[Module 1 Overview Document]

Table 1: Timeline of Tasks in the Module

Timeline of tasks in the Module	Day 1	75 Minutes	1.1 Comparing and Contrasting Tasks and Technology with a Focus on Digital Equity Read: McCulloch, A. W., Lovett, J. N., Dick, L. K., & Cayton, C. (2021). Positioning each and every student as a mathematical explorer with technology. *Mathematics Teacher: Learning and Teaching PK-12: Special Issue on Digital Equity and the Digital Divide, 114*(10), 738–749.
		Homework	1.2 Noticing Student Thinking: Quadratic Functions - Making Sense of "h"
	Day 2	30 Minutes	1.3 Introduction to Noticing Students' Mathematical Thinking in a Technology-Mediated Learning Environment
		Homework	Read: Dick, L. K., McCulloch, A. W., & Lovett, J. N. (2021). When students use technology tools, what are you noticing? *Mathematics Teacher: Learning and Teaching PK-12, 114*(4), 272–283.

1.2 Facilitation Notes

Create a class code for the Desmos Quadratic Sliders task and provide the link to your teachers. We recommend asking teachers to log in so that the task will appear in their history, and they can revisit it at any time. In addition, they must be logged in to receive any feedback you provide.

[Desmos Quadratic Sliders]

The purpose of this task is to establish a need for teachers to learn the skill of professional noticing in the context of students' thinking with technology enhanced tasks. This will be used to introduce the framework that guides our work.

Once teachers have completed this task, move directly to the 1.3 Introduction to Professional Noticing in a Technology-Mediated Learning Environment.

Note: You will formalize the concept of noticing student thinking in the whole class discussion that follows this task (1.3).

1.2 Sample Responses
Noticing Student Thinking: Quadratic Functions - Making Sense of "h"

In the video you will see a pair of high school students currently enrolled in an Integrated Math 1 course working on a task in which they are being introduced to parameters of quadratic functions in vertex form (i.e., $f(x) = a\,(x - h)^2 + k$).

The learning goal for the lesson is:

- Students will understand the connection between the structure of a quadratic function in vertex form and its related graph with respect to the location of the vertex, whether it opens up or down, and the vertical stretch compared to the parent function.

Specific performance goals include:

- Given a quadratic function in vertex form, students will determine the location of the vertex
- Given a quadratic function in vertex form, students will qualitatively describe its shape with respect to the parent function
- Given a quadratic function in vertex form, students will determine if the function opens up or down
- Given a quadratic function in vertex form, students will describe its vertical stretch/compression related to the parent function
- Given a quadratic function in vertex form, students will sketch a graph
- Given a quadratic function in vertex form, students will write its equation in vertex form

Before going any further, take a moment to get familiar with the task.

Desmos Task

Now that you are familiar with the task, you are going to analyze a video of a pair of students, Sara and Julian, working on the same task. As was noted above, Sara and Julian are currently enrolled in an Integrated Math 1 course. They have been working with quadratic functions but have not been formally introduced to vertex form. This task serves as their introduction.

In this video Sara and Julian are working on page 2 and then 8 of the Desmos Quadratic Parameters Task.

Q1. Attend to (i.e., describe in detail) how the students determined the effect of the *h* slider on the graph of the quadratic function.

Most teachers note that the students move the sliders, but do not typically describe in detail how they use the sliders (e.g., what numbers they try, what they see when they change the values). Often once noting the use of the sliders, teachers jump to the students' final conclusions rather than describing how they get there. A few typical responses are shown below:

> First the students began playing around with the graph. The boy noticed that when the number was negative the graph was negative. They agreed that it changes what the value is, because it changes what the x is.
>
> Julian moves the slider left and right to see how it effects the function. Julian notices when the h value is in the negatives so is the quadratic function. Sara and Julian think that the h value on the slider gives the quadratic function a different value because it changes the x value.

It is not unusual for teachers to not explicitly mention the use of the technology explicitly at all in their responses. For example,

> Sara determined the h value changes the x value and where it's located on the graph

Finally, some teachers will focus solely on comparing what the students do to their own work on the task. For example,

> To determine the effect, the student did the same thing we did, they moved the dot on the left side back and forth.

Q2. Interpret the students' current (rough draft) understanding of the *h* parameter. Provide evidence from the video to support your claims.

Many teachers describe what they believe the students understand and do provide some evidence, that evidence sometimes refers to what they learn from watching the students' exploration. For example,

> Their current understanding is that the value of h decides where the starting point will be in relation to the x-axis. On the second part of the video they placed their initial point by rationalizing from their previous understanding of the h value.
>
> They both say that the h changes the value of the function because if it starts off at the origin and you move it over one left or right it then changes the x value of the function. They know that the h value is left to right.

It is typical for teachers to provide vague descriptions of the students' current understandings. In these cases, they often note something from the video as evidence of student understanding, but do not describe that understanding. For example,

> The students first found that the graph is negative as soon as they saw the equation. You can see this as 2:56 in the video. They started graphing the equation and they were saying stuff like "h, so it goes left and right." This lets us know that the students understand the concept of the h perimeter and how to graph it.
>
> At 3:20 in the video, Julian said that the h value goes left to right. They were correct about that, however, they put it on negative two instead of positive two. I believe they forgot that when the function is $(x-h)^2$, then it would be on the right portion of the graph. If the function were $(x+2)^2$ then they would have had it correct.

Finally, it is not unusual for teachers to include more description of what the students did (i.e., attending) in this response as they realize they needed to pay closer attention to be able to interpret the students' current understandings. For example, the teacher that wrote "First the students began playing around with the graph. The boy noticed that when the number was negative the graph was negative. They agreed that it changes what the value is, because it changes what the x is" for Q1 expanded their idea here writing:

> When the students first started trying to figure out the vertex of the graph, they originally put the dot at the wrong spot (positive 2) but then eventually realized that they were incorrect and moved it to the left side of the graph to show that it was negative. Afterwards, they went back to figure out if "H" went left to right in which it did and that helped them plot their graph. Looking at the graph, you see the students going on the right track and that was showed by them both communicating and talking to each other which helped bring their ideas and thoughts together.