CADRE Learning Series:
Using Video in DRK Research

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Project Overview

Video in the Middle

An NSF DRK12 *Design and Development Project*

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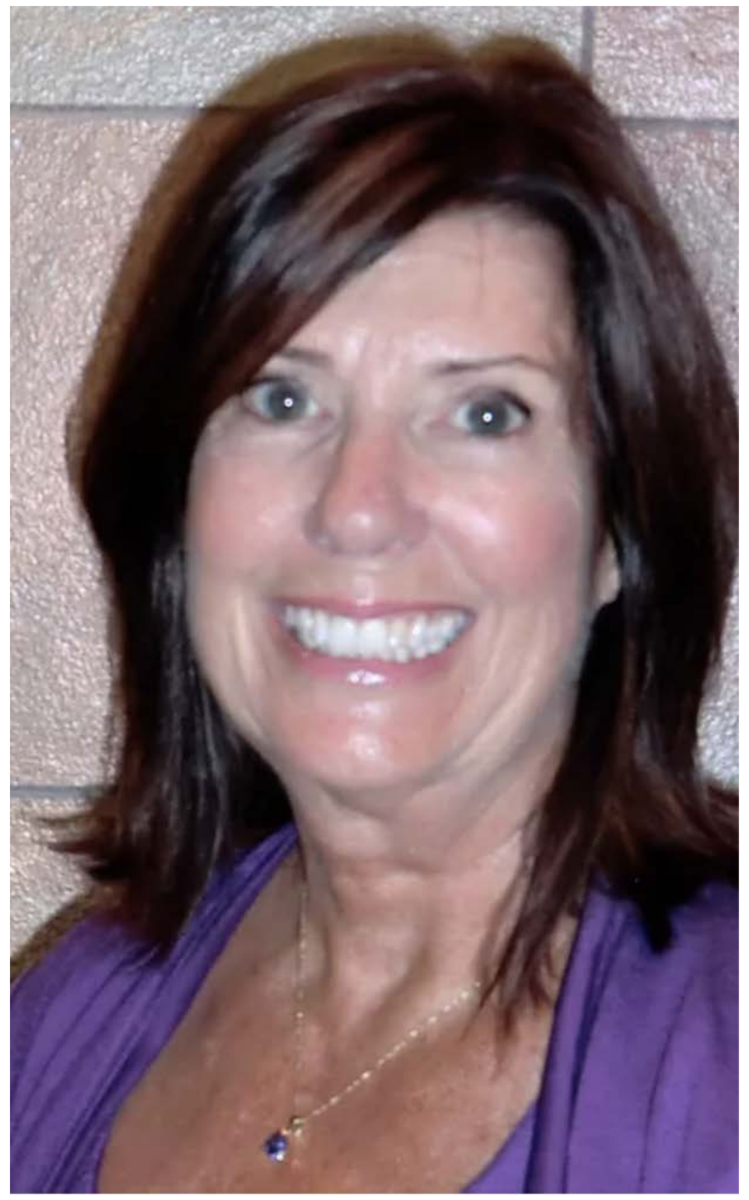
Video in the Middle Project Team



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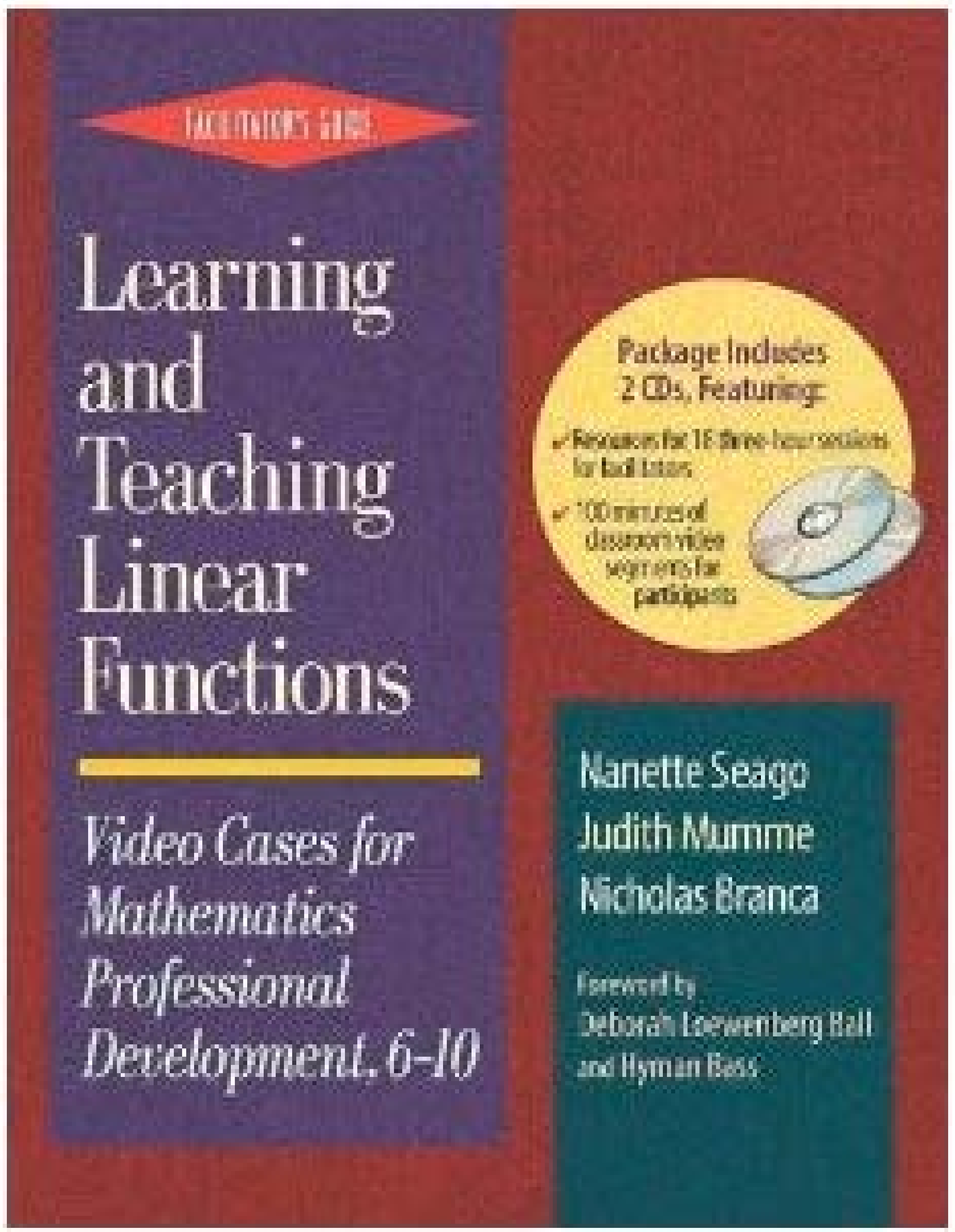
Video in the Middle Asynchronous PD Design

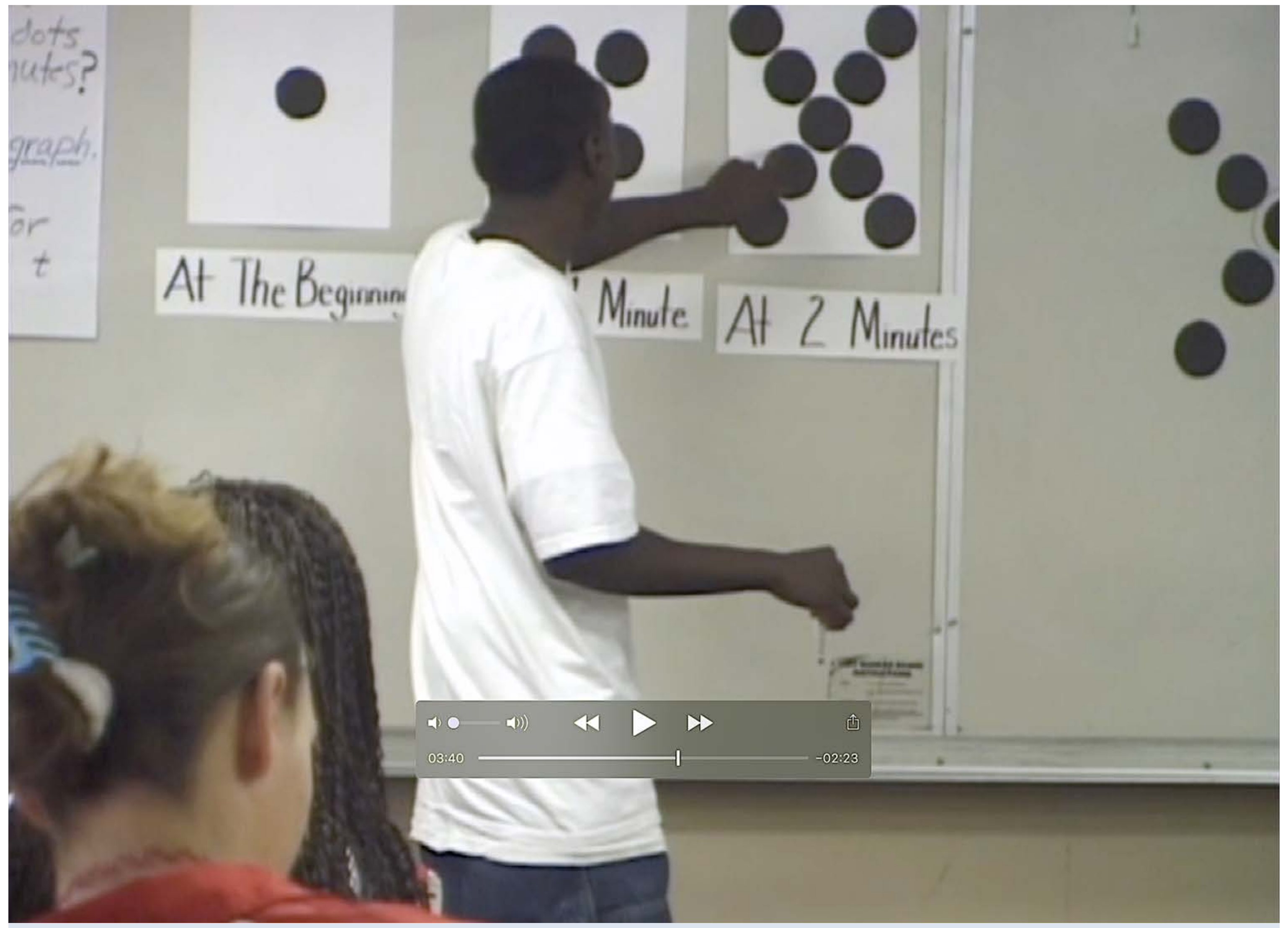
The PD components will be described through our four key design decisions.

Key Design Decision #1

Use video-based specified PD content and pedagogy that worked well in the past.

Adapted the Learning and Teaching Linear Functions Face-to-Face Video-Based Mathematics PD Materials to an Asynchronous Format





Create 40 open education resource two-hour modules, centered around ~5-minute video clips that present classroom instruction, student thinking and teacher decision-making. Focused on specified MKT goals.

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Key Design Decision #2

Create self-contained online modules no longer than two hours in length that utilize video at the center, surrounded by pre and post video activities that allow users choices around content and pedagogy goals.

Video in the Middle Two-Hour Module Design Structure

Pre-Video

0 Module Learning Goals

1 Explore Math Task

2 Share a Picture of Your Work on the VIM Community Wall

3 Consider Alternative Approaches & Perspectives

- *Examine Solution Methods document and compare to your and your peers' methods.*
- *Consider a mathematician's perspective*

Video

4 Review Classroom Context

5 Watch Classroom Video

6 Reflect on Lesson Resources (Lesson Graph and Solution Methods)

7 Analyze a Segment of the Transcript

Post-Video

8 Revisit Video with Mathematics Educator Comments

9 Reflect

"I used to think… Now I think…"

10 Bridge to Practice

11 Module Reflection on Learning

- *What did you learn from this module?*
- *What new ideas do you intend to take/use from this professional development experience?*

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Key Design Decision #3

Embed key facilitation moves (vanEs et al., 2014) into the prompts, activities, and discussion boards to focus on noteworthy events, student strengths and encourage teachers to make connections to their own teaching.

van Es, E. A., Tunney, J., Goldsmith, L T., & Seago, N. (2014). A framework for the facilitation of teachers' analysis of video. Journal of Teacher Education, 65(4), 340–356. https://doi.org/10.1177/0022487114534266

Video Activity: Analyze Transcript

7. Analyze and Annotate a Selected Section of Transcript

1.7 - Annotate Video Transcript - RCT1

Instructions:

The selected section of the transcript below focuses on Kirk's interaction with James about his recursive approach. As you read the transcript, consider:

- *What is James paying attention to?*
- *What is his focus?*
- *What is his argument for not counting the center?*

Post a comment where you notice an interesting moment and explain what makes this moment interesting.

(3:26) - James:	This right here, I wasn't worried about this in the center. I didn' really think of that as one. I was thinking like... 6

0 Image and Video comments

Paragraph 8 6

Paragraph 8, Sentence 3 6

Erica : James' Thinking
I think James was thinking of the "center" as being 5, not 1. Then, he was adding 4 to 5 each time.
REPLY
Feb 8

Zane : Still doesn't explain how come he didn't get 401 instead of 400!!!
REPLY
Feb 9

Ester : I think he forgot to add the first dot from the first picture. He added four to each one to get 400, but he didn't include the first picture which he would get 401.
REPLY
Feb 20

Facilitator : I think he was thinking on his feet. He disregarded the one, which was an error. When confronted with it, he switched to 5 as a revision or non-example? I am not sure which.
I might posed the question how many after 5 minutes and
Feb 11

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Post-Video Activity: Bridge to Practice

10. Bridge to Practice Activity

Step 1: Compare Kirk (Algebra I) and Alicia's (Grade 6) goals and launches of the Growing Dots lesson. How are they similar? How do they differ?

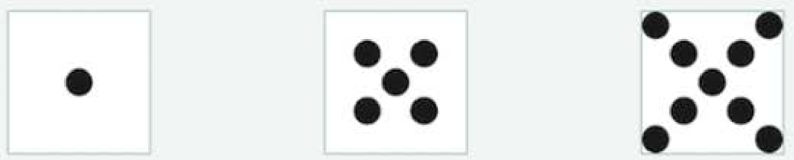
KIRK
ALGEBRA 1

Lesson Goals

- Find a formula for the number of dots at *t* minutes
- Link the formula to a visual pattern and a table
- Use color-coding to examine various methods and corresponding formulas

Kirk's Launch

Kirk puts the posters below on the whiteboard, one at a time. When all three are posted, he asks students to describe the pattern.



At the beginning **At 1 minute** **At 2 minutes**

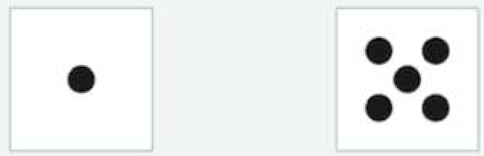
ALICIA
GRADE 6

Lesson Goals

- Find a variable and raise a question about what is going to happen.
- Find another variable that is in relation to the first one. Realize how they are related. Find an answer to develop the thinking process of functions.
- In addition, encourage students to find their own rules describing the changes to achieve developmenal thinking.

Alicia's Launch

Alicia begins the lesson by posting a paper with one dot in the center and another paper with five dots. She then pauses for a moment, asking students to think quietly about what they notice.



Step 2: What would your lesson goals be in using the Growing Dots lesson with your students? How might you launch the lesson with your students?

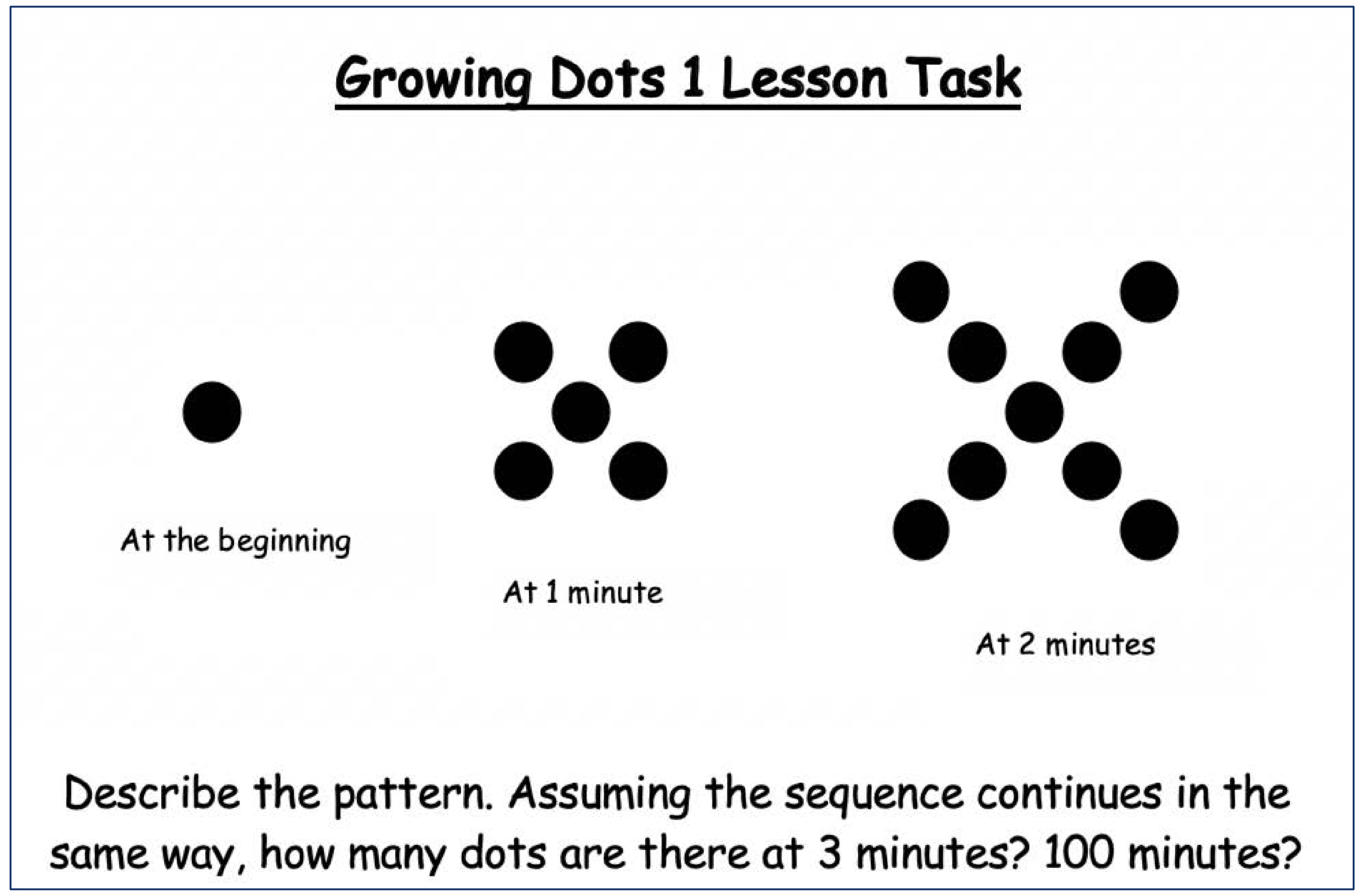
Key Design Decision #4

Insert alternative perspectives (peers, resources, mathematicians, mathematics educators) within various module activities across all three phases.

Pre-Video Activities

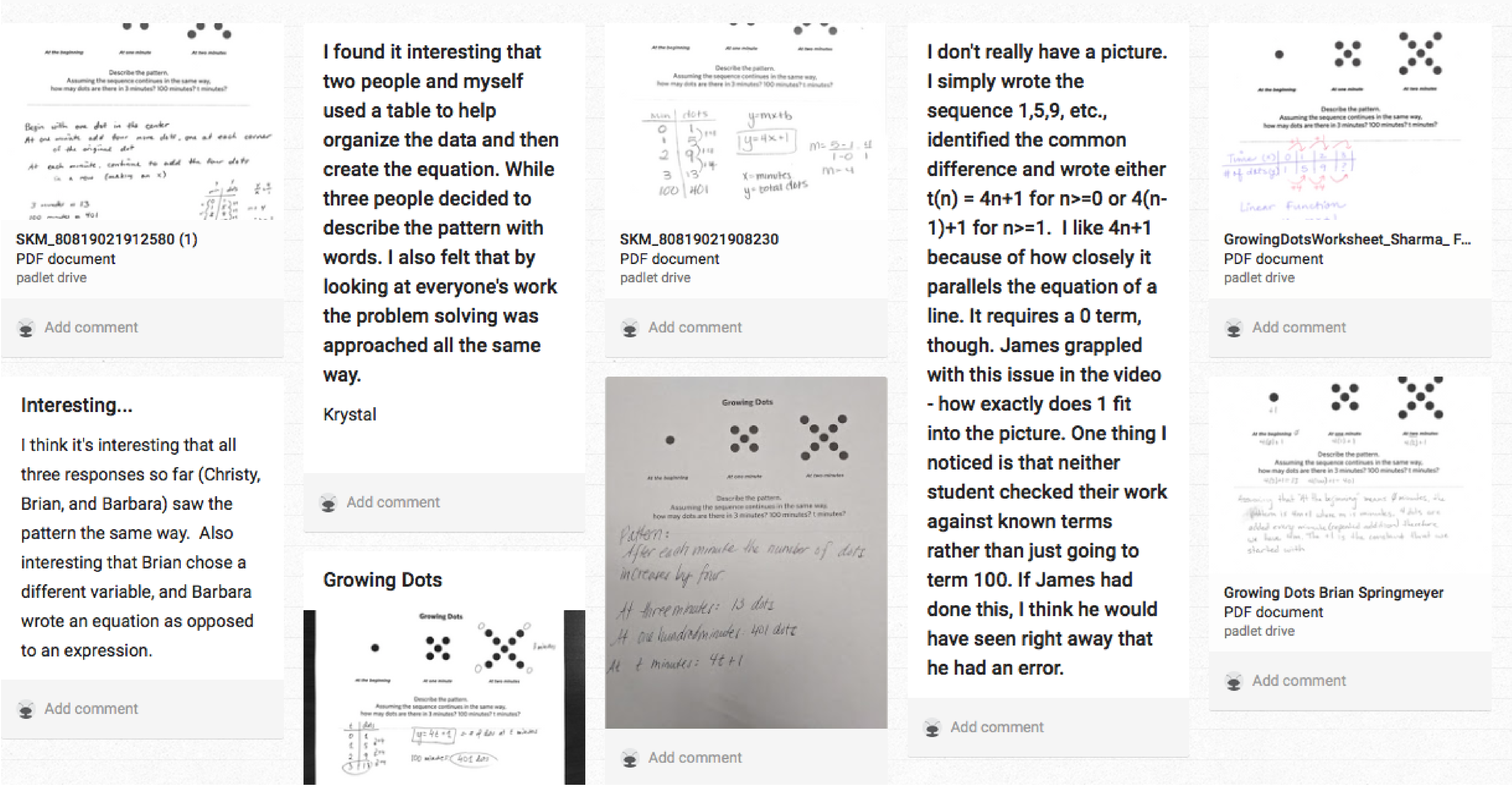
1. Explore the Math Task

Explore the math task that the students in the video worked on.



2. Share a Picture of Your Work on the Community Wall

Take some time to look at the solutions of others. Add comments to the posts of your peers and/or create a new post to add a general comment on the wall.



3. Consider Other Perspectives

Step 1: Consider and compare the various solution methods and corresponding representations by examining the Solution Methods Document.

Step 2: Consider the slide show of a Mathematician's perspective on the Growing Dots task.

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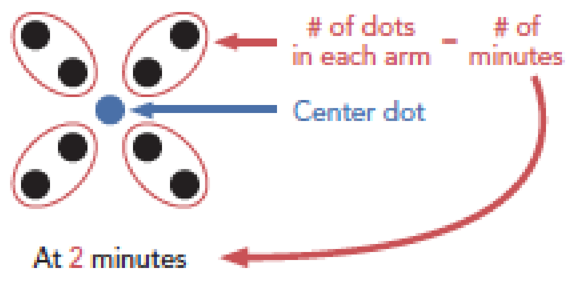
Video Activity

6. Compare Solution Methods Document to Student Methods

GROWING DOTS SOLUTION METHODS

1 Arms + center

Expression: $t4 + 1$ → Generalized formula: $d = t(n) + 1$



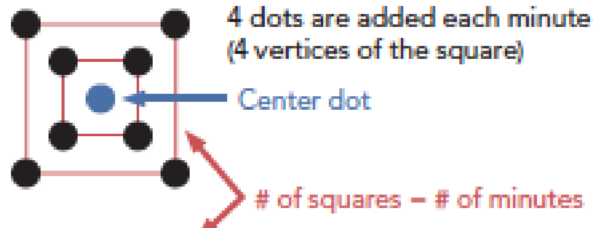
At 2 minutes

t	d
0	0(4) + 1
1	1(4) + 1
2	2(4) + 1
3	3(4) + 1
100	100(4) + 1
t	t(n) + 1

t = number of minutes
n = number of arms
d = total number of dots

2 Squares + center

Expression: $4t + 1$ → Generalized formula: $d = n(t) + 1$



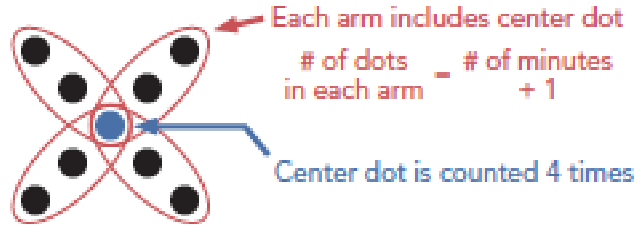
At 2 minutes

t	d
0	4(0) + 1
1	4(1) + 1
2	4(2) + 1
3	4(3) + 1
100	4(100) + 1
t	n(t) + 1

t = number of minutes
n = number of dots in each square
d = total number of dots

3 Extended arms – overcounted centers

Expression: $(t + 1)4 - 3$ → Generalized formula: $(t + 1)n - 3$



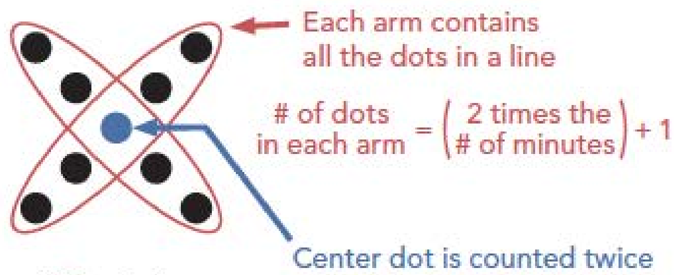
At 2 minutes

t	d
0	(0 + 1)4 – 3
1	(1 + 1)4 – 3
2	(2 + 1)4 – 3
3	(3 + 1)4 – 3
100	(100 + 1)4 – 3
t	(t + 1)n – 3

t = number of minutes
n = number of arms
d = total number of dots

4 Crossed arms – overcounted center

Expression: $2(2t + 1) - 1$ → Generalized formula: $n(2t + 1) - 1$



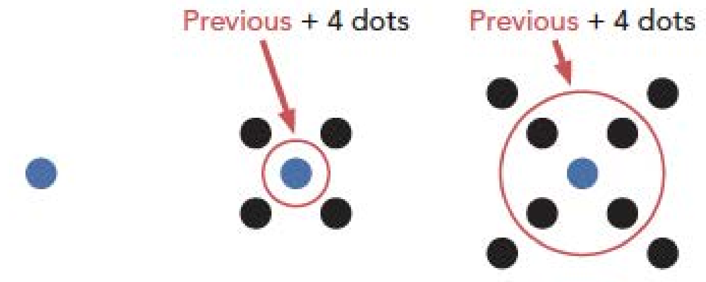
At 2 minutes

t	d
0	2(2 • 0 + 1) – 1
1	2(2 • 1 + 1) – 1
2	2(2 • 2 + 1) – 1
3	2(2 • 3 + 1) – 1
100	2(2 • 100 + 1) – 1
t	n(2t + 1) – 1

t = number of minutes
n = number of arms
d = total number of dots

5 Recursive method:

$1 + (4 + 4 + 4 + \ldots + 4 + 4)$ → Recursive formula: $f_{t+1} = f_t + 4;\ f_{initial} = 1$



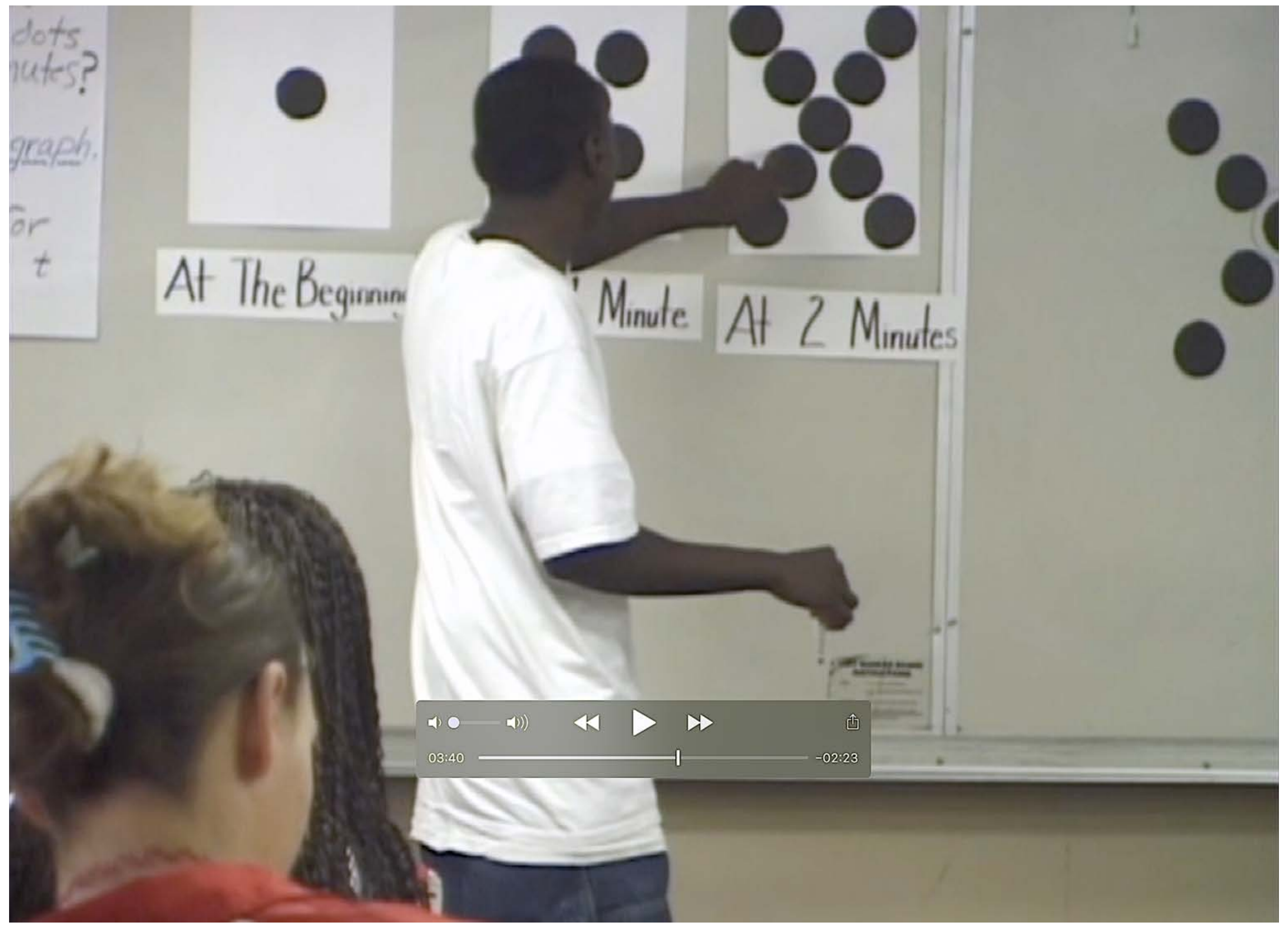
At the beginning 1 | At 1 minute 1 + 4 | At 2 minutes 5 + 4

t	d
0	1
1	1 + 4
2	1 + 4 + 4
3	1 + 4 + 4 + 4
100	$\underbrace{1 + 4 + 4 + \ldots + 4}_{\text{100 fours}}$
t	$\underbrace{1 + 4 + 4 + \ldots + 4}_{t\text{ fours}}$

t	d
0	1
1	1 + 4
2	5 + 4
3	9 + 4
100	397 + 4
t	1 + t4

Post Video Activity: Revisit Video

8. Revisit Video with Mathematics Educator Comments



Step 2: Consider a mathematics educator's comments

Read the mathematics educator comments below and, if you are engaging in this module with others, discuss and share your thoughts with colleagues.

Mathematics Educator Comments	
(02:06)	Danielle appears to have noticed the fact that there is a common difference between the terms in the sequence and uses a variation of the rule: The dependent variable, the value of the sequence, or number of dots *d*, at time *t* can be found by multiplying the independent variable, the time *t*, by the common difference and adding the result to the initial value of the sequence, or the value of the sequence at $t = 0$. Danielle uses the variable *x* to represent "how many dots out from the center," a notion that is related to the number of minutes, but she doesn't make the explicit connection. She states, "I got the equation *x* times four plus one."
(02:18)	In explaining her method, she describes the four as "all the dots except the center" and "Four ends. Like a circle. It's like a circle going around." Kirk, the teacher, uses the more common form of the equation in his summary, "Anybody else have four *x* plus one as their rule?"
(04:44)	James focuses on one aspect of the recursive nature of the sequence, the fact that the sequence grows by four each time. "I just took they added four every time. See like four, four, four. And that's why I got *x* plus four for the equation." He doesn't have the vocabulary or symbolism to help explain his thinking and his use of the same symbol *x* that Danielle used, which adds to the confusion. In effect, James has the idea that $S_n = S_{n-1} + 4$, but the issue of language and symbolism are not in his favor.

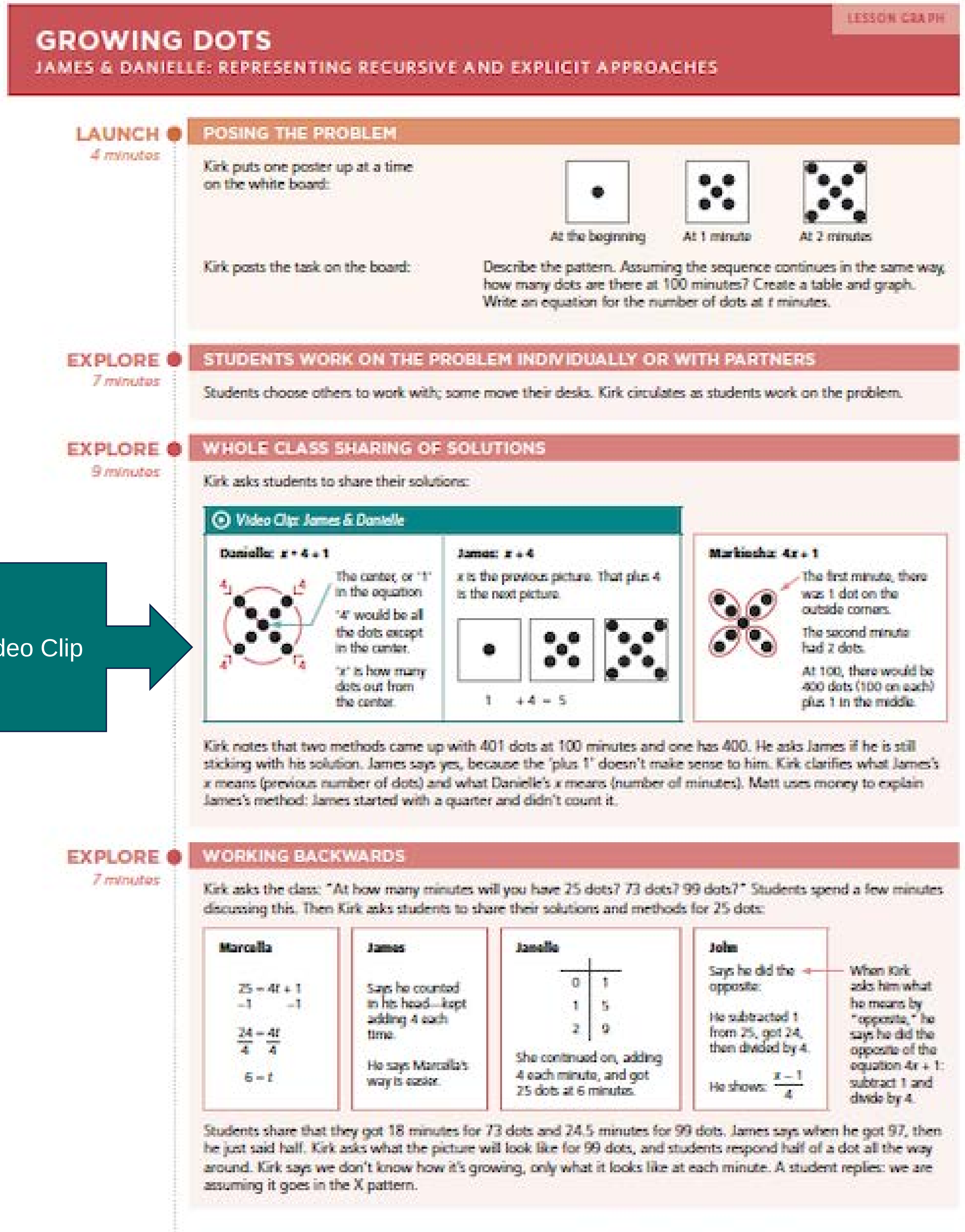
What Lessons Have We Learned So Far?

Lessons Learned

- We learned in both the face-to-face and asynchronous design the importance of situating the short video clips within the whole lesson so that teachers have a sense of the mathematical storyline of the lesson as well as what came before and after the video clip.

  We chose to use a "lesson graph" as a representation to do this.

Video Clip


LESSON GRAPH

GROWING DOTS

JAMES & DANIELLE: REPRESENTING RECURSIVE AND EXPLICIT APPROACHES

LAUNCH 4 minutes — POSING THE PROBLEM

Kirk puts one poster up at a time on the white board:

At the beginning | At 1 minute | At 2 minutes

Kirk posts the task on the board: Describe the pattern. Assuming the sequence continues in the same way, how many dots are there at 100 minutes? Create a table and graph. Write an equation for the number of dots at t minutes.

EXPLORE 7 minutes — STUDENTS WORK ON THE PROBLEM INDIVIDUALLY OR WITH PARTNERS

Students choose others to work with; some move their desks. Kirk circulates as students work on the problem.

EXPLORE 9 minutes — WHOLE CLASS SHARING OF SOLUTIONS

Kirk asks students to share their solutions:

Video Clip: James & Danielle

Danielle: $x \cdot 4 + 1$ — The center, or '1' in the equation. '4' would be all the dots except in the center. 'x' is how many dots out from the center.

James: $x + 4$ — x is the previous picture. That plus 4 is the next picture. 1 +4 = 5

Markiesha: $4x + 1$ — The first minute, there was 1 dot on the outside corners. The second minute had 2 dots. At 100, there would be 400 dots (100 on each) plus 1 in the middle.

Kirk notes that two methods came up with 401 dots at 100 minutes and one has 400. He asks James if he is still sticking with his solution. James says yes, because the 'plus 1' doesn't make sense to him. Kirk clarifies what James's x means (previous number of dots) and what Danielle's x means (number of minutes). Matt uses money to explain James's method: James started with a quarter and didn't count it.

EXPLORE 7 minutes — WORKING BACKWARDS

Kirk asks the class: "At how many minutes will you have 25 dots? 73 dots? 99 dots?" Students spend a few minutes discussing this. Then Kirk asks students to share their solutions and methods for 25 dots:

Marcella: $25 = 4t + 1$; $-1 \quad -1$; $\frac{24}{4} = \frac{4t}{4}$; $6 = t$

James: Says he counted in his head—kept adding 4 each time. He says Marcella's way is easier.

Janelle: 0 | 1; 1 | 5; 2 | 9. She continued on, adding 4 each minute, and got 25 dots at 6 minutes.

John: Says he did the opposite: He subtracted 1 from 25, got 24, then divided by 4. He shows: $\frac{x-1}{4}$ — When Kirk asks him what he means by "opposite," he says he did the opposite of the equation $4x + 1$: subtract 1 and divide by 4.

Students share that they got 18 minutes for 73 dots and 24.5 minutes for 99 dots. James says when he got 97, then he just said half. Kirk asks what the picture will look like for 99 dots, and students respond half of a dot all the way around. Kirk says we don't know how it's growing, only what it looks like at each minute. A student replies: we are assuming it goes in the X pattern.

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Lessons Learned

- VIM modules allowed us to provide flexible and convenient access to high-quality learning opportunities and therefore allowed us to reach more teachers.
- Embedding key facilitation moves into the design appeared to support teachers' positive experiences. One teacher captured how the experience worked for her: "*I like this particular experience because I can go at my own pace, and it was still almost like it was facilitated because there were questions that you had to answer. We weren't having discussions necessarily, but there was group input*."
- The independent time that is unique to asynchronous online platforms allows time for teachers to step back and contemplate ideas at their own pace. Teachers found that this opportunity to pause and reflect independently before engaging with others gave them "space to think and space to share."