Hi everyone, we're glad you're here
We have two handouts.
We'll use the second and third so if you have time, go ahead and download now.

UNC CHARLOTTE

Anchors & Bridges: Developing Students' Understanding with Real-World Contexts

Luke Reinke
UNC Charlotte

Jerold Griggs
Kannapolis Middle School

NCTM 2019 Annual Conference

What are the benefits of using real world contexts for math?

- Engagement
- “When am I going to use this?”

YES

...and

UNC CHARLOTTE

Our argument

- Contexts allow students to make sense of abstract mathematical ideas

- This sense making won't happen automatically. It needs to be intentionally developed.

Setting

- Title I middle school
- Four 7th grade math teachers
- 5-week unit on ratio and proportions
- 4-week unit on expressions, equations, and inequalities
- Typically 20-25 students per class
- Demographics
    - 30% Hispanic
    - 30% Black
    - 30% White
    - 10% Multiracial, Asian American, Pacific Islander, Native American

UNC CHARLOTTE

The Hook

UNC CHARLOTTE

Alien invasion!

2. Is there enough food? Explain.

Hook versus Anchor

Hook	Anchor
• Engages and excites students • Introduces the story context for the day	• Engages and excites students • Establishes the purpose… one that is related to the key mathematical ideas to build on. • Introduces the anchoring context for the unit

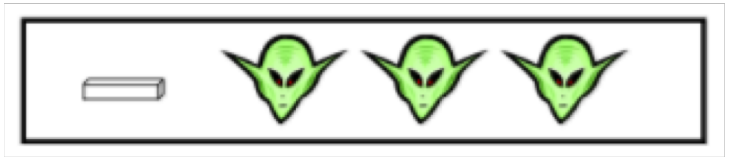
UNC CHARLOTTE

Recommendations

- Create an anchor, which is more than a hook, by emphasizing the big mathematical ideas as you introduce the problem purpose.

(see handout 2 in NCTM app)

Alien invasion!



Is there enough food for the aliens?

1. Will 12 food bars be enough to feed 36 aliens? Explain.

2. Will 6 food bars be enough to feed 18 aliens? Explain.

3. Will 8 food bars be enough to feed 20 aliens? Explain.

4. Will 24 food bars be enough to feed 72 aliens? Explain.

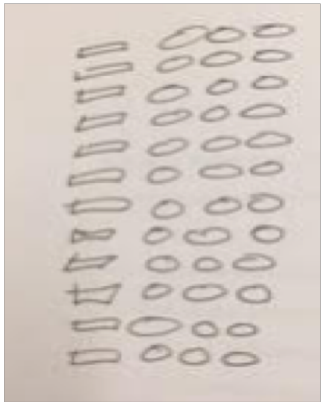
5. How many food bars are needed to feed 39 aliens? Explain.

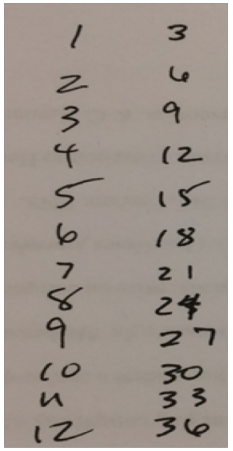
UNC CHARLOTTE

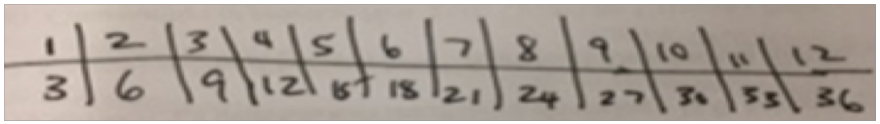
What are the different ways students might solve the problem?

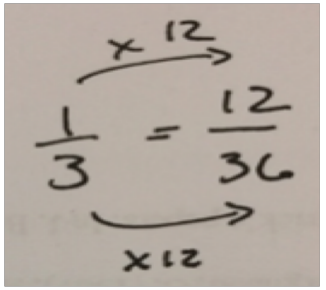
UNC CHARLOTTE

Possible Solutions



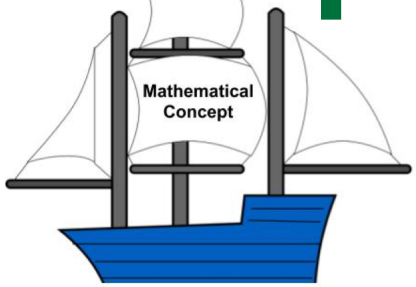




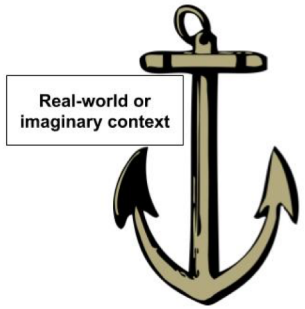


UNC CHARLOTTE

Anchoring Students' Conceptual Understanding



Question: How do we ground students' conceptual understanding of the mathematics to their understanding of these contexts?

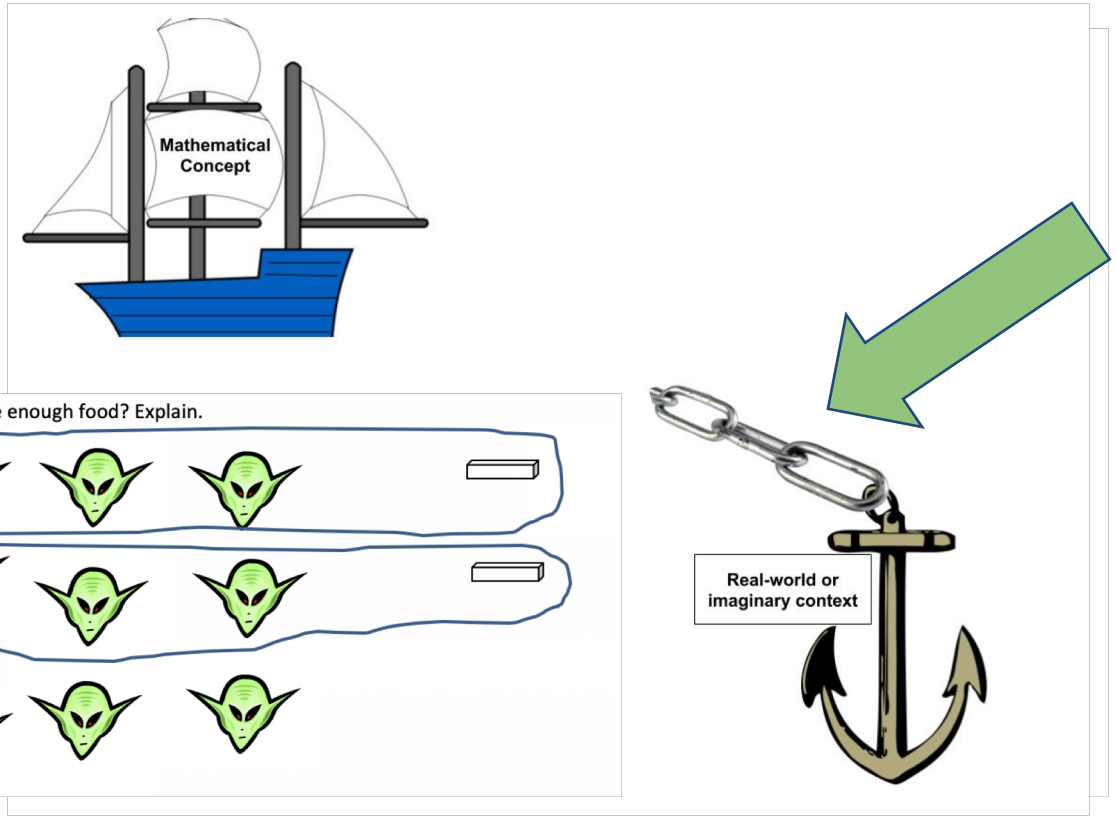


UNC CHARLOTTE

Alien invasion!

2. Is there enough food? Explain.

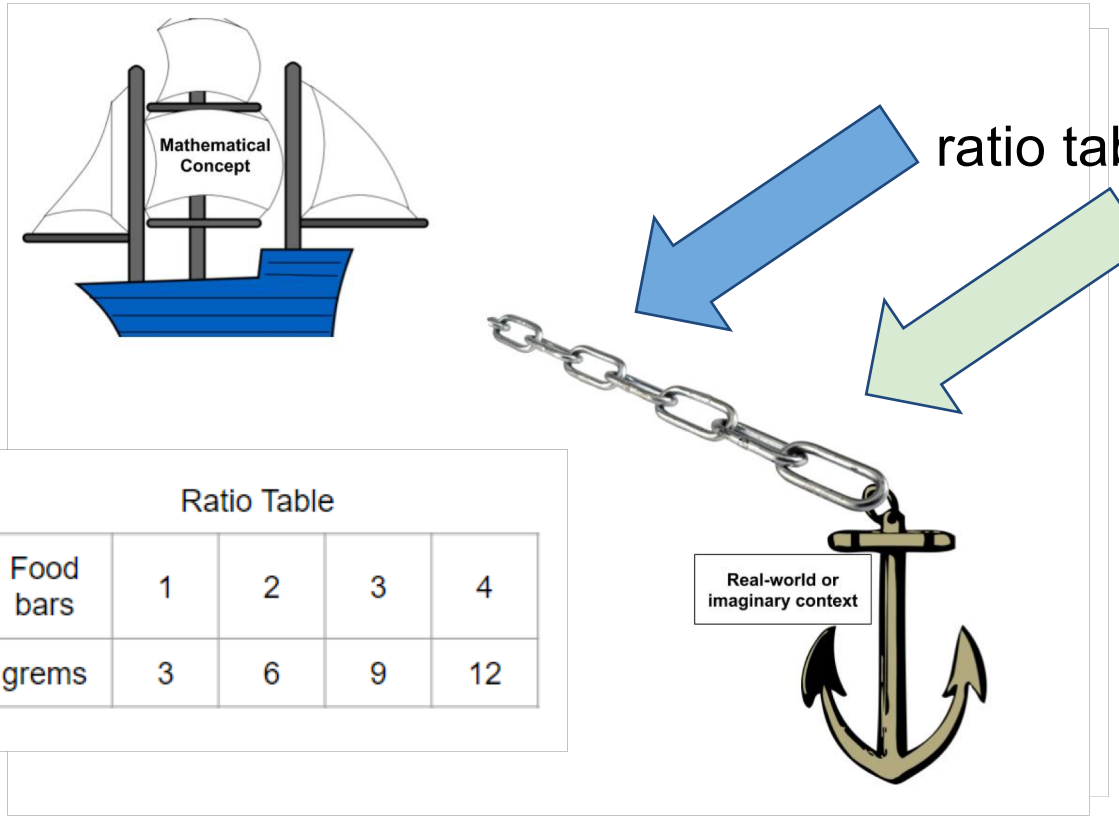
Informal Representations



pictures and diagrams

UNC CHARLOTTE

Pre-formal Representations

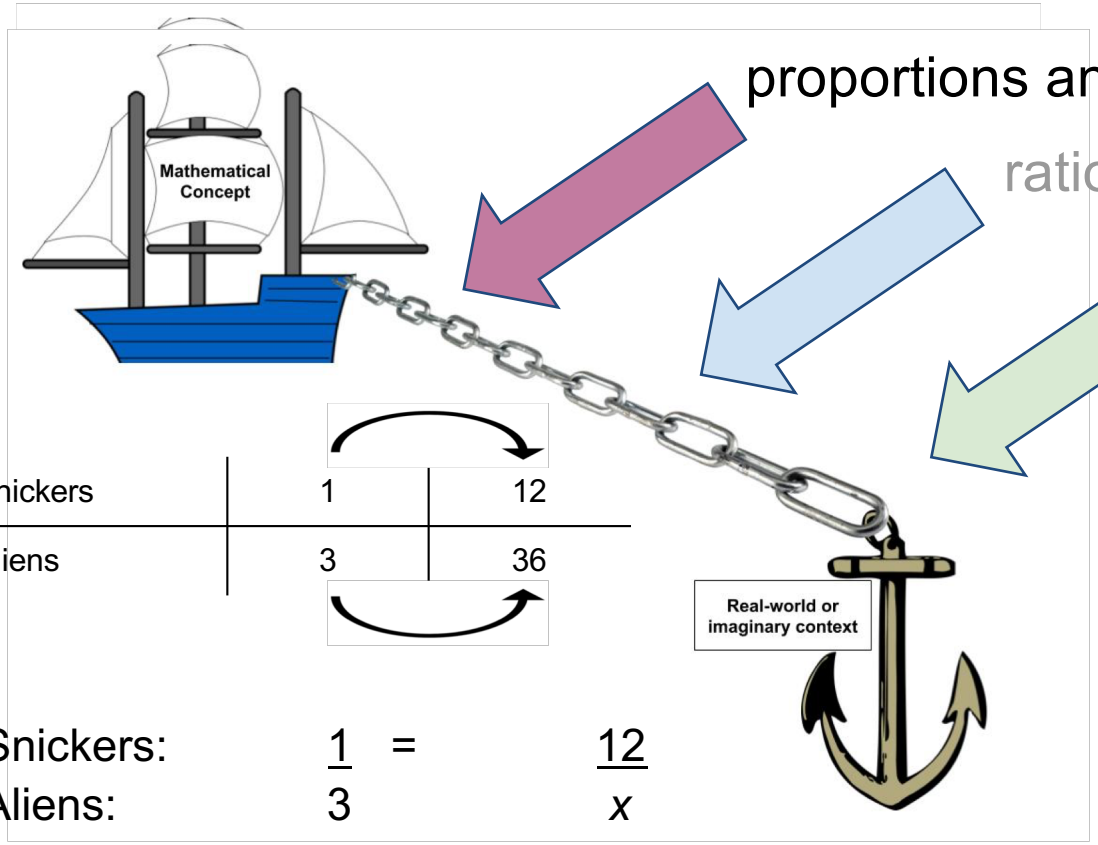


Ratio Table

Food bars	1	2	3	4
grems	3	6	9	12

UNC CHARLOTTE

Formal Representations



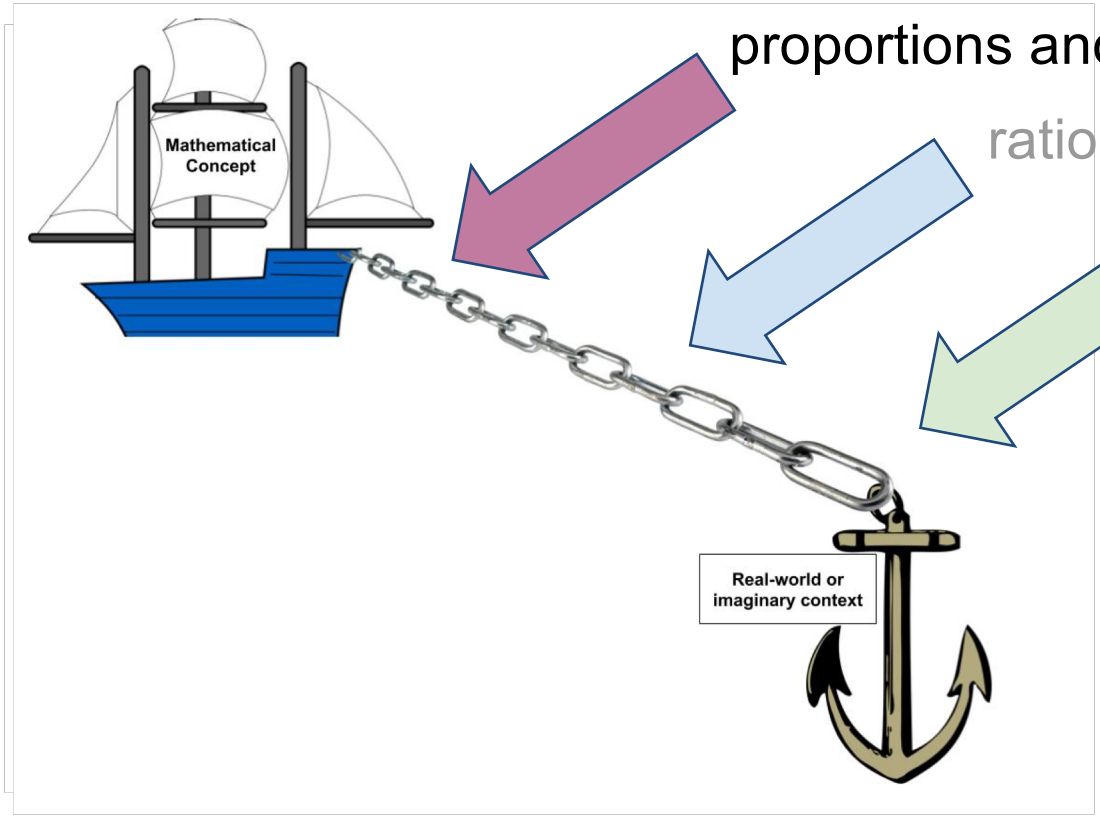
Snickers	1	12
Aliens	3	36

Snickers: $\frac{1}{3} = \frac{12}{x}$

Aliens:

UNC CHARLOTTE

Goal



UNC CHARLOTTE

Does their use of the ratio table seem connected to their picture drawing (and the context)?

After solving aliens problems using pictures, students were shown the following table:

Snickers	1	2	3	4	5	6
Aliens	3	6	9	12	15	?

Teacher: Yes? So, what did you do to get 18? Green group? What did you do to get 18?

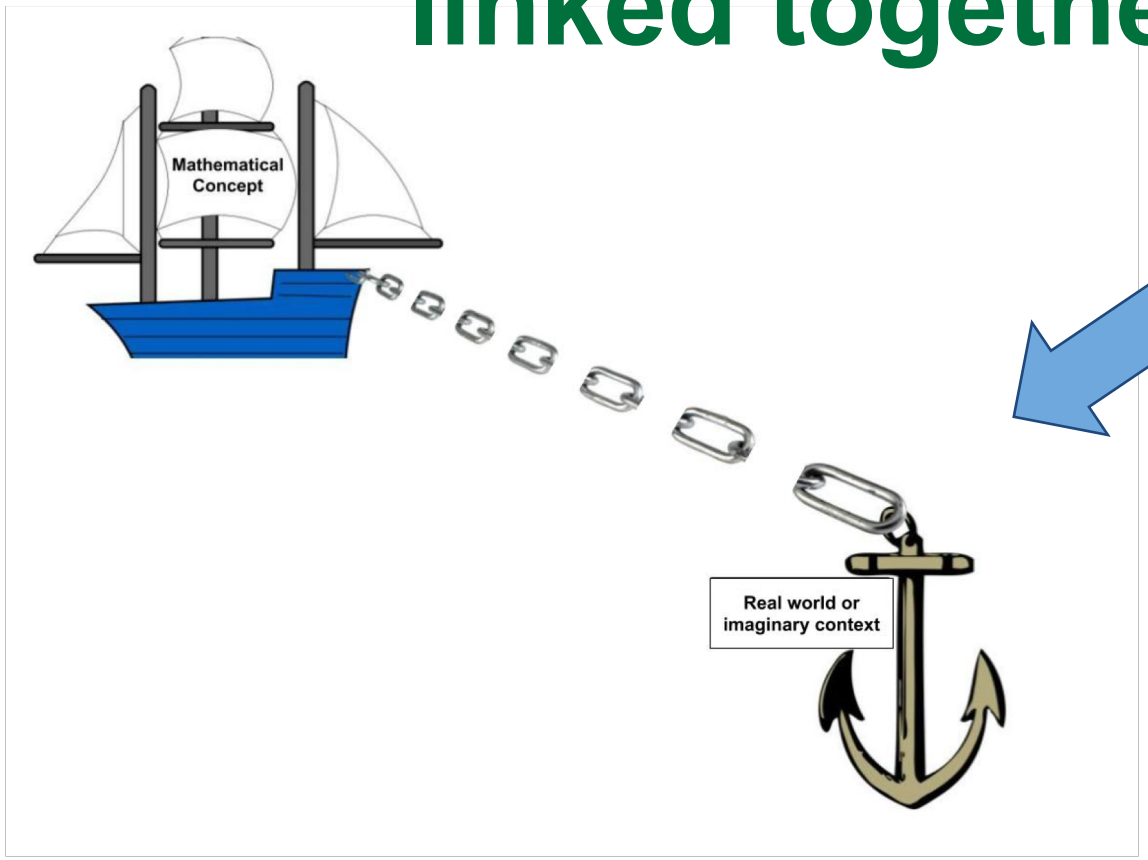
Student(s): Six times three.

Teacher: Six times three. That gave us 18? Why did we multiply by three?

Student(s): Because one times three equals three, two times three equals six, three times three equals nine, four times three equals 12, and five times three equals 15.

UNC CHARLOTTE

What happens if the chains aren't linked together?



ratio tables

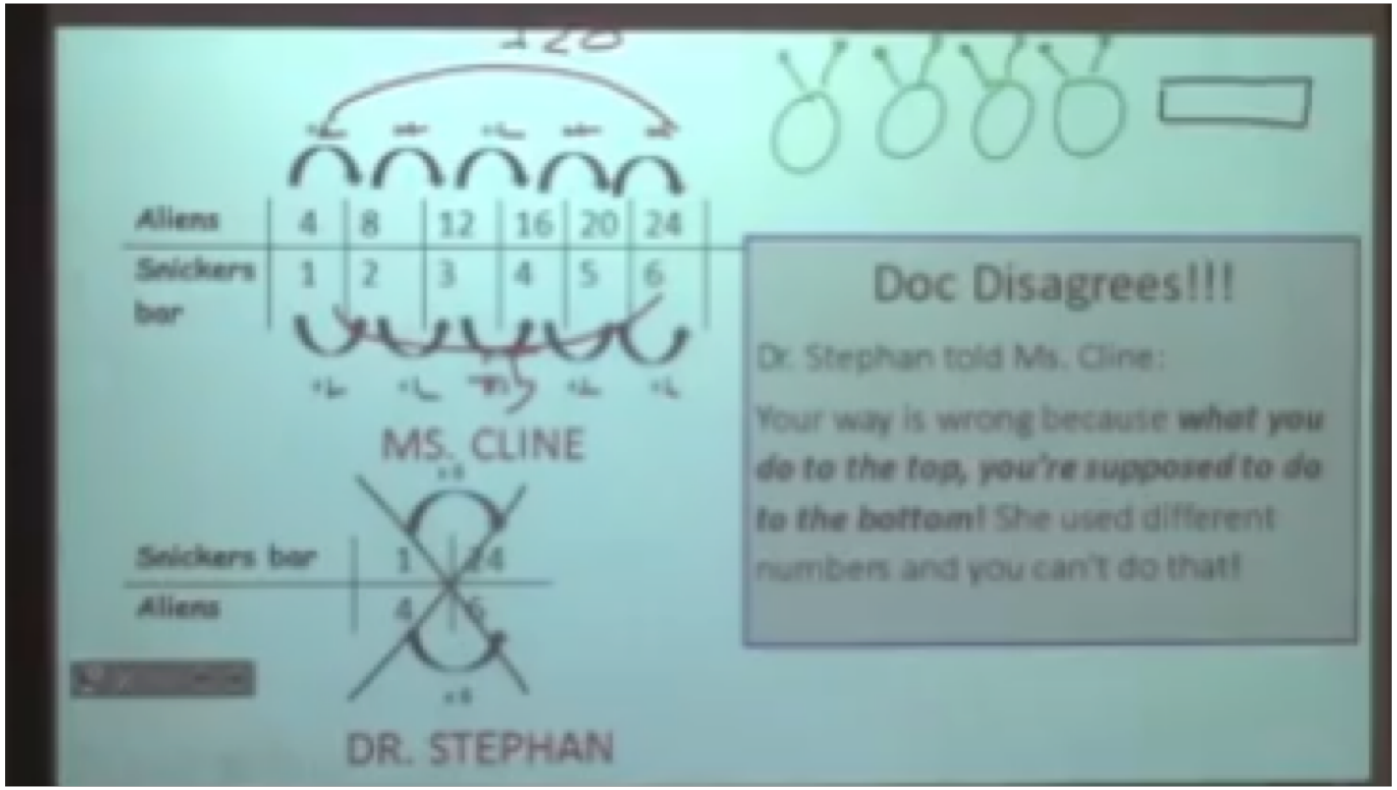
pictures and diagrams

UNC CHARLOTTE

What happens if the chains aren't linked together?

UNC CHARLOTTE

What do we do to build a linked chain?

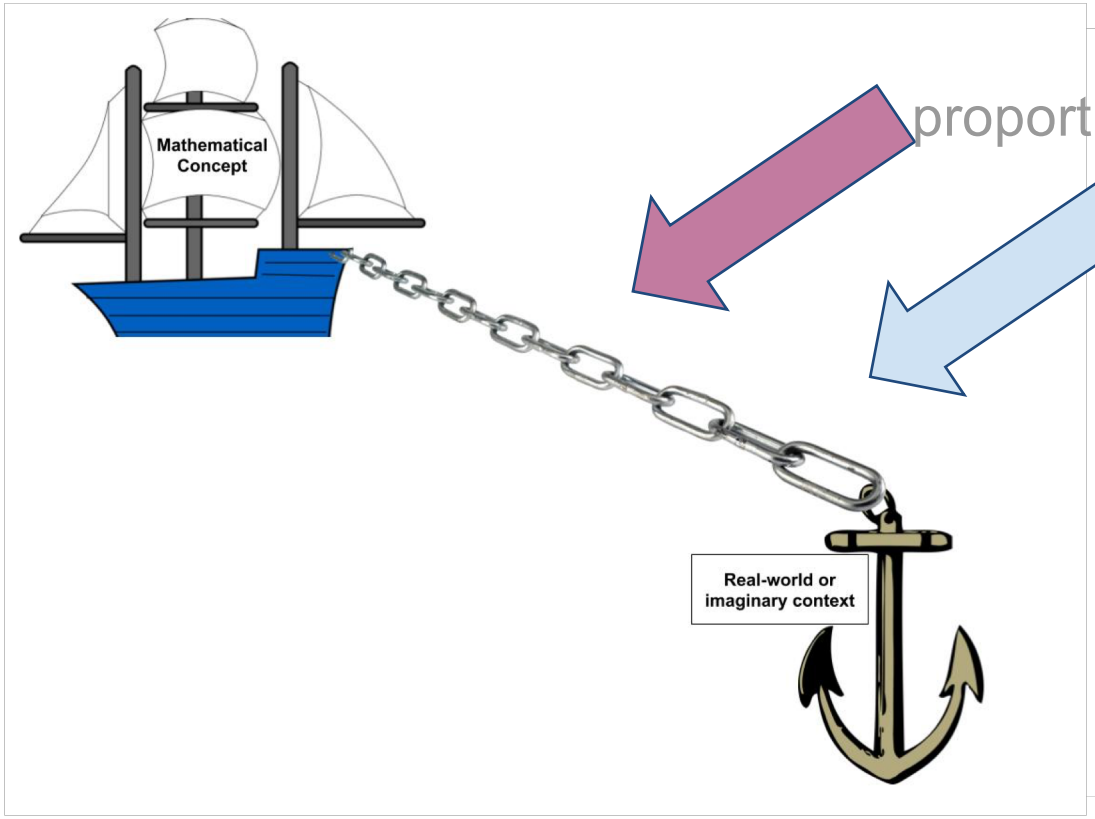


UNC CHARLOTTE

On your computer or device, see handout 3 for this session for a transcript

UNC CHARLOTTE

Is it connected?

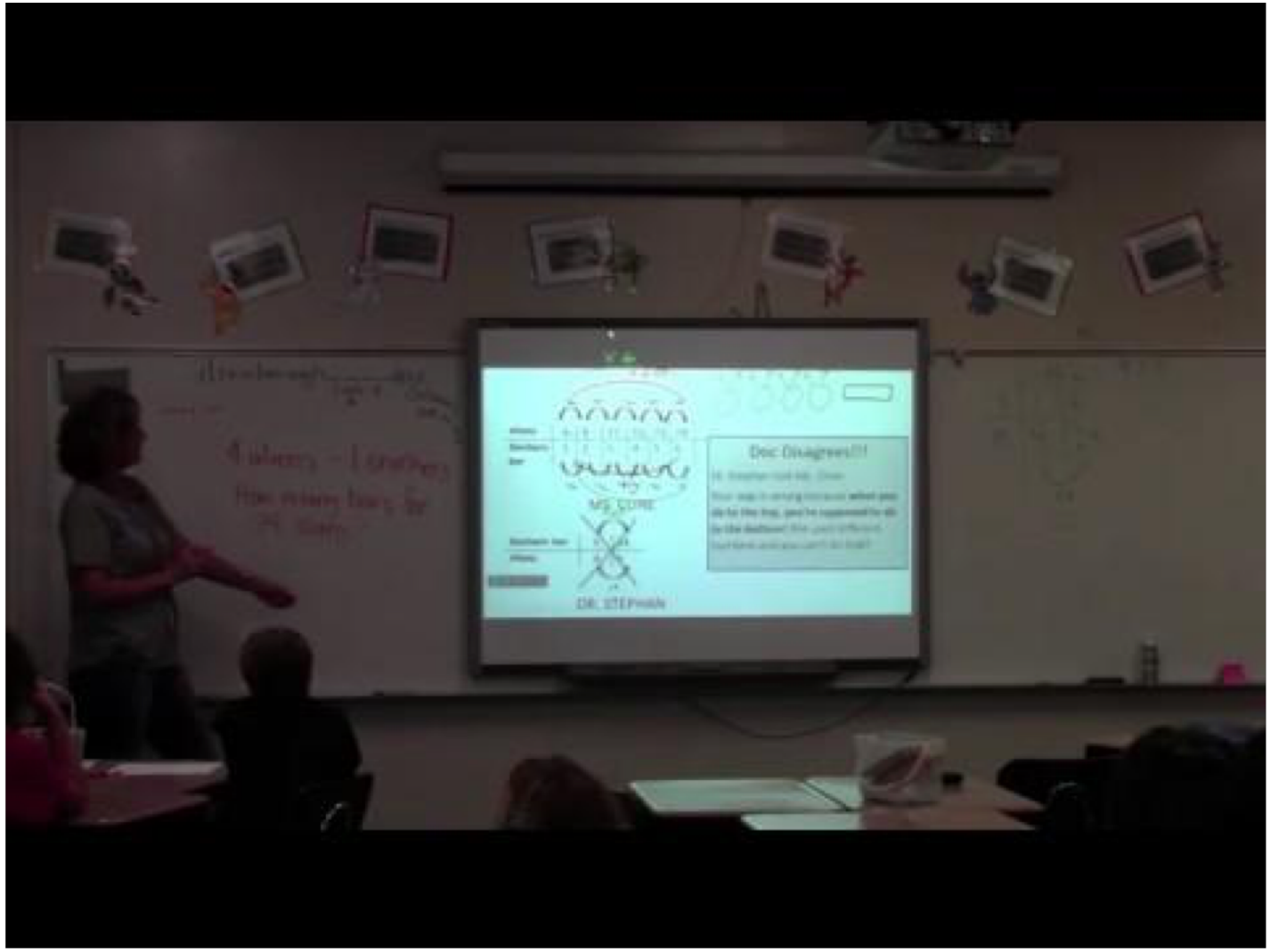


proportions and equations

ratio tables

pictures and diagrams

UNC CHARLOTTE



UNC CHARLOTTE

What were the specific questions or moves Ms. Cline made **to connect** the operating she and the students did with **the table** to the work **with the pictures** (and to the story)?

Were the ways of **operating using the short table** (Dr. Stephan's way) **connected to the long table**?

...to the picture?

If so, in what lines?

UNC CHARLOTTE

Recommendations

- Create an anchor, which is more than a hook, by emphasizing the big mathematical ideas as you introduce the problem purpose.
- Sequence from informal to formal and ask questions aimed at helping students make sense of the formal representations in terms of the informal representations.

Enhancing the Anchor

How can we continue to use this anchor after the sequence has progressed to new problems?

UNC CHARLOTTE

Launching the next context...

Griggs: When you were younger, some of you may have gone to this particular day care.. called We Love Um, ok?

So with We Love Um, and with any daycare, there are state guidelines that those daycares have to adhere to.

It's also kinda like us teachers in schools, we have to adhere to these rules, we have to have a certain teacher to student ratio.

Launching the next context...

So, here, you'll see the teacher to infant ratios for We Love Um....we have 5 to 1 for infants.

Infants	5	
Teachers	1	

We're going to see if We Love Um really loves their kids. Because the thing is with daycares, if they're not maintaining these ratios what could happen?

...they could get closed down. They would get in trouble. They could be shut down by the state of North Carolina and not be able to do business anymore

We often assume that...

- students will naturally see the mathematical connections, or…
- students will just apply what they did on the previous problem

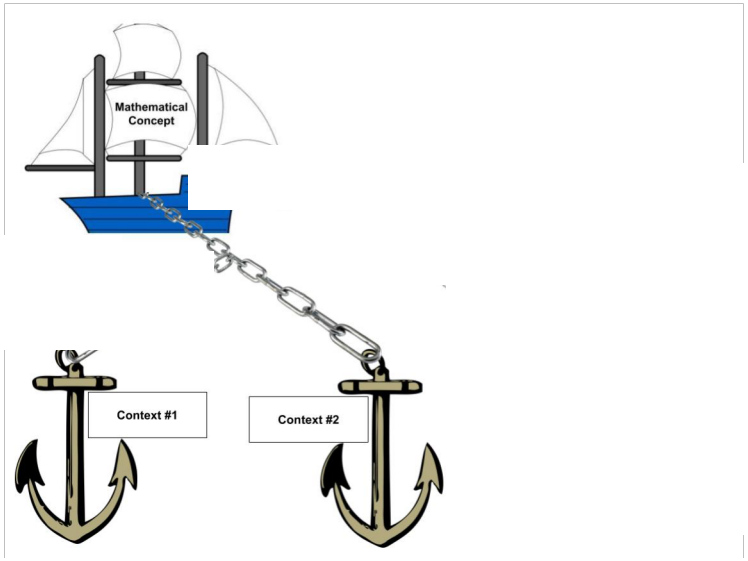
but research shows that..

- some students have trouble understanding how contextual problems relate to each other
- applying the strategies from the previous problem without considering whether the problems are similar doesn't set students up for success

UNC CHARLOTTE

So what can we do?

- How can we encourage students to thoughtfully recall and use the strategies developed in the alien context to help them solve the daycare problems?



UNC CHARLOTTE

Highlight connections when launching

Teacher: Ok. Alright, so **how does this relate to the aliens story that we just did**? How does this relate to that? Raise your hands. Tonya?

Tonya: **It was times how many aliens can eat one loaf of bread. So, like, 3 would equal 1. So with kids it's 5 kids to 1 teacher**.

Teacher: Ok. Anyone else? How does this relate to aliens and food bars? How does the child to staff ratio relate to that, Price? The aliens story?

Price: **1 food bar feeds 5, and 1 staff can take care of 5 children**?

Teacher: Ok. Alright. Any questions?

UNC CHARLOTTE

Pressing further...

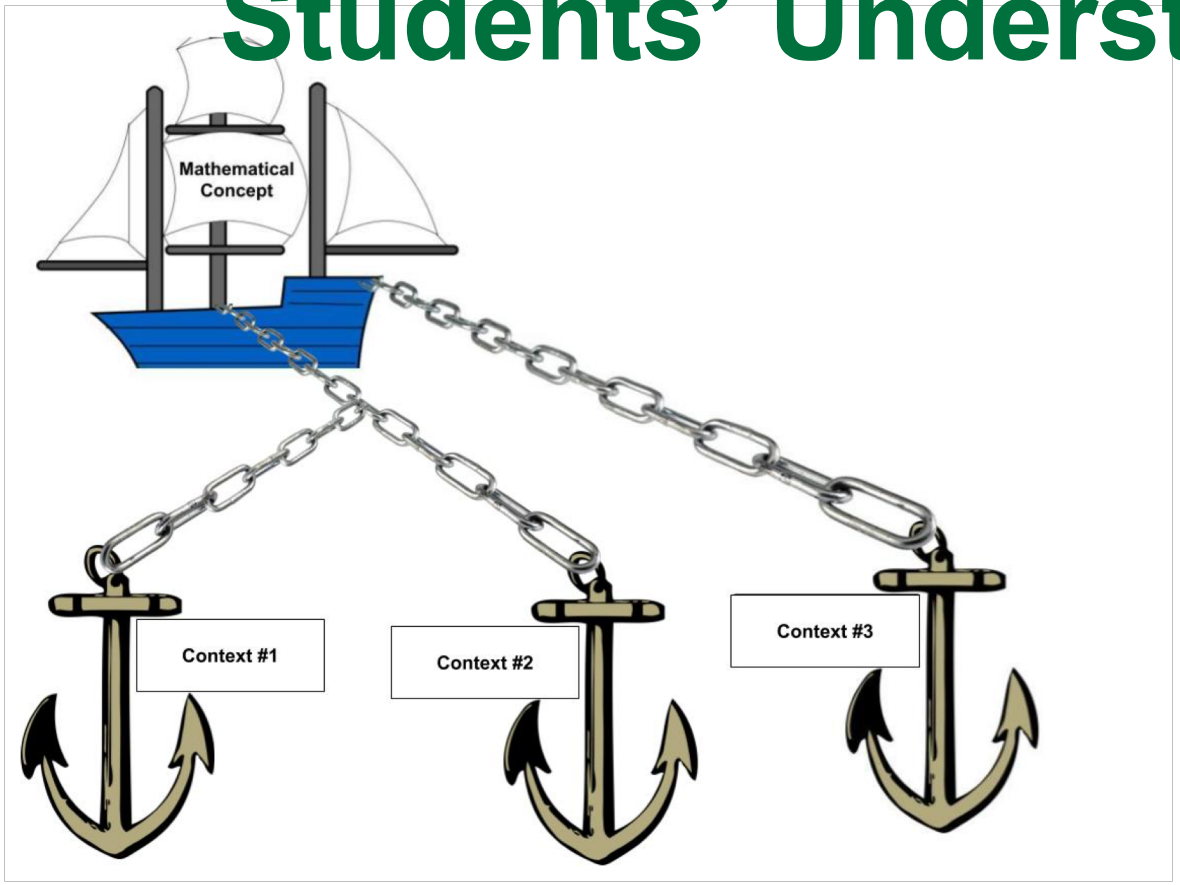
- “What is similar about these situations?”
  - In both situations _____.

Reminding students as they work...

Student: I'm not sure what to do for this one.
Teacher: What is the problem asking?
Student: If there are 6 teachers, what's the most infants that could be in there.
Teacher: **How is this one similar to what we were working on yesterday?**
Student: before it was 3 aliens for every 1 food bar. Now it's 5 infants for every 1 teacher.
Teacher: So what strategies were you using with the aliens and food bars.
Student: I made the long tables.
Teacher: Could that work here?
Student: I think so, let me try.

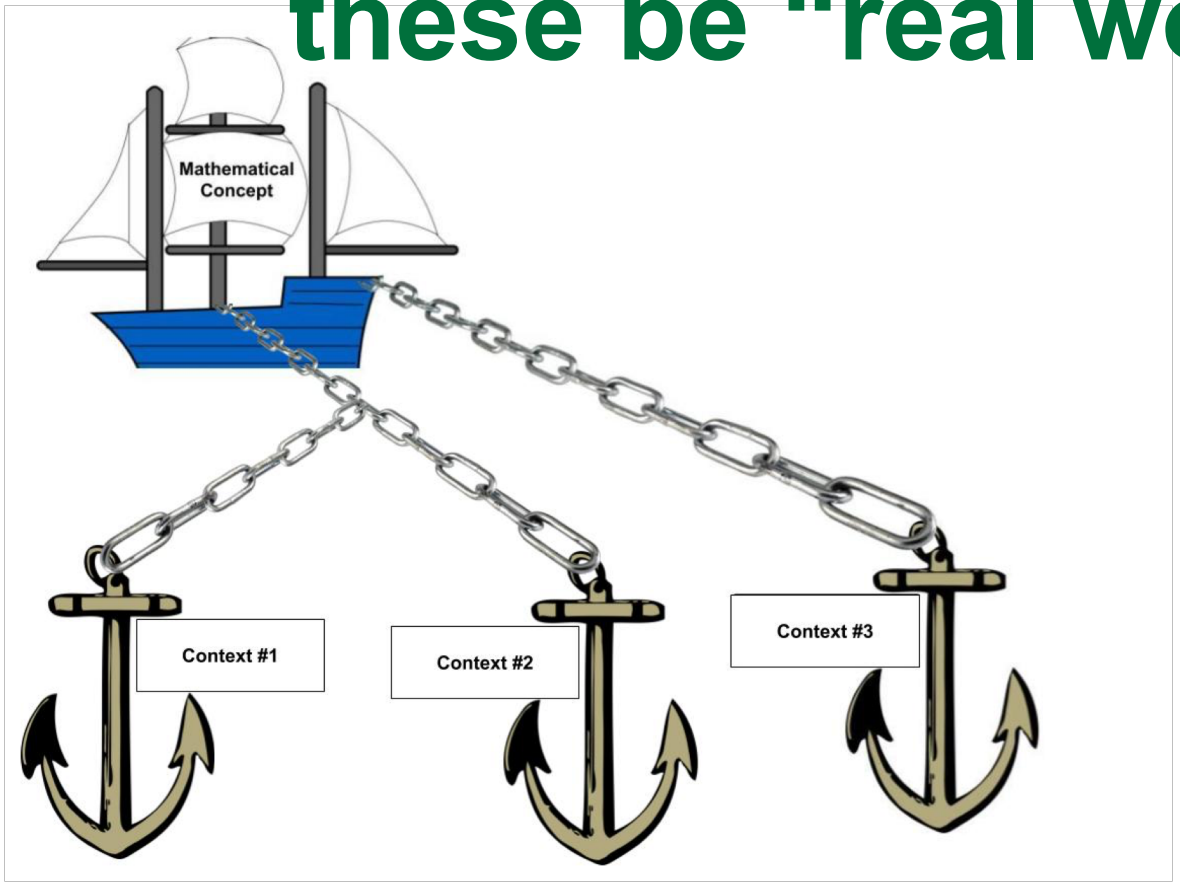
UNC CHARLOTTE

Multiple Contexts Enhance the Students' Understanding



UNC CHARLOTTE

Aliens? Foodbars? Shouldn't all these be "real world?"

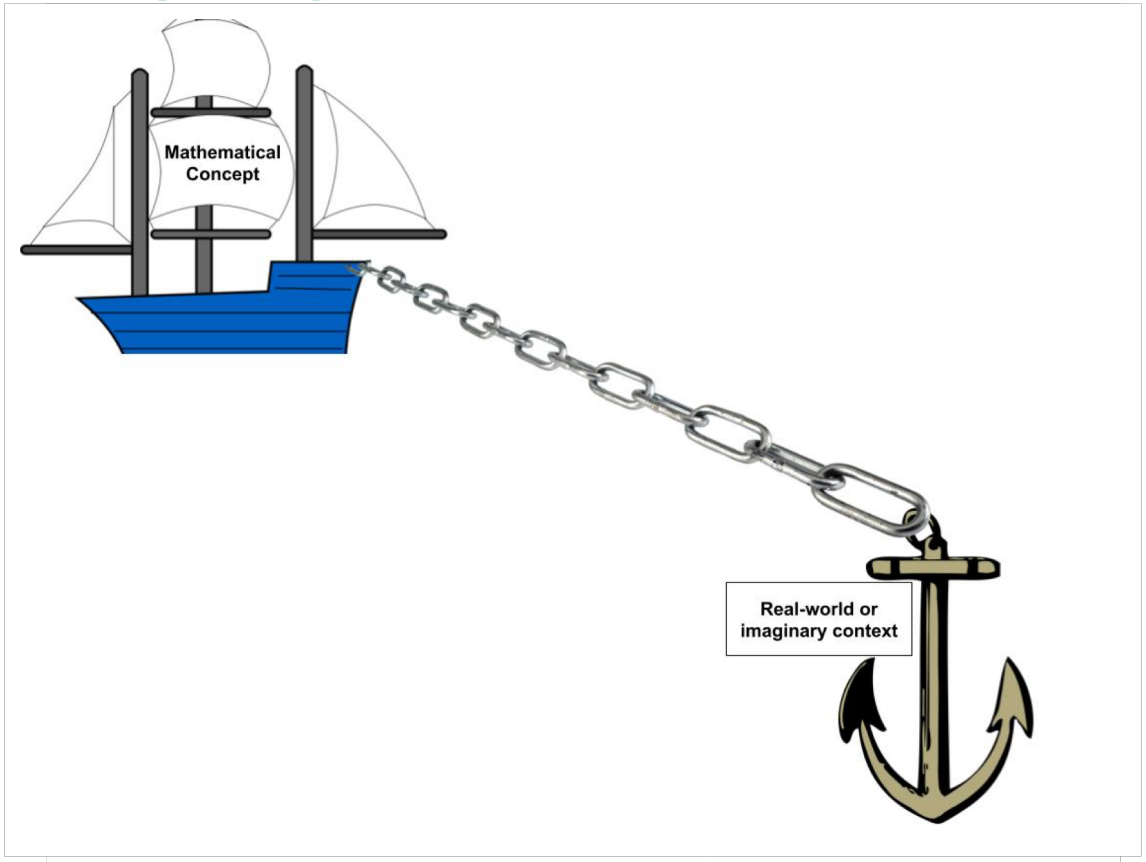


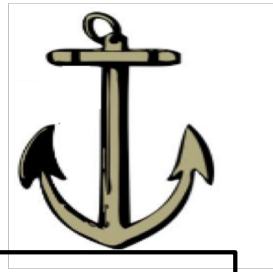
UNC CHARLOTTE

Recommendations

- Create an anchor, which is more than a hook, by emphasizing the big mathematical ideas as you introduce the problem purpose.
- Sequence from informal to formal and ask questions aimed at helping students make sense of the formal representations in terms of the informal representations.
- Help students attend to the connections across contexts, so that they understand how they are mathematically related.

Bridging to non-contextual examples





non-contextual

UNC CHARLOTTE

Bridging to non-contextual examples

What's in the Mystery Bag?

Focus Question:
Who will keep up with the King's coins?

The King loves to count his gold coins so one day the Jester wanted to play a game with the King. The Jester took an unknown amount of coins and placed them into pouches (each pouch contained the same amount). He would then ask the King to figure out how many coins were placed into each pouch using similar pictures as below.

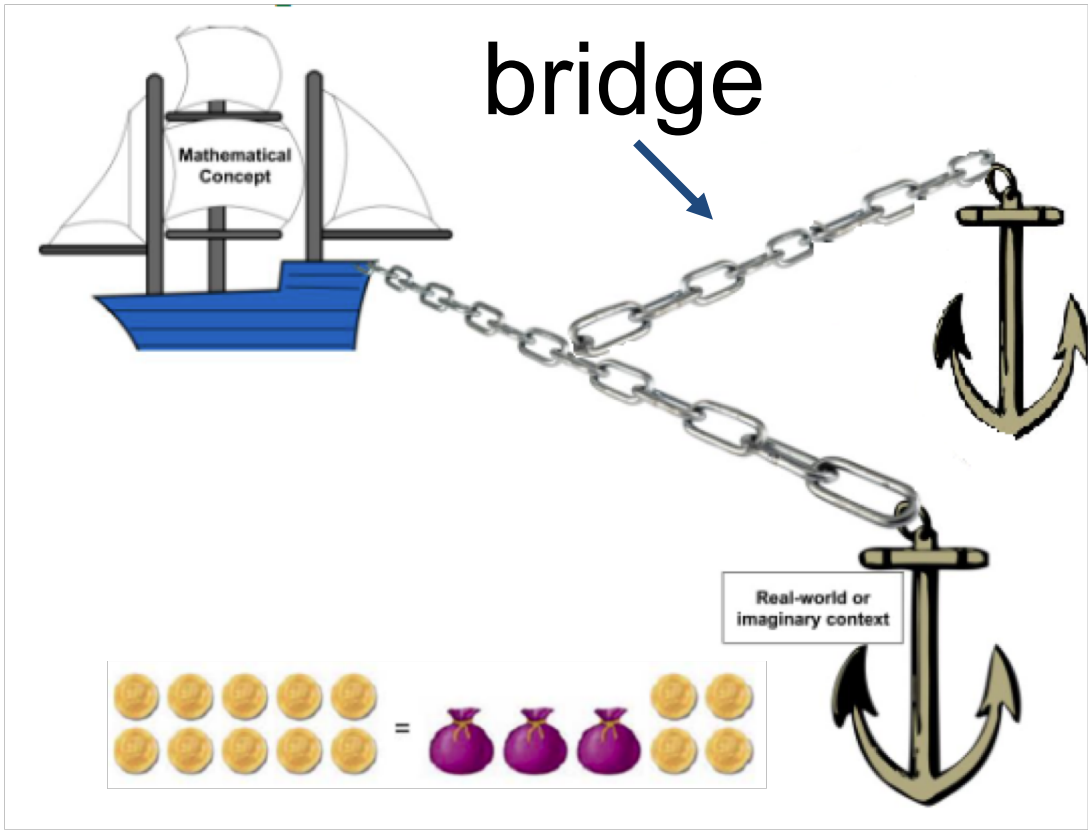
How many coins are in each pouch?

UNC CHARLOTTE

The non-contextual goal...

Solve $7x = 5x + 5$

Bridging to non-contextual examples



$7x = 5x + 5$

non-contextual

UNC CHARLOTTE

Where do you see bridges between the contextual and the symbolic?

=

Equation

Solution

Steps/Work

1.

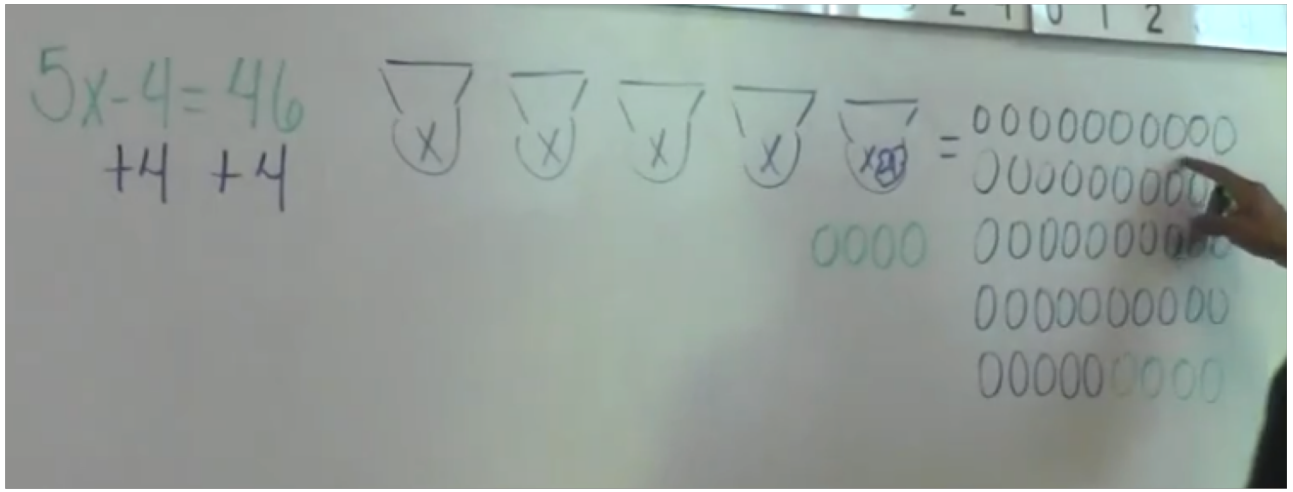
2.

Representing steps symbolically

1.

2.

UNC CHARLOTTE



[After drawing 4 coins on the left and asking what needs to happen on the right?

T: We have to add the coins on. I would show it in the picture like this, right? [adds four coins to right]... How would I show it in the actual equation?

S: You would add four to forty six.

…

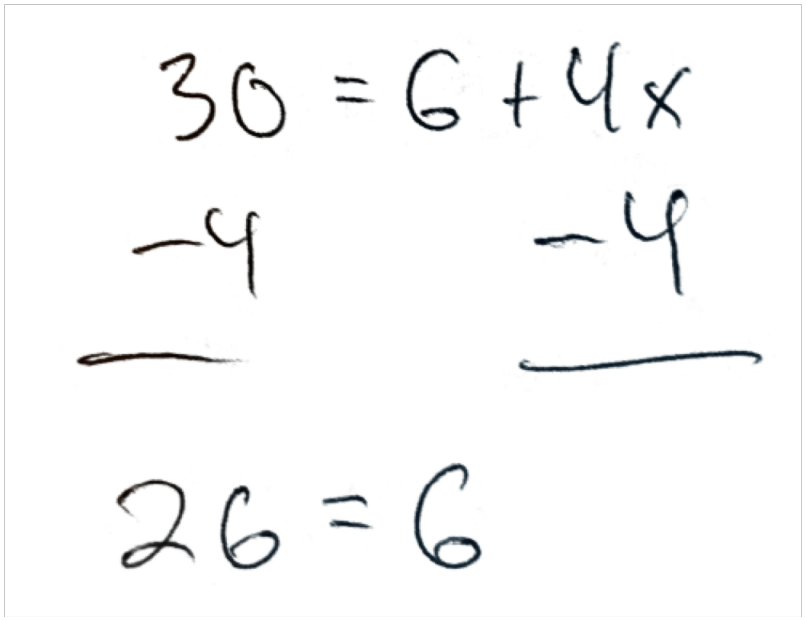
T: So I have to add coins here (on the left side of equation) and I also have to add coins here on this side as well (on the right side)

Solve each equation below. Draw a picture of pouches and coins if you need to.

1. $30 = 6 + 4x$

1. $7x = 5 + 5x$

You see this…



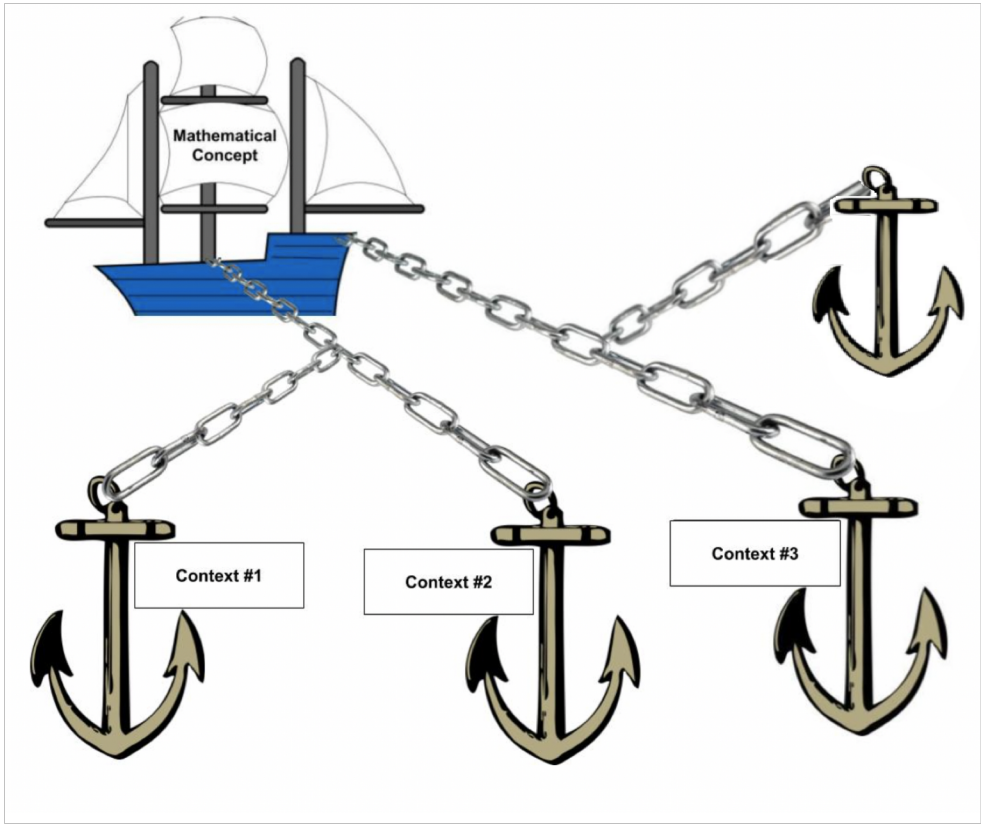
what do you do?

UNC CHARLOTTE

Recommendations

- Create an anchor, which is more than a hook, by emphasizing the big mathematical ideas as you introduce the problem purpose.
- Sequence from informal to formal and ask questions aimed at helping students make sense of the formal representations in terms of the informal representations.
- Help students attend to the connections across contexts, so that they understand how they are mathematically related.
- Intentionally bridge between contextual and non-contextual tasks, so that students are able to leverage their contextual experiences when they encounter non-contextual tasks.

Anchors and Bridges



non-contextual

UNC CHARLOTTE

Thank you!

Jerold Griggs
jerold.griggs@kcs.k12.nc.us

Luke Reinke
LReinke@uncc.edu

Handout has a link to the Aliens Ratio unit.

UNC CHARLOTTE