[Module 7 Overview Document]

Table 1: Timeline of Tasks in the Module

Timeline of tasks in the Module	Day 0	Homework	7.1 Introduction to the Sine Graph Desmos Task
	Day 1	20 min	7.1 Discussion Optional: Extend the Discussion: Task Design
		35 min	7.2 Launching a Technology-Mediated Math Task
		20 min	7.3 Noticing Student-Teacher Interactions
		Homework	7.4 Monitoring Student Thinking: Introduction to the Sine Function
	Day 2	15 min	7.4Discussion
		20 min	7.5 Noticing Student Thinking about Amplitude
		40 min	7.6 Noticing Student Thinking about Period
	Day 3	40 min	7.7 Designing a Sequence of Tasks (optional project)

7.2 Facilitation Notes

The focus of this task is the effective launch of a high cognitive demand task that incorporates math action technology. The task begins with framing what an effective launch of a high cognitive demand task that includes a math action technology includes. We adapted Jackson et al.'s (2013) elements of an effective launch to include the role of technology in a launch.

If you are using this task out of the order of the modules, keep in mind that it assumes teachers are familiar with the math task framework (Figure 1) and the importance of maintaining cognitive demand of a task. *Tasks as set up by teachers* is what is now commonly referred to as the *task launch*. In addition, it assumes teachers have already engaged in 7.1 Introduction to the Sine Graph Desmos task.

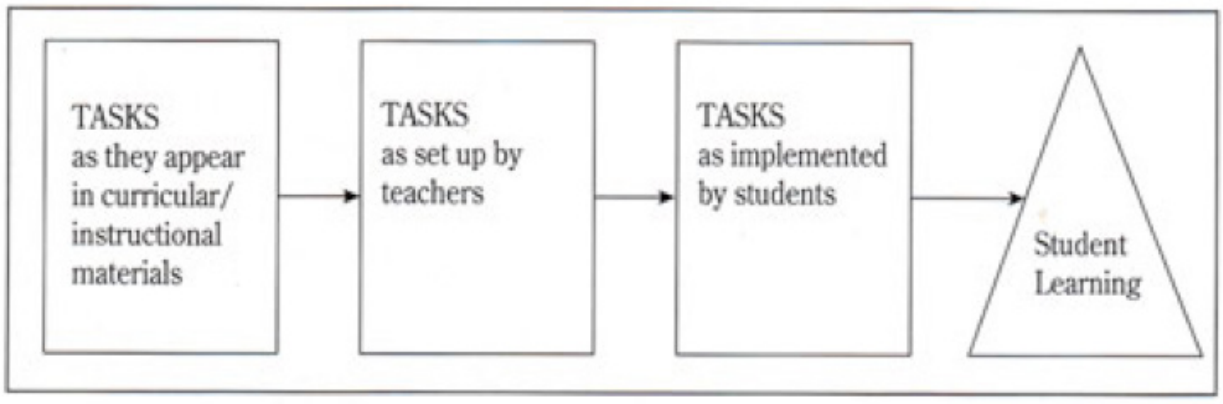

Figure 1: Stein & Smith, 1998, pg. 270

Note: "Tasks as they appear in curricular/instructional materials" is addressed in Chapter 2 of the PTMT Algebra materials.

We recommend having teachers read Jackson et al. (2013) prior to doing this task. It is helpful to ask teachers to consider what would be important to add to Jackson et al.'s four elements if the task being launched includes the use of a math action technology. After recording their ideas, pass out the task sheet. Compare and contrast their list of brainstormed ideas with the descriptions in the task. The descriptions (adaptations in red) are included below for your reference.

1. **Discuss the Key Contextual Features of the Task:**
   If the task is situated within a context, some students might have trouble getting started because the context or scenario is unfamiliar. Thus, it is important to discuss any features of the context of the task that might be unfamiliar. You might do this through sharing pictures or video, asking students to imagine the situations, *using digital simulations*, or by making connections to people, places, or things that you think might be more familiar to them.

2. **Discuss the Key Mathematical Ideas of the Task:**
   Being able to engage in the task means being able to interpret key mathematical ideas presented in the task. This includes addressing basic barriers regarding language and ensuring that students have an image of the mathematics represented in the task. *If the task includes dynamic representations of the key mathematical ideas, it is important that the launch include ways to interact with the technological representations to investigate the key mathematical ideas.*

3. **Develop Common Language to Describe Key Features:**
   Effective launches are those where you don't just talk to the students, but engage them in the conversation so that a common language is developed when identifying the key features (contextual and mathematical) of the task that are central to students successfully beginning the task.

4. **Maintain the Cognitive Demand:**
   Throughout the launch, it is important that the cognitive demand of the task is not lessened. For example, when discussing the key mathematical ideas, it is very important not to suggest methods to solve the task. Doing so robs students of the opportunity to develop important understandings and practices.

(adapted from Jackson et al., 2013)

After teachers discuss the key elements of an effective launch generally, it is an appropriate time to set up this specific task. Here teachers will first consider what they think would be important to include in a launch of the Introduction to the Sine Graph Desmos task and then compare their ideas to what the teacher, Ms. Fye, actually did in her launch of the task. Finally, teachers will plan how to launch a similar task using a

different technology, explaining how their launch addresses the elements of an effective launch.

It is very important to emphasize that this task was launched in a remote class setting, so choices made (in both design of the task and the way it is launched) might be different than if the task were used face to face. In the example here, Ms. Fye has included her launch in the first few pages of the task itself. Q4 is intended to support teachers in thinking about how to launch a task without having the launch included in the task prompts themselves. This question is very important to include as without it teachers tend to mimic Ms. Fye's task design in all tasks and disregard tasks that do not have the launch included as specific prompts.

Note: If you use video annotating software with your teachers (e.g., VideoAnt, GoReact), you might consider doing Q2 in the software with teachers tagging specific video clips and then using the comments to explain their tags.

7.2 Sample Responses
Launching a Technology-Mediated Math Task

The mathematical tasks you pose during class determine the nature of your students' engagement with mathematics. However, as we all know, you can't just put a task in front of your students and expect them to engage with it perfectly. The way you introduce tasks to your students makes a big difference in the effectiveness of your lesson. Good tasks only live up to their potential if students productively engage in them. The ways you set up a task (i.e., introduce it) is often referred to as "launching the task".

An effective launch sets students up for meaningful engagement, provides support needed to promote opportunities for productive struggle, and helps to maintain the cognitive demand of the task. As you can imagine, this is especially important when using a technology-mediated mathematics task. Consider these four important elements of setting up high-cognitive demand tasks to support all students' learning:

1. ### Discuss the Key Contextual Features of the Task:
   If the task is situated within a context, some students might have trouble getting started because the context or scenario is unfamiliar. Thus, it is important to discuss any features of the context of the task that might be unfamiliar. You might do this through sharing pictures or video, asking students to imagine the situations, using digital simulations, or by making connections to people, places, or things that you think might be more familiar to them.

2. Discuss the Key Mathematical Ideas of the Task:

Being able to engage in the task means being able to interpret key mathematical ideas presented in the task. This includes addressing basic barriers regarding language and ensuring that students have an image of the mathematics represented in the task. If the task includes dynamic representations of the key mathematical ideas, it is important that the launch include ways to interact with the technological representations to investigate the key mathematical ideas.

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Effective launches are those where you don't just talk to the students, but engage them in the conversation so that a common language is developed when identifying the key features (contextual and mathematical) of the task that are central to students successfully beginning the task.

4. Maintain the Cognitive Demand:

Throughout the launch, it is important that the cognitive demand of the task is not lessened. For example, when discussing the key mathematical ideas, it is very important not to suggest methods to solve the task. Doing so robs students of the opportunity to develop important understandings and practices.

Context

Ms. Fye is using the Introduction to the Sine Graph Desmos Task in a remote synchronous class session.

This is an introduction task focused on reasoning about the relationship between the equation of a sine function and characteristics of the sine graph. Ms. Fye designed the task knowing that her students had explored the relationship between function structure and their graphs by varying the parameters for many different function families. With that in mind she had the following learning goals:

- Students will recognize the connection between the structure of a sine function equation (i.e., $y = a\sin(bx) + k$) and its related graph with respect to amplitude, midline, and period. Specifically,
    - Amplitude is $|a|$
    - Midline is $y = k$
    - Period is $\frac{360}{|b|}$

Specific performance goals include:

- Given a sine function equation, students will determine the amplitude, period, and midline without graphing.
- Given the amplitude, midline, and period, students will determine the function equation.

- Given the graph of a sine function, students will determine the amplitude, period, and midline.
- Given the graph of a sine function, students will determine the function equation.

Q1. Given your engagement with the Introduction to the Sine Desmos task and what you have read about launching tasks, what do you think it would be important to attend to when launching this task with students in Ms. Fye's class? Explain.

Note: For this task, what is noticeably missing compared to the task in Jackson et al. (2013) is context. Most teachers will say there is no context to discuss for the first element. This is not a typical contextual task (i.e., in a real-ish scenario), as such the contextual features are not as easy to identify. However, there is context provided—an image of a graph. In this task, the context is on page 2 where an image and a title is provided.

Teacher responses typically include the following:

- That students know that the sine wave goes on and on in both directions.
- Students know how to use the sliders and connect the value of the slider to the parameter in the function and to the graph of the function.
- Students know how to use Desmos (turn pages, type)
- Don't lower the cognitive demand by accidentally using terms or relationships you intend them to explore.

Q2. Next, watch this video clip of Ms. Fye launching this task in a remote synchronous class. Identify moments in the video where you see Ms. Fye enacting any of the four elements of an effective launch (listed above). Note the time, what she does, and how it addresses one (or more) of the four elements.

Ms. Fye Launching the Task

Ms. Fye's Teacher Dashboard

There is a link to the teacher dashboard as it looked at the end of Ms. Fye's class. You can examine the pages Ms. Fye referred to as she launched the task.

Teacher responses typically include the following:

Discuss the Key Contextual Features of the Task

- Time [0:30-1:10] - she asks students to record what they notice about the graph of the sine function. Then she shares their noticings [1:17-5:21].
- Time [0:30-5:21] - Ms. Fye first restricted the students to work only on pages 1 - 3. She began by reading page 1 and noting they are focusing on degrees

today (suggested they'd do it differently tomorrow). Then she showed page 2 and how they could click to see a larger graph window. She said she wanted them to look at it, drag it around and see what they notice. Then she showed slide 3 and said she wanted them to record what they noticed and highlighted some of the features they have discussed in the past she'd like them to notice (more than what is listed in the hint). And then gave them a few minutes to do so. When she brings them back she reads through all of their responses.

Discuss the Key Mathematical Ideas of the Task

- Time [5:25-7:41] - Ms. Fye has students play with the sliders on page 5 and record what they notice the sliders do on page 4. She noted that they are connecting things they know from other function families to this function. Then she opened the rest of the task up explaining that they were going to be given a new definition and then were to use the sliders to describe the relationship between the feature being defined and the structure of the sine function. This made sure students knew they were to be focused on the sliders, the new definitions, and the relationship between the function and the graph.

Develop Common Language to Describe Key Features

- Time [4:20-5:21] - after reading through the students noticings on page 3 the teacher went back to the graph on page 2 and did a recap of things that students noticed and pointed to them on the graph using the terms students used. For example, she said "some people noticed the maximum and minimum values" and she clicked on a max and a min to show those points. This helped develop a common language to describe those key features which would be very important later as those terms are used in the new definitions in the task.
- Time [7:43-8:36] - After summarizing students ideas about what the sliders do on page 4 Ms. Fye opened up the rest of the task and showed them that they would be exploring new features of the sine function and for each they would be given a name, definition, and image to go with it. This helped to make sure students were starting with a common definition and image as they explored the function.

Maintain the Cognitive Demand

- Time [0:39-1:05] - when she read page 3 and added more hints I thought she might be lowering the cognitive demand of the task, but then I realized she was just trying to get them to enter the task using their prior knowledge and those hints weren't related to the learning goals of the task.
- Time [1:17-5:21] - when she was reading students' response to page 3 she might have lowered the cognitive demand if she reacted to the student response that used terms like amplitude, but she didn't react in any way so I don't think it did.

- Time [7:43-8:36] - students were provided a definition and an image of the definition for each new term, but were not told how the new term was related to the structure of the function. So the cognitive demand was maintained.

Q3. Reflect on the way in which Ms. Fye launched the task. Describe how she used her students' ideas in this process.

Teacher responses typically include the following:

- Ms. Fye shared her teacher dashboard and showed that she was reading the students' ideas as she discussed pages 3 and 4. She highlighted how they were drawing on their prior knowledge.
- Ms. Fye used students' written responses in Desmos in the launch process. Students did not speak during this time.
- The teacher first scrolled through and read student responses out loud on page 3 and then she moved to page 2 (the graph) and did a summary of their ideas by pointing out what they said and how it related to the graph. She then did the same with pages 4 and 5 where they were playing with sliders and just noticing how they affected the graph. She summarized what they noticed using their words.

Q4. Ms. Fye thought carefully about the way she planned to launch this task and noted it in her planning guide. Compare and contrast what you noticed in the video with what she planned for her launch of the task.

Here is her planning guide for implementing the task.

Teacher responses typically include the following:

- They are the same.
- There is more detail in the actual launch than what is written, but they are pretty much the same.
- There is just a guiding framework in what is written in the plan. She says she is going to use the first 5 pages, but does not provide details about how. It is probably plenty to remind her as she works though. Ms. Fye first restricted the students to work only on pages 1 - 3. She began by reading page 1 and noting they are focusing on degrees today (suggested they'd do it differently tomorrow). Then she showed page 2 and how they could click to see a larger graph window. She said she wanted them to look at it, drag it around and see what they notice. Then she showed slide 3 and said she wanted them to record what they noticed and highlighted some of the features they have discussed in the past she'd like them to notice (more than what is listed in the

hint). And then gave them a few minutes to do so. Then she used their responses and highlighted what they noticed. After that she moved them to pages 4 and 5. She told students to play with the sliders on page 5 and record what they do on page 4. She then summarized their ideas using their words and noted that she noticed they used some of what they know from other functions and some new features as well. Finally, she opened the rest of the activity and explained what they would do going forward - learn about new features with the sliders.

- Her written plan is not scripted, but it is clear that she thought about how not to lower the cognitive demand, how to make sure students understood the context and the technology. It took much longer in class than it looked like it would on paper.

Imagine Ms. Fye had designed the same task using a worksheet and an NCTM dynamic graphing applet rather than Desmos Activity Builder.

Introduction to Sine Graphs Task

Q5. Consider how you would launch this same task if you were to use it in a face to face (not remote) classroom setting. Describe how you would launch the task. Then explain how your launch addresses the elements of an effective launch.

Teacher responses typically include the following:

- Most teachers will describe a launch very similar to what Ms. Fye did for the Desmos Activity. Their responses vary in detail about how they will include students in the development of shared language, making sense of the context, and learning how to interact with the technology. Sometimes they overlook showing students how to show the base (parent) function and noting not to change the function family. A few examples follow.
- I would do the launch very similarly to Ms. Fye. I would display the applet and ask students what they notice about the graph as it is shown. I would record all of the features of the graph that they note on the board and point to them on the graph as well. I expect this to be things like the maximum and minimum, x intercepts, y intercepts, when it is increasing and decreasing, and that it looks like a wave. I will point out here that what they are looking at is the parent function for the sine graph and will record that equation on the board so they have it to refer to later. Then I would point to the part of the applet in grey and ask what they think they can do with it. When someone suggests changing a value in one of the white boxes. I will change it to what they suggest and ask what they notice happens using the drop-down boxes. I will then point out that we are going to be exploring the sine graph today, so we do not want to change that part of the function but we do want to explore how the other parameters affect the graph. Then I would ask them to take a

few minutes to play around with a, b, c, and d and see what they notice. I will show them that they can check the "show base function" button to see the parent function at the same time. After a few minutes of exploration, I would ask that they share what they notice emphasizing the connections they are making to prior function parameter explorations (e.g., horizontal and vertical shifts, horizontal and vertical stretch). Finally, I would have them look at the worksheet and explain what the goal is today, pointing out the definitions and images and that the goal is to explore these new terms using the applet and applying what they learn about each to making sense of sine graphs and equations.

- I will ask them what they notice about the graph and then I will show them how to use the drop-down boxes to change the parameters and how to click and show the base function. Once they know how to use the applet I'll summarize the goal of the activity looking at amplitude together and then get them started.
- I would launch the task by asking students what they notice about the sine graph. Then I would tell them to change the values of a, b, and d and share what they notice. Then I would have them read #1 on the activity and make sure everyone knows what is being asked.