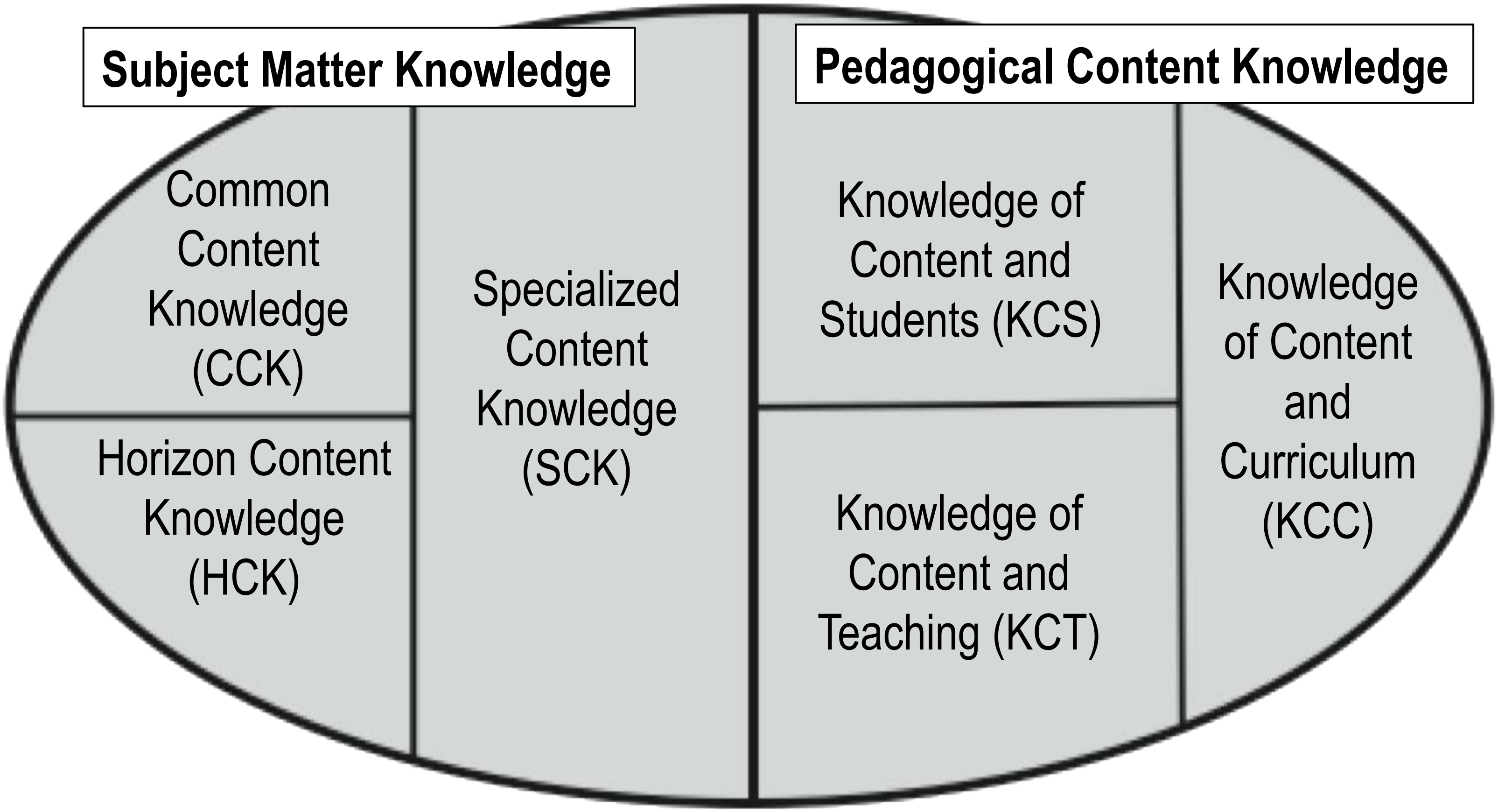
ASSESSING CONTENT KNOWLEDGE FOR TEACHING (CKT)



(Ball, Thames, & Phelps, 2008)

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ASSESSING CONTENT KNOWLEDGE AND TEACHING PRACTICES

Must also assess content knowledge as it is actually used in the work of teaching, for example:

- Choosing examples
- Posing questions
- Interpreting students' thinking and choosing what to say or do in response
- Explaining ideas to students
- Using representations and materials to show the meaning of disciplinary ideas to students
- Leading productive class discussions about and for engagement in disciplinary practices

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PROGRAM LEVEL ASSESSMENT

UM's redesigned Elementary Teacher Education Program includes program level assessment:

- Focus on the pillars of the program
  - ❑ High leverage teaching practices, content knowledge for teaching, and professional ethical obligations
- Serve multiple purposes
  - ❑ Gauge proficiency used for feedback to interns, instructional design, program effectiveness
- Involve and inform core stakeholders
  - ❑ Interns, instructors, program administrators, accrediting organizations
- Infused into the program at multiple points in time
  - ❑ Outset, midpoint, and conclusion of the program
  - ❑ Within courses and in designated assessment windows

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EXAMPLES OF PROGRAM LEVEL ASSESSMENTS

- Video demonstration of management practices
- Written introduction letter to families
- Simulation of eliciting and interpreting student thinking
- Analysis of instructional ethics/equity case
- Modification of lesson from curriculum materials
- Responses to multiple choice assessment of content for knowledge teaching
- Enactment of lessons and portions of lessons (like discussions)
- Surveys of views of teaching, learning, and learning to teach

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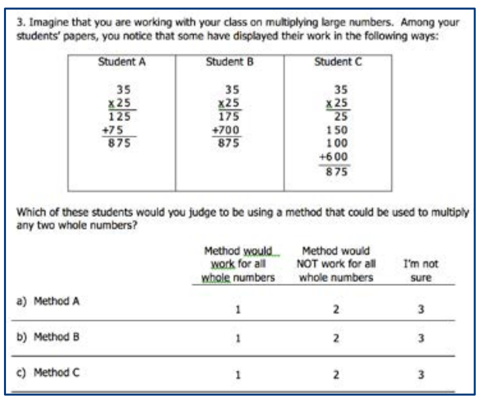
CONSIDERING EXAMPLE ASSESSMENTS

① Selected response assessment

② Simulation assessment

③ Field-embedded performance assessment



3. Imagine that you are working with your class on multiplying large numbers. Among your students' papers, you notice that some have displayed their work in the following ways:

Student A	Student B	Student C
35 x25 125 +75 875	35 x25 175 +700 875	35 x25 25 150 100 +600 875

Which of these students would you judge to be using a method that could be used to multiply any two whole numbers?

	Method would work for all whole numbers	Method would NOT work for all whole numbers	I'm not sure
a) Method A	1	2	3
b) Method B	1	2	3
c) Method C	1	2	3

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ATTENDING TO CKT THROUGH SELECTED RESPONSE ASSESSMENTS

Special thanks to Merrie Blunk for her analysis of the data shared in this section.

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ASSESSMENT OVERVIEW

Focus: Mathematical knowledge for teaching (MKT) for elementary grades Number Concepts and operations

- Common content knowledge (CCK)
- Specialized content knowledge (SCK)

Timing: As a pre-assessment at the beginning of the program; post-assessment at the end of the program

WHAT ARE INTERNS ASKED TO DO?

3. Imagine that you are working with your class on multiplying large numbers. Among your students' papers, you notice that some have displayed their work in the following ways:

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c) Method C	1	2	3

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WHICH OF THESE STUDENTS IS USING A METHOD THAT COULD BE USED TO MULTIPLY ANY TWO WHOLE NUMBERS?[1]

Student A	Student B	Student C
35	35	35
x25	x25	x25
125	175	25
+75	+700	150
875	875	100
		+600
		875

[1]Measures copyright 2001, Learning Mathematics for Teaching/Study of Instructional Improvement (SII)/ Consortium for Policy Research in Education (CPRE). Not for reproduction or use without written consent of SII. Measures development supported by NSF grants REC-9979873, EHR-0233456 and by a subcontract to CPRE on Department of Education (DOE), Office of Educational Research and Improvement (OERI) award #R308A960003.

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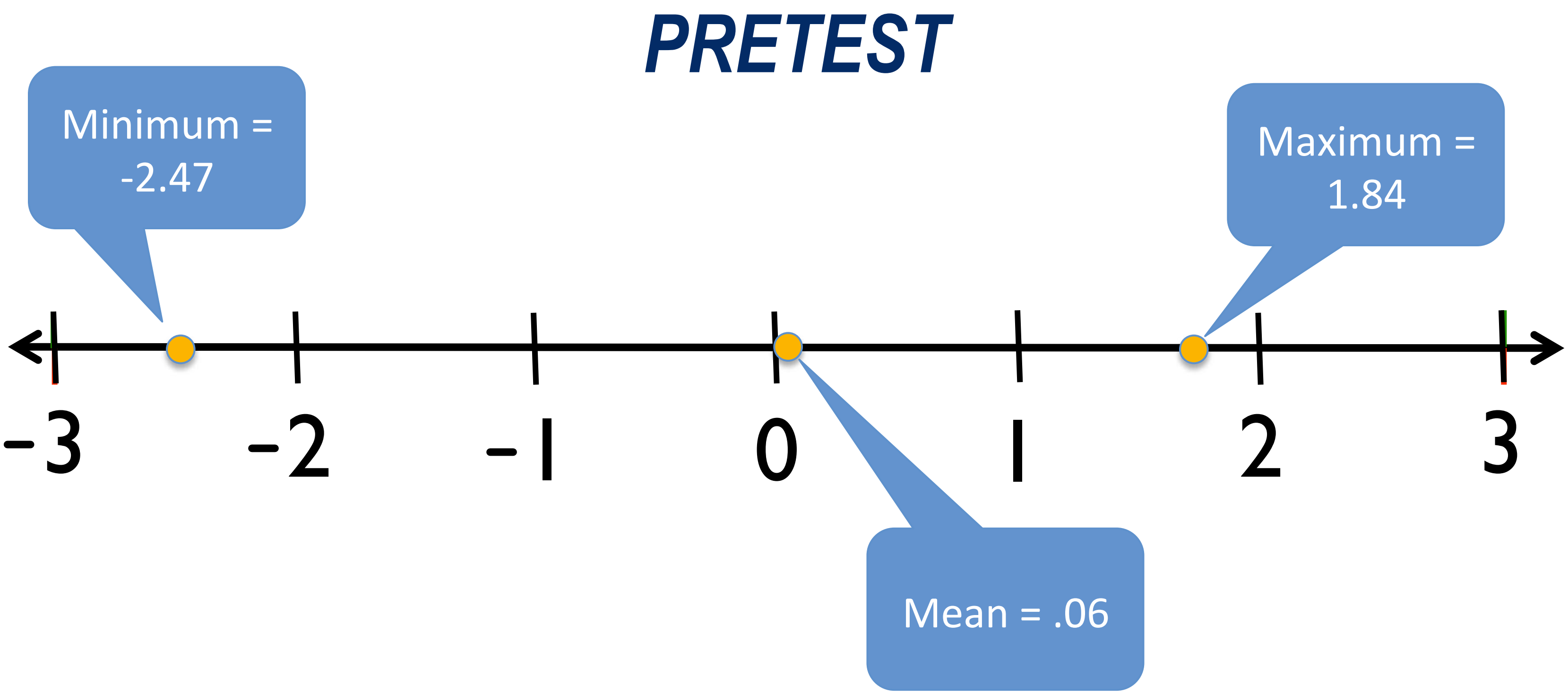
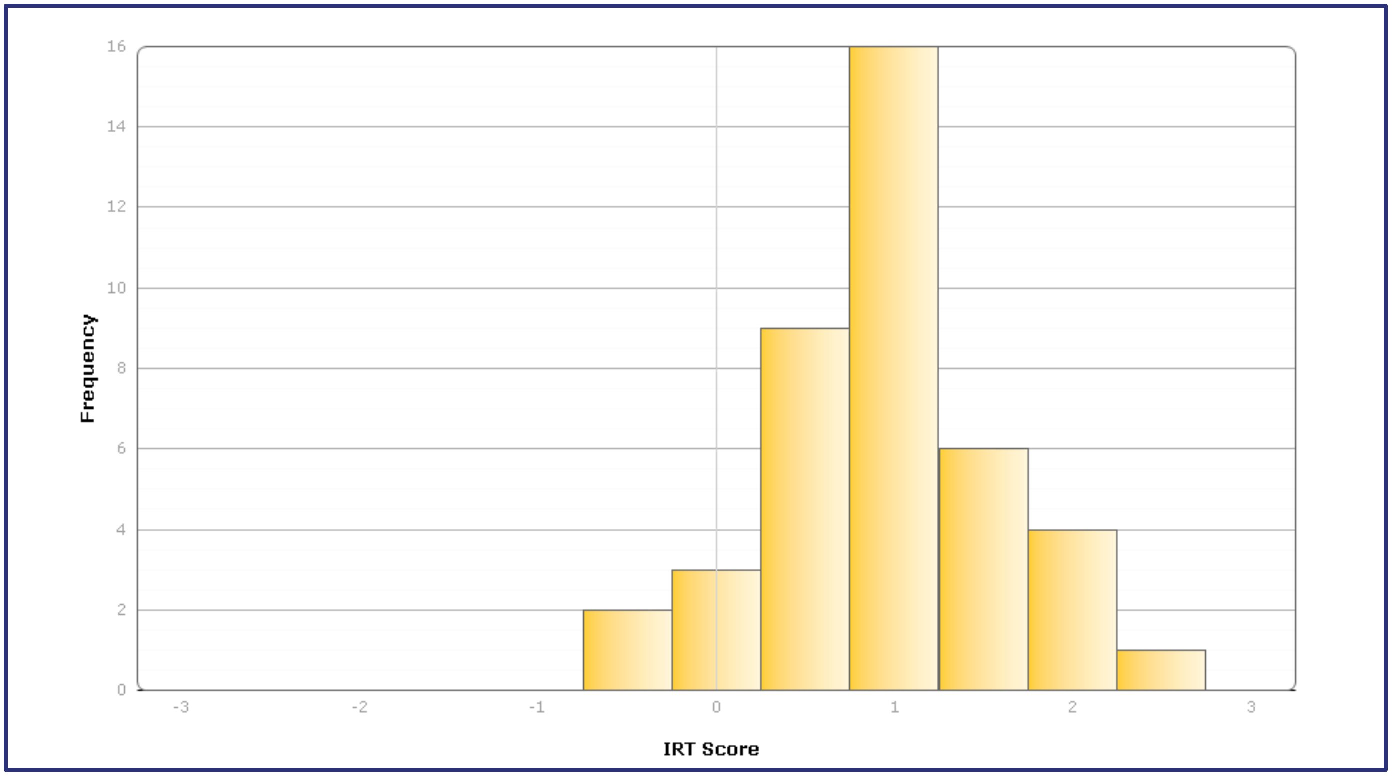
WHAT ARE WE LEARNING FROM THIS ASSESSMENT?



N=104 mean = .06 min= -2.47 max= 1.84 sd= 0.77

WHAT ARE WE LEARNING FROM THIS ASSESSMENT?

POST TEST



n=41 min= -0.557 max= 2.513 mean= 0.969 sd= 0.643

USING THIS TYPE OF ASSESSMENT

Using a selected response assessment allows us to:

- Assess the same CKT territory for all interns
- Understand the CKT of interns as a group, but not as reliable for understanding the CKT of particular interns
- Gather information for program level purposes

Using this assessment has revealed that our interns:

- Enter the program with MKT levels similar to the "average" U.S. teacher
- Gain about one standard deviation worth of MKT in the program
- Develop knowledge of science practices
- Perform differently depending on the type of problems or questions

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ATTENDING TO CKT THROUGH SIMULATION ASSESSMENT

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ELICITING AND INTERPRETING STUDENT THINKING

A core teaching practice: To find out what students know or understand, and how they are thinking/ reasoning

- Posing questions to get student to talk
- Listening to and hearing what student says
- Posing questions to probe
- Developing an idea of what student thinks
- Checking one's interpretation or pressing to learn more by extending or posing questions

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WHY TRY SIMULATIONS?

- **Standardization:** Appraises on-demand rather than at an intern's discretion
- **Parity:** Makes possible fairness with respect to specific contextual aspects
- **Detail:** Enables specification of content, situation, teaching "problem" to ensure that important aspects of teaching are being assessed

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ASSESSING SKILLS OF ELICITING AND INTERPRETING STUDENT THINKING

CONTEXT

- **Focus**: Eliciting and interpreting student thinking with particular mathematics content
  - Provides an opportunity to assess mathematical knowledge for teaching
- **Timing:** Mid-program; after coursework focused on eliciting and interpreting student thinking

ASSESSMENT OVERVIEW

An intern:

- Interacts with a “standardized student” about a sample of student work
- Responds to a series of follow-up questions to surface the intern’s
  - Interpretation of the student’s thinking
  - Hypothesis about how the student would perform on a similar task

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OPPORTUNITIES TO SEE MKT IN USE

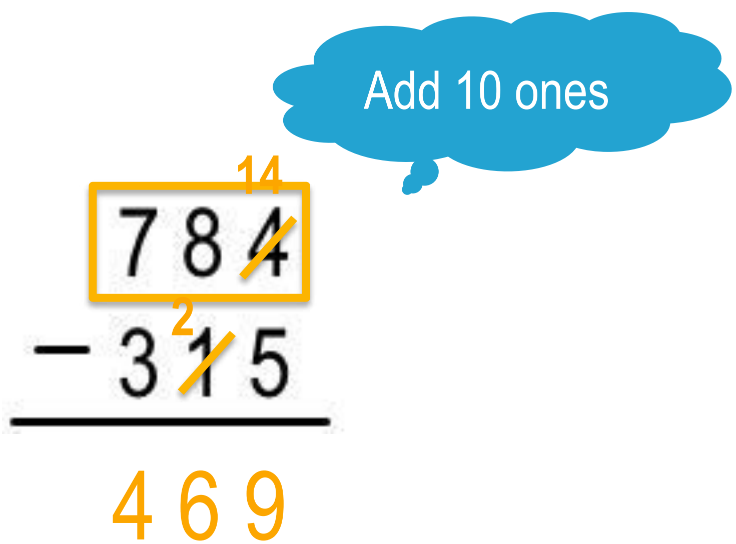
When we assess interns' skills with eliciting and interpreting a student's thinking, we can learn about their use of mathematical knowledge for teaching as they —

- Focus on specific elements of the mathematics in the problem
- Word particular questions
- Figure out an additional problem to probe the student's thinking
- Predict how a student might approach a similar problem

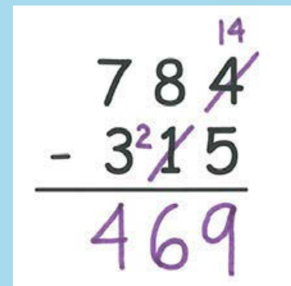
SETTING THE STAGE FOR ELICITING AND INTERPRETING

The intern:

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.



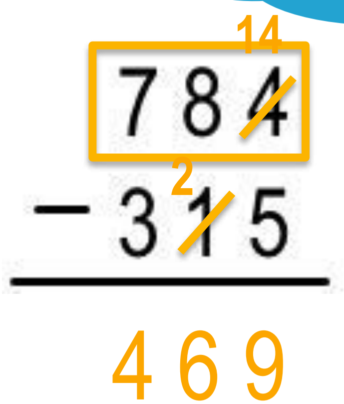
Correct answer, alternative algorithm, degree of understanding is unclear

SETTING THE STAGE FOR ELICITING AND INTERPRETING

The intern:

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

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



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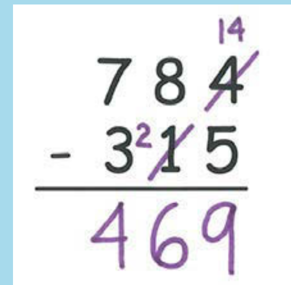
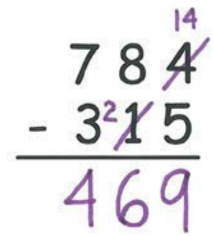


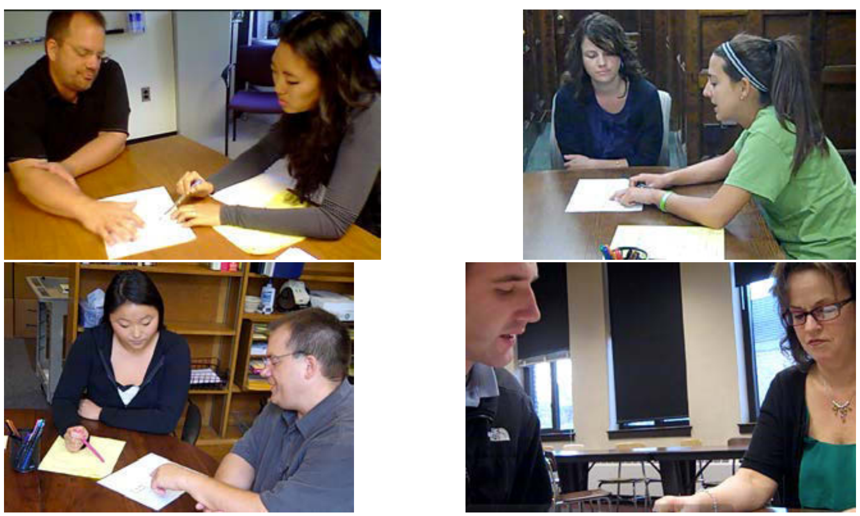
Correct answer, alternative algorithm, degree of understanding is unclear

HOW IS EVIDENCE OF ELICITING SKILLS AND MKT OBTAINED?



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**



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

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ELICITING STUDENT THINKING: VIEWING FOCUS

What opportunities exist to assess the intern's mathematical knowledge for teaching and what do you notice about his MKT?

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ELICITING A STUDENT'S THINKING

$$\begin{array}{r} {}^{14} \\ 7\;8\;\cancel{4} \\ -\;3\;{}^{2}\cancel{1}\;5 \\ \hline 4\;6\;9 \end{array}$$

$$\begin{array}{r} {}^{13} \\ 6\;5\;\cancel{3} \\ -\;2\;{}^{3}\cancel{7}\;6 \\ \hline 4\;2\;7 \end{array}$$

ELICITING STUDENT THINKING: VIEWING FOCUS

$$\begin{array}{r} 7\,8\,\overset{14}{\cancel{4}} \\ -\;3\,{}^{2}\cancel{1}\,5 \\ \hline 4\,6\,9 \end{array}$$

What opportunities exist to assess the intern's mathematical knowledge for teaching and what do you notice about his MKT?

- 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

$$\begin{array}{r} 6\,5\,\overset{13}{\cancel{3}} \\ -\;2\,{}^{3}\cancel{2}\,6 \\ \hline 4\,2\,7 \end{array}$$

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HOW IS EVIDENCE OF INTERPRETATION AND MKT OBTAINED?

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**

Questions with an MKT focus

a) Posing another mathematics task:
   - Another problem was posed: why were the numbers were selected
   - Another problem was NOT posed: identify a problem that would be useful and why

   Applying the student's method to a similar problem

$$\begin{array}{r} 761 \\ -\,342 \\ \hline \end{array}$$

b) Explain whether the method is generalizable and why

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INTERPRETING STUDENT THINKING: VIEWING FOCUS

What opportunities exist to assess the intern's mathematical knowledge for teaching and what do you notice about his MKT?

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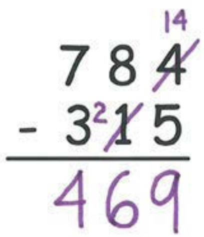
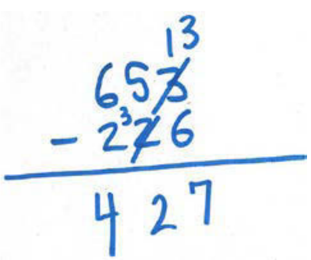
INTERPRETING STUDENT THINKING

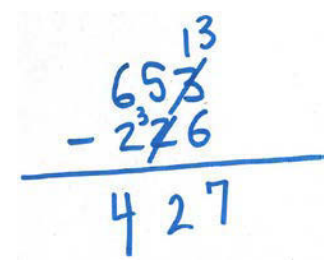




INTERPRETING STUDENT THINKING: VIEWING FOCUS

What opportunities exist to assess the intern's mathematical knowledge for teaching and what do you notice about his MKT?

- Mathematical justification for the additional task that was posed during the eliciting part
- Explanation for why the method always works



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USING THIS TYPE OF ASSESSMENT

Using a simulation of a teaching practice allows us to:

- Assess CKT and pedagogical skill with eliciting and interpreting
- Provide feedback to individual interns while also learning about the group as a whole
- Information to guide continued instruction and support

Learning from and about this assessment

- Reveals differences among interns with respect to generating mathematically similar problems
- Reaffirms that skill in eliciting does not necessarily translate into skill with interpreting
- This form of assessment provides substantial leverage on persistent challenges (time, resources, fairness, and judgment)
- Serves as a model for developing simulations of teaching practice in other subjects

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ATTENDING TO CKT THROUGH FIELD-EMBEDDED PERFORMANCE ASSESSMENT

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ASSESSMENT OF THE ABILITY TO SUPPORT STUDENTS' CONSTRUCTION OF EXPLANATIONS

CONTEXT

- **Focus**: Teaching a full science lesson
  - Provides an opportunity to assess scientific knowledge for teaching
- **Timing:** Third semester of a four-semester program; during science methods course
- **Location:** Occurs in intern's field placement classroom

ASSESSMENT OVERVIEW

A teaching intern:

- Analyzes and modifies an existing science lesson plan used in the field placement
- Teaches the science lesson to the students in the classroom
- Reflects, using video records, on the enactment of the lesson

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WHY ASSESS FIELD-EMBEDDED ENACTMENT?

- **Authenticity:** Appraises the use of CKT in actual teaching practice
- **Complexity:** Allows us to see how CKT is used in the intricacies of the classroom (rather than, for example, just looking at a lesson plan)

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HOW WE CAN LOOK FOR CKT IN ENACTMENT

Area of Strength	Area for Growth	Missed Opportunity	Standards for content knowledge for teaching
			1. Clearly and accurately **communicates and represents** the subject's **ideas, practices, and principles**. *(does not misrepresent or miscommunicate content)*
			2. Conveys understanding of the ways in which the **composite parts of complex disciplinary practices** work. *(does not convey that practices are too complex to understand or that the goal is to simply memorize and execute)*
			3. Supports learning experiences that **make the subject matter accessible and preserve its disciplinary integrity**. *(does not simplify ideas in ways that undermine the topic in order to make it easier to learn; does encourage engagement that is consistent with disciplinary norms)*
			4. Accounts for **patterns of student thinking** about the content. *(does not introduce or reinforce misconceptions through instructions, tasks, etc.)*
			5. **Steers ongoing learning** toward subject matter learning goals, including revoicing, interpreting, and following up on student thinking in ways that convey awareness of its subject matter implications. *(does not abandon substance as instruction unfolds)*
			6. Teaches in ways that are likely to **provide a firm disciplinary foundation** for subsequent learning. *(subsequent reteaching or other compensatory strategies are likely needed to address flaws in the subject matter as represented in instruction)*

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FEATURES OF "GOOD" CKT FOR SCIENCE

- Science ed reforms (e.g., Next Generation Science Standards) emphasize the fusion of…
  - Disciplinary core ideas
  - Scientific practices
  - Crosscutting concepts

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CONTEXT FOR THE VIDEO

- Seventh grade classroom
- Investigation focuses on identifying phyla for different organisms
  - Students and teacher co-construct investigation procedure
  - Students make observations of multiple organisms (“critters”)
  - Students individually generate claims supported by observational evidence
  - Teacher leads discussion of claims & evidence (i.e., scientific explanations)

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FOCUS QUESTION

What opportunities exist to assess the intern's scientific knowledge for teaching and what do you notice about her scientific knowledge for teaching?

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SHARING STUDENTS' SCIENTIFIC EXPLANATIONS

FOCUS QUESTION

What opportunities exist to assess the intern's scientific knowledge for teaching and what do you notice about her scientific knowledge for teaching?

TOOLS THAT SUPPORT CKT-FOCUSED ANALYSIS OF ENACTMENT

Area of Strength	Area for Growth	Missed Opportunity	Standards for content knowledge for teaching
0:00-6:00 co-constructs investigation procedure with students	0:00-6:00 implies a linearity to the scientific work that isn't accurate		1. Clearly and accurately **communicates and represents** the subject's **ideas, practices, and principles**. *(does not misrepresent or miscommunicate content)*
			2. Conveys understanding of the ways in which the **composite parts of complex disciplinary practices** work. *(does not convey that practices are too complex to understand or that the goal is to simply memorize and execute)*
5:30-6:25 discusses features of strong observations & rationale for why those are important. 33:55-35:10, 39:15-end of class: Uses effective sentence starter for claim & evidence; collects accurate and sufficient evidence to support claim.	Throughout: refers to "critters" rather than "organisms" or "animals"	~41:00 Intern asks if people agree that the evidence supports the claim (is appropriate), but doesn't ask if it's sufficient to support the claim.	3. Supports learning experiences that **make the subject matter accessible and preserve its disciplinary integrity**. *(does not simplify ideas in ways that undermine the topic in order to make it easier to learn; does encourage engagement that is consistent with disciplinary norms)*
		4:23-6:00 Students made contributions ("write	4. Accounts for **patterns of student thinking** about the content.

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IDENTIFYING CKT THROUGH ENACTMENT

Identifying areas of strength

- Co-constructs an investigation procedure
- Discusses features of strong observations, with rationale
- Uses sentence-starter to support explanation construction
- Conducts discussion of claims supported by evidence

Identifying areas for growth

- Implies inaccurate linearity to scientific work
- Refers to "critters" (not organisms, animals)

Identifying missed opportunities

- Asks about appropriateness but not sufficiency of evidence to support claim
- Does not revoice student contributions (e.g., about investigation procedure) to reflect scientific language

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IDENTIFYING CKT THROUGH ENACTMENT

Identifying areas of strength

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USING ENACTMENT-BASED ASSESSMENT OF CKT

Using a field-embedded assessment of teaching practice allows us to:

- Assess CKT in use with actual students
- See each intern handling unique situations in classrooms
- Provide feedback that may be of use to further develop CKT
- Provide support for others learning to attend to CKT in specific subject areas

Learning from and about this kind of assessment

- This tool can easily be applied across content areas and serves as a tool for supporting growth among our teacher educators, as well
- Beginning teachers display a range of CKT for science – including some quite strong examples of integrating disciplinary core ideas with scientific practices
- It is challenging to gain a coherent or systematic sense of the CKT of the group of beginners from enactment-based assessments

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NEXT STEPS

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NEXT STEPS

① Establish justifiable thresholds for the proficiency of interns at different points in their development

② Analyze relationships between estimates of CKT…

- … and skill with particular teaching practices
- … provided by different assessments
- … across different subject matter areas

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