



$$\begin{array}{r} 4 \\ \cancel{5}27 \\ -135 \\ \hline 392 \end{array}$$

Why does this work?

Eva Thanheiser  
Portland State  
University

Matt Petersen  
Portland State  
University

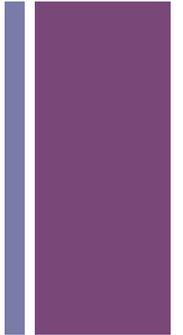
Randy Philipp  
San Diego State  
University

Jodi Fasteen  
Portland State  
University

## Using Interviews With Preservice Teachers as a Tool to Motivate Them to Learn Mathematics



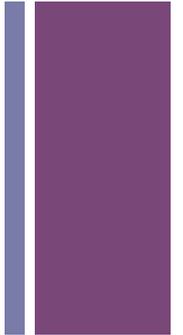
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- Setting the stage
- The problem
- What we did
- Results & Discussion
- What we have learned
- Final Comments

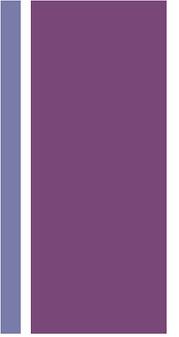


# Using Interviews With Preservice Teachers as a Tool to Motivate Them to Learn Mathematics

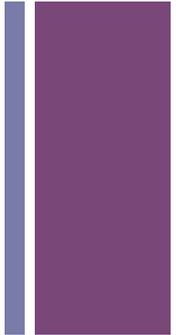


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# + Watch Crystal's Interview

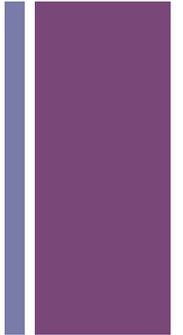


# + Interviews - Purposes



- Demonstrate caring attitude towards students ([Philipp & Thanheiser, 2010](#)).
- Assess PSTs content knowledge to inform the teacher ([Bransford, Brown, & Cocking, 1999](#)).
- Help PSTs learn about their own mathematical understanding

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# US Standard Algorithm

$$\begin{array}{r} \overset{4}{\cancel{5}}\overset{1}{2}7 \\ -135 \\ \hline 392 \end{array}$$



# US Standard Algorithm

$$527 = 500 + 20 + 7$$

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$$400 + 100$$

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# US Standard Algorithm

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$$400 + 100$$

$$527 = 400 + 120 + 7$$

Groups of Ones

<sup>4</sup>~~5~~<sup>1</sup>27

-135

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$$\begin{array}{r} \overset{4}{\cancel{5}}\overset{1}{2}7 \\ -135 \\ \hline 392 \end{array}$$

$$527 = 5 \text{ hundreds} + 2 \text{ tens} + 7 \text{ ones}$$

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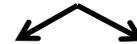
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$$4 \text{ hundreds} + 1 \text{ hundred}$$



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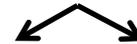
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$$527 = 5 \text{ hundreds} + 2 \text{ tens} + 7 \text{ ones}$$



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10 tens

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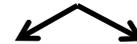
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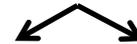
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Reference Units



# US Standard Algorithm

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Groups of Ones

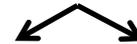
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$$527 = 5 \text{ and } 2 \text{ and } 7$$

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10 tens

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Reference Units



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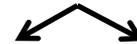
$$527 = 5 \text{ and } 2 \text{ and } 7$$

I take one from the 5 and put it by the 2

I take one from the 5 and move it back, that makes it a 10

Concatenated Digits

$$527 = 5 \text{ hundreds} + 2 \text{ tens} + 7 \text{ ones}$$



$$4 \text{ hundreds} + 1 \text{ hundred}$$



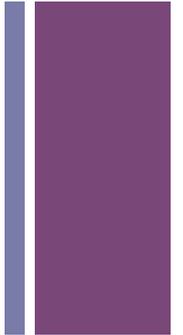
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Reference Units



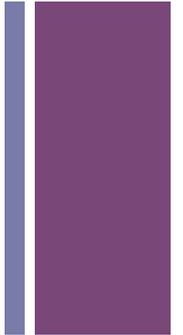
# PSTS' CONCEPTIONS OF MULTIDIGIT WHOLE NUMBERS



CONCEPTION	2005	2007	2008	2011	2011
<i>Reference-units.</i>					
<i>Groups-of-ones.</i>					
<i>Concatenated-digits plus.</i>					
<i>Concatenated-digits only.</i>					



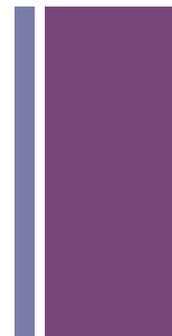
# PSTS' CONCEPTIONS OF MULTIDIGIT WHOLE NUMBERS



CONCEPTION	2005	2007	2008	2011	2011
<i>Reference-units.</i>	3	1	5	0	2
<i>Groups-of-ones.</i>	2	1	2	3	4
<i>Concatenated-digits plus.</i>	7	2	14	9	11
<i>Concatenated-digits only.</i>	3	2	5	1	6



# PSTS' CONCEPTIONS OF MULTIDIGIT WHOLE NUMBERS



CONCEPTION	2005	2007	2008	2011	2011
<i>Reference-units.</i>	$3 \left. \vphantom{3} \right\} \frac{1}{3}$	$1 \left. \vphantom{1} \right\} \frac{1}{3}$	$5 \left. \vphantom{5} \right\} \frac{1}{4}$	$0 \left. \vphantom{0} \right\} \frac{1}{3}$	$2 \left. \vphantom{2} \right\} \frac{1}{4}$
<i>Groups-of-ones.</i>	$2 \left. \vphantom{2} \right\}$	$1 \left. \vphantom{1} \right\}$	$2 \left. \vphantom{2} \right\}$	$3 \left. \vphantom{3} \right\}$	$4 \left. \vphantom{4} \right\}$
<i>Concatenated-digits plus.</i>	$7 \left. \vphantom{7} \right\} \frac{2}{3}$	$2 \left. \vphantom{2} \right\} \frac{2}{3}$	$14 \left. \vphantom{14} \right\} \frac{3}{4}$	$9 \left. \vphantom{9} \right\} \frac{2}{3}$	$11 \left. \vphantom{11} \right\} \frac{3}{4}$
<i>Concatenated-digits only.</i>	$3 \left. \vphantom{3} \right\}$	$2 \left. \vphantom{2} \right\}$	$5 \left. \vphantom{5} \right\}$	$1 \left. \vphantom{1} \right\}$	$6 \left. \vphantom{6} \right\}$



## CONCEPTION

*reference-units* conception:

527, the digits can be seen as

5 hundreds      2 tens      7 ones

50 tens      20 ones

500 ones

*groups-of-ones* conception:

527, the digits can be seen as

500 ones, 20 ones, 7 ones

*concatenated-digits-plus* conception:

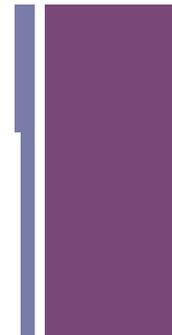
527

500 ones, 2 ones, and 7 ones

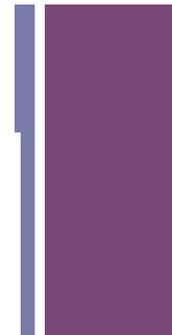
*concatenated-digits-only* conception,

527

5 ones, 2 ones, and 7 ones

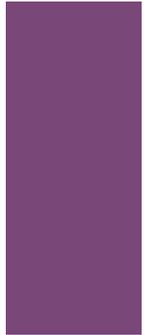


+ CONCEPTION	PRE
<p><i>reference-units</i> conception:</p> <p>527, the digits can be seen as</p> <p>5 hundreds      2 tens      7 ones</p> <p>50 tens      20 ones</p> <p>500 ones</p>	2
<p><i>groups-of-ones</i> conception:</p> <p>527, the digits can be seen as</p> <p>500 ones, 20 ones, 7 ones</p>	4 (+1)
<p><i>concatenated-digits-plus</i> conception:</p> <p>527</p> <p>500 ones, 2 ones, and 7 ones</p>	11 (+ 3)
<p><i>concatenated-digits-only</i> conception,</p> <p>527</p> <p>5 ones, 2 ones, and 7 ones</p>	6

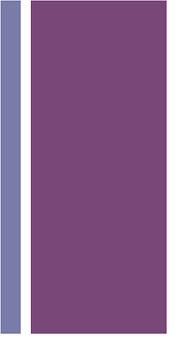


+ CONCEPTION	PRE	POST
<p><i>reference-units</i> conception:</p> <p>527, the digits can be seen as</p> <p>5 hundreds      2 tens      7 ones</p> <p>50 tens      20 ones</p> <p>500 ones</p>	2	19
<p><i>groups-of-ones</i> conception:</p> <p>527, the digits can be seen as</p> <p>500 ones, 20 ones, 7 ones</p>	4 (+1)	2
<p><i>concatenated-digits-plus</i> conception:</p> <p>527</p> <p>500 ones, 2 ones, and 7 ones</p>	11 (+ 3)	2
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+ CONCEPTION	PRE	POST
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# + Watch Crystal's Interview



# + Interviews - Purposes

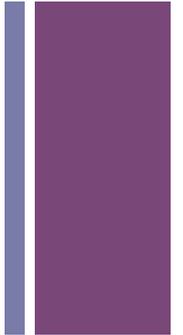
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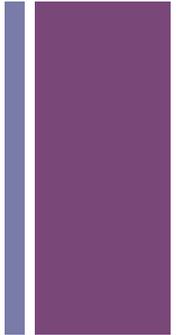
## One PSTs' Written Reflection on the Interview:



- I think the interview affected me by introducing me to the idea that there were things in elementary math I did not know and that I had/have much yet to learn. **It was humbling yet motivating.**
- I think without the interview, I might have gone into class a bit cockier (if possible) and possibly have **taken the class less seriously** in terms of the amount of work I would have to put forth. **As it was, I knew from the relative start I had work to do.**



# Using Interviews With Preservice Teachers as a Tool to Motivate Them to Learn Mathematics

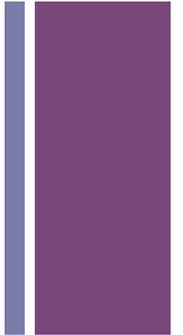


- Setting the stage
- The problem
- What we did
- Results & Discussion
- What we have learned
- Final Comments



# The Problem

## PSTs' views of the content courses



- PSTs often enter our content courses thinking they already know all the math they need to know.

[\(Thanheiser 2009\)](#)

- “Do you think that your current mathematics knowledge is enough to teach K–3 [5–9-year-olds]?”
  - 16 yes
  - 4 no
  - 3 ambivalent.

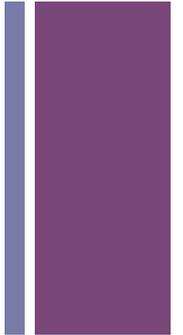


# The Problem

## PSTs' views of the content courses

“If I, a college student, do *not* know something, then children would not be expected to know it, and if I *do* know something, I certainly don't need to learn it again.” [\(Philipp et al., 2007\)](#).

- Thus PSTs often view content courses for teachers as annoying prerequisites rather than as opportunities to learn.

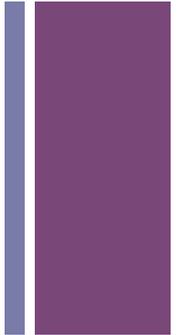




# The Problem

## PSTs' content knowledge for teaching

- PSTs can often execute algorithms, but many struggle when asked to explain them conceptually ([Ball, 1988/1989](#); [Ma, 1999](#); [Thanheiser, 2009](#)) and may be unaware that a rationale for the algorithms exists
- To help children learn PSTs must have a deep and flexible understanding of the mathematics they are teaching ([Ball, 1990](#); [Ma, 1999](#); [Sowder, Philipp, Armstrong, & Schappelle, 1998](#))
- TEACHER EDUCATORS need to help PSTs recognize that there is something for them to learn.

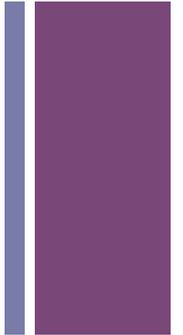




# The Problem

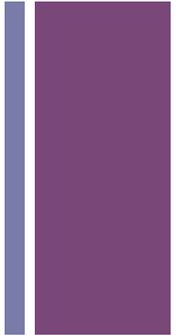
TEACHER EDUCATORS need to help PSTs recognize that there is something for them to learn.

- PSTs need to move beyond procedures
- PSTs need to recognize that there is a *why* (that they don't know).
- PSTs need to recognize that they should know the *why*.
- PSTs need to recognize that there is something for them to learn.
- Reflect on their own knowledge/learning.



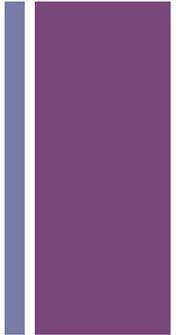


# Using Interviews With Preservice Teachers as a Tool to Motivate Them to Learn Mathematics



- Setting the stage
- The problem
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# + What we did - WHO



- First course in sequence of three courses
  - Number and Operation
  - Fractions and Statistics
  - Geometry
- 23 PSTs consented to have their data used.

# + What we did - WHAT

Interview 1 at the beginning of the term

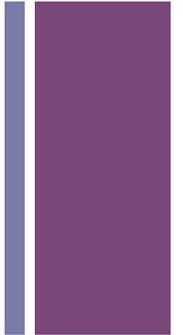
Reflection immediately after the interview

Reflection in the middle of the term

Reflection at the end of the term

Interview 2 and the end of the term

Students watch Interview 1 and reflect on the experience of watching it



# + What we did - WHAT

Interview 1 at the beginning of the term

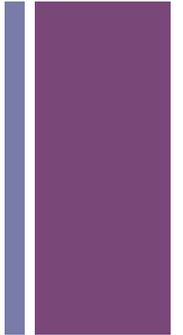
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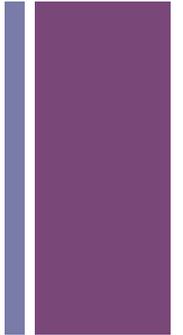
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# + What we did - WHAT



- Interview 1: Individual interview during first week of the course
  - Individual interviews
  - Video taped
  - 10 -15 min
  - 3 content questions (2 subtraction and 1 addition tasks)

# + What we did - WHAT

Interview 1 at the beginning of the term

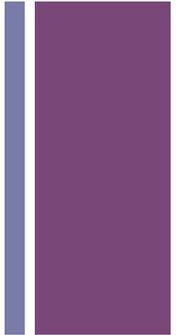
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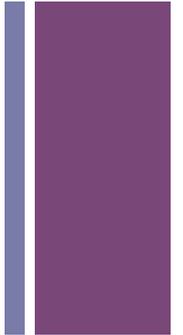
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# + What we did - WHAT

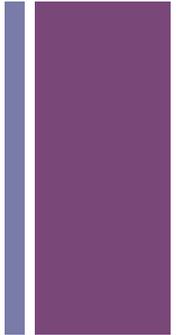


- Reflection immediately following the interview
  - I would imagine that the interview with me was kind of an unusual experience for you. Would you agree or not? Explain
  - Did you learn something from this experience? If so what?



## Did you learn something from this experience? If so what? (R1)

- Yes. That I need instruction for explaining the small steps of mathematical processes to kids. I also learned how much I just accepted the rules and "right ways" of doing math as a kid. **Crystal R1**



# + What we did - WHAT

Interview 1 at the beginning of the term

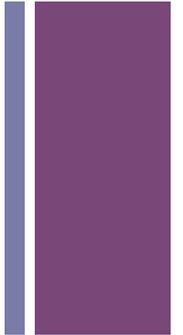
Reflection immediately after the interview

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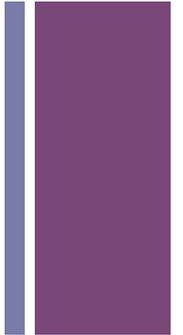
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Students watch Interview 1 and reflect on the experience of watching it



# + What we did - WHAT

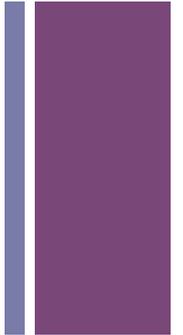


- Email reflection in the middle of the course
  - Thinking back to the interview at the beginning of class, how do you think that interview affected your learning in this class?  
Please try to be as specific as you can in this response.
  - Do you think your experience would have been different without having participated in the interviews? If so, how?
  - Do you have any additional comments for us?



# Do you have any additional comments for us? (R2)

- Without the interview I would have been a bit more lax and complacent with this subject matter. I would have been thinking, "but I already know this stuff!" **Crystal R2**



# + What we did - WHAT

Interview 1 at the beginning of the term

Reflection immediately after the interview

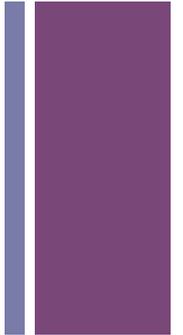
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# + What we did - WHAT

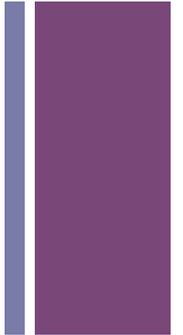


- PSTs viewed their intake interview and answered survey questions
  - Watch your first interview and give your general reactions to the interview, we are very interested in your reactions so feel free to share.
  - How do you think having this interview at the beginning of the term affected your learning in this class?
  - Given that it takes a LOT of the instructor's time to conduct interviews with all students (and thus the teacher may rather not do interviews) could you please share with us how you feel about the interviews?



How do you think having this interview at the beginning of the term affected your learning in this class? (R3)

- It really affected my learning a lot! It truly humbled me and made me realize how much there was to learn before teaching math in elementary classes. I realized that I just simply did not have the vocabulary to teach elementary math. My inability to clearly explain each step of my trusty algorithm really demonstrated a lack of awareness that is necessary before teaching others. **Crystal R3**



# + What we did - WHAT

Interview 1 at the beginning of the term

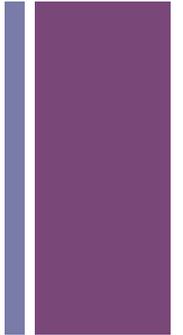
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Reflection in the middle of the term

Reflection at the end of the term

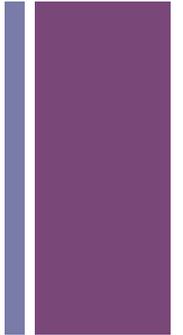
Interview 2 and the end of the term

Students watch Interview 1 and reflect on the experience of watching it





# What we did – DATA ANALYSIS



## CONCEPTIONS ON PRE and POST Interviews

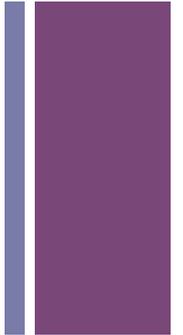
- Identify conceptions (Thanheiser's framework) on pre and post interviews
  - Double coding with 86% agreement – disagreements were resolved through discussion

## THEMES in INTERVIEW REFLECTIONS

- Read the responses
  - Identified themes
  - Compared themes across data sets (pilot study and larger study)
  - Once themes were identified 2 researchers agreed on each instance.



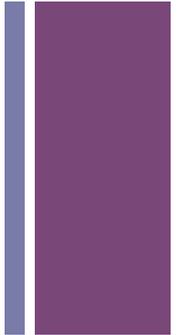
# Using Interviews With Preservice Teachers as a Tool to Motivate Them to Learn Mathematics



- Setting the stage
- The problem
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- Final Comments



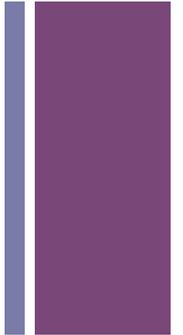
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## Theme

1. PSTs are not typically asked to think about or explain mathematics beyond procedures.
2. The PSTs recognized the limitations of their own understanding, the value of knowing more than the procedures, or both.
3. The PSTs stated that they were motivated to learn the mathematics of the course.
4. The PSTs reflected on their own knowledge and learning.

<b>Theme</b>	<b>Number of PSTs</b>
1. PSTs are not typically asked to think about or explain mathematics beyond procedures.	5
2. The PSTs recognized the limitations of their own understanding, the value of knowing more than the procedures, or both.	15
3. The PSTs stated that they were motivated to learn the mathematics of the course.	21
4. The PSTs reflected on their own knowledge and learning.	19



*1. PSTs are not typically asked to think about or explain mathematics beyond procedures*

- Although I had no trouble performing the actual calculations, I experienced difficulty in explaining the reasoning behind my work. ... It is assumed that you know how to perform these kinds of problems, *but no one actually asks you “why.”*





*2. The PSTs recognized the limitations of their own understanding, the value of knowing more than the procedures, or both.*

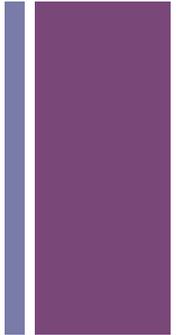
- I think having the interview was very eye opening. I realized **THAT** how I did addition and subtraction wasn't really with complete understanding in how it works. Having this experience helped me to see how instrumental understanding can only take me so far and how important it is that students understand why it works.





*3. The PSTs stated that they were motivated to learn the mathematics of the class.*

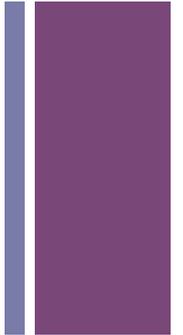
- I think the interview affected me by introducing me to the idea that there were things in elementary math I did not know and that I had/have much yet to learn. It was humbling yet motivating. ... I think without the interview, I might have gone into class a bit cockier (if possible) and possibly have taken the class less seriously in terms of the amount of work I would have to put forth. As it was, I knew from the relative start I had work to do.





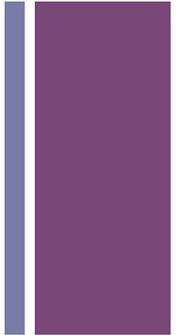
## *4. The PSTs reflected on their own knowledge and learning.*

- Without the interview I do not think I would have learned much about myself as a math learner. **I personally do not think that I would have taken more information and thought to myself more about the "why" in math. As well as I might have not known where I was lacking in math or how to even teach it in the first place.**





# Using Interviews With Preservice Teachers as a Tool to Motivate Them to Learn Mathematics



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## Theme

A. Recognition of their limited mathematics knowledge at the beginning of the course (akin to Theme 2 above but in stronger language).

PSTs explicitly acknowledged feeling embarrassment, shock, or surprise at their own lack of knowledge and noted how confusing and unorganized their explanations were.

B. Recognition of what they learned in the course. PSTs expressed pride in their correct explanations and feelings of accomplishment and recognition or pride at what they had learned in the course.



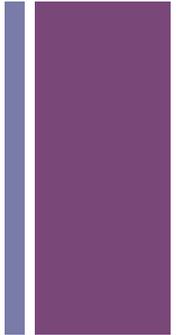
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Watch your first interview and give your general reactions to the interview, we are very interested in your reactions so feel free to share.

### **Recognition of limited math knowledge at the beginning**

- I was **shocked** at the level of understanding of math I had. I am surprised that it did not occur to me to think about the ones that were being carried over were tens or hundreds, not just one. My understanding of numbers were the idea that the number represented one value. For example, I did not know that the one carried to the tens place was not a 1 but a group of ten ones. Overall, I am surprised by my thinking at the time.

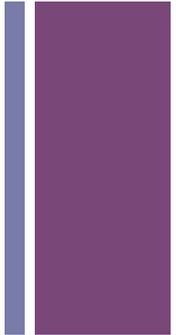




Watch your first interview and give your general reactions to the interview, we are very interested in your reactions so feel free to share.

**Recognition of limited math knowledge at the beginning/  
Recognition of what has been learned**

- After watching my first interview I was really shocked to say the least. I couldn't help but laugh at myself at how little I actually knew and now realizing how far I have come. If I had only knew then what I know now.
- Wow. I was obviously taught the standard method. I can't believe that I couldn't really explain myself, like what I was borrowing. It shocks me to see myself now after I have taken the course. Taking this course really opened my mind, and I see now how much I have learned. It seems silly now that I couldn't explain myself very well. I couldn't really explain that the one was a ten I just called it a one.

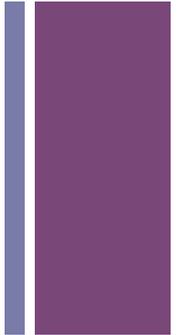




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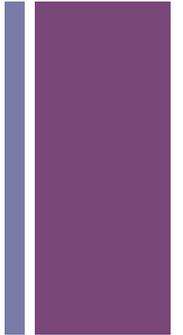
**Recognition of limited math knowledge at the beginning/  
Recognition of what has been learned**

- I can not believe how much I have learned in 10 short weeks! My heart was beating fast while watching this video partly because of embarrassment and partly because it brought back the stress that math always seemed to cause me before taking this class. While watching the video I kept saying to myself "Come on Kristin [pseudonym]! You can do it!" I would be able to explain both problems in much more of a comprehensive easy to understand way if I was asked to do the interview again.



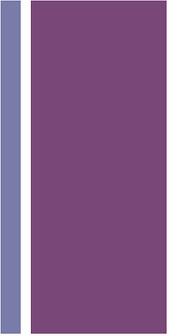


# Using Interviews With Preservice Teachers as a Tool to Motivate Them to Learn Mathematics



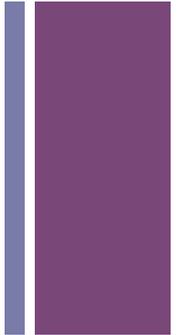
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+ What have we learned?





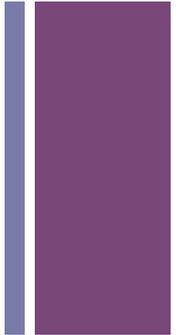
## Interviews combined with sense-making activities in class can serve four interrelated purposes:



1. PSTs recognize that there is something to know beyond the procedures and that they themselves are unable to explain beyond procedures.
2. The PSTs come to understand that knowing more than the procedure (understanding the mathematics underlying the procedure and various other ways of thinking/sense making) has value.
3. The PSTs realize that until they learn to make sense of such mathematics, they will be unprepared to support their future students beyond learning procedures.
4. The PSTs are able to reflect on their own knowledge (at various points throughout the course) and their learning.

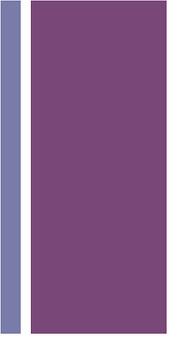


# As a result



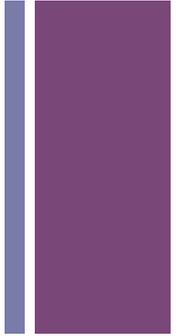
- PSTs were motivated to attend carefully to the activities in the content course and to engage with them more deeply than they otherwise would have engaged
- PSTs were aware of and proud of what they have learned
  - Value their course
  - Motivated for future courses

+ Would you recommend the interview experience?



# + Would you recommend the interview experience?

- Given that it takes a LOT of the instructors time to conduct interviews with all students (and thus the teacher may rather not do interviews) could you please share with us how you feel about the interview?



# + Would you recommend the interview experience?

- Given that it takes a LOT of the instructors time to conduct interviews with all students (and thus the teacher may rather not do interviews) could you please share with us how you feel about the interview?

**Definitely keep them ... I know they take a lot of time but they are worth it**

The interviews are nice ... but I think you can accomplish the same things other ways

I would prefer no interviews

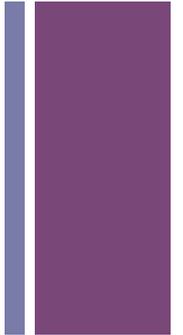
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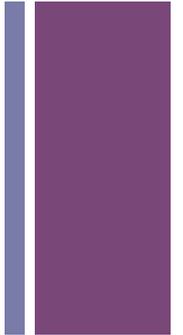


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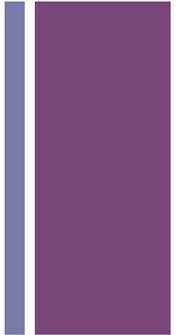
# + Final Comments



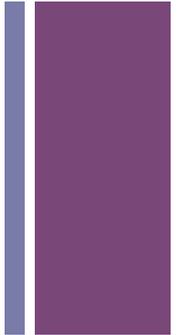
- A one-on-one interview between each PST and his or her instructor can serve as a powerful tool to learn about the PSTs' content knowledge and motivate PSTs to engage in their content courses.
- Another benefit of interviewing our students relates to the important role that mathematics educators play in modeling mathematics instruction for their students ([Thanheiser, Browning, Moss, Watanabe, & Garza-Kling, 2010](#)).
  - In our courses, we often ask PSTs to conduct interviews with children, view video clips of children's mathematical thinking, or react to other artifacts of children's mathematical thinking to help them better understand students.
  - By modeling an approach of learning about our students, we send a powerful message to PSTs about the importance of assessment.

# + Final Comments – is it doable?

- I conducted 33 interviews
  - 10 – 15 min each
  - Approximately 8.25 hours during the first week of classes.



# + Audience Discussion



- How would an interview like this work in a different setting?
  - Secondary Mathematics Methods Course
  - Secondary Mathematics Content Course
  - Elementary Mathematics Methods Course
  - Elementary Content Course with focus on fractions, statistics, ...
- Is it essential that the instructor conducts the interviews?
- Is there something else that you could do if you cannot do interviews?
- Is it really worth it?
- ...