[Module 1 Overview Document]

*Table 1: Timeline of Tasks in the Module*

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|---|---|---|---|
| **Timeline of tasks in the Module** | Day 1 | 75 Minutes | 1.1 Comparing and Contrasting Tasks and Technology with a Focus on Digital Equity<br>Read:<br>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:<br>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. |

## 1.3 Facilitation Notes

Start the discussion by noting one of the most important things you do as a teacher is notice and build on students’ mathematical thinking during instruction. Noticing student thinking is more complex when technology is involved.

Next, we recommend creating a list of what teachers ‘noticed’ in their responses to #1 and #2 on task 1.2.

Then, use the PowerPoint for introduction to framework to guide the rest of the discussion.

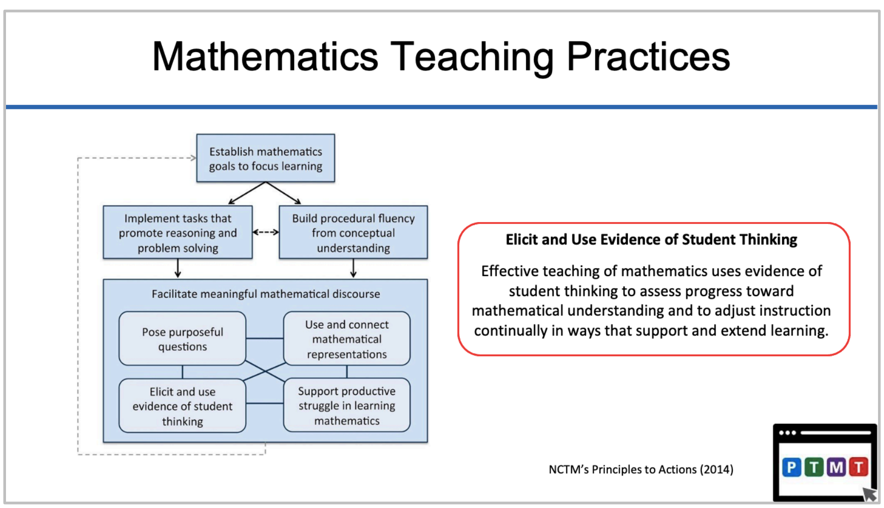
# 1.3 Commentary
# Introduction to Noticing Students' Mathematical Thinking in a Technology-Mediated Learning Environment

Before formally introducing teachers to the construct of noticing student's mathematical thinking in a technology-mediated learning environment, have them complete the 1.2 Noticing Student Thinking - Quadratic Functions: Making Sense of "h" task (this is ideally completed as homework). They will watch a brief video of a pair of students, Sara and Julian, working on a task in which they are being introduced to parameters of quadratic functions in vertex form.

Once teachers have completed this task, you can use the Introduction to Noticing PowerPoint to guide your discussion (slide descriptions are shown below).

*Table 2: Notes to guide your discussion when using the slides*

<table>
<tr><th>Slide</th><th>Notes</th></tr>
<tr><td>1</td><td>Title Slide</td></tr>
<tr><td>2</td><td>The intent of this slide is to use the NCTM Mathematics Teaching Practices, specifically eliciting and using student thinking, as grounding for the importance of learning to notice. Noticing is essentially going through this process, attending to students' mathematical strategies, interpreting their understandings, and then using that information to adjust your instruction.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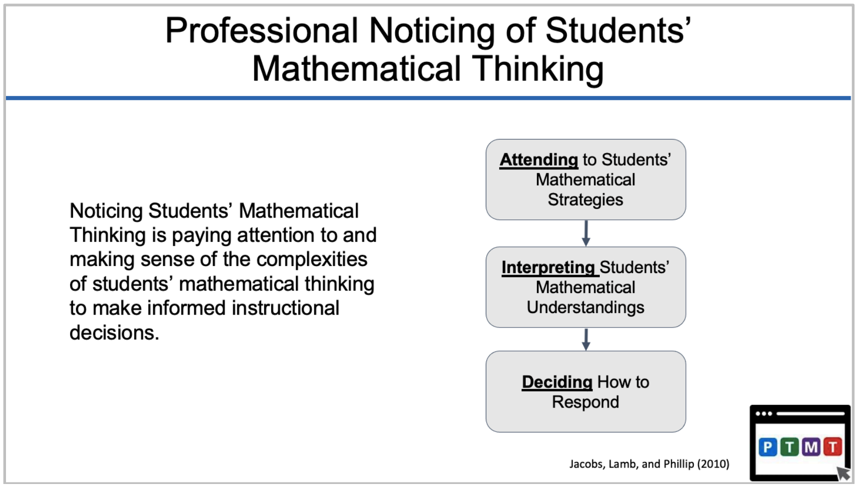
<tr>
<td>3</td>
<td>Here we introduce the 3 components of Professionally Noticing of Students' Mathematical Thinking as defined by Jacobs et al. (2010). The three components are intertwined, as they inform each other. We will refer to the practice generally as "noticing" and the three components as "Attend", "Interpret", and "Decide how to respond".<br><br>


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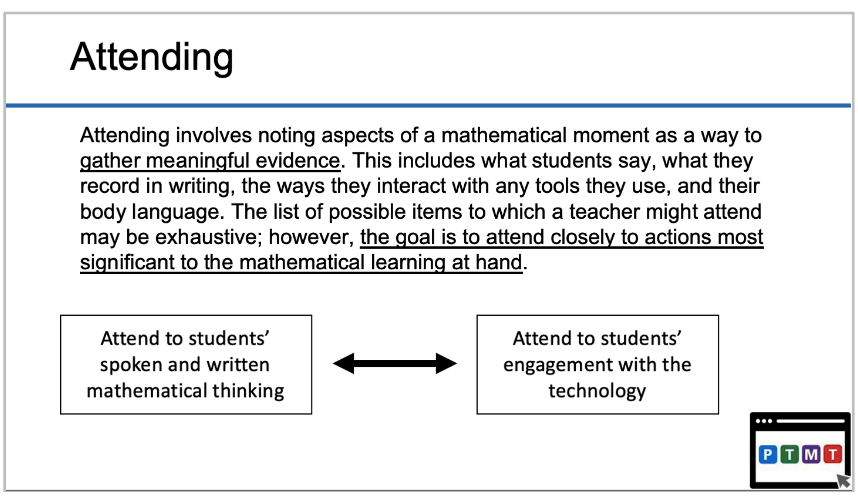
<td>4</td>
<td>Attend is often thought of as a play-by-play of what the student does while making sense of the mathematics task. (We suggest using that phrase as a reminder for teachers to include detail, not just broad generalizations)<br><br>
We have separated attending to students' written and spoken work and their engagement with the technology to highlight that teachers need to consider both and make sense of the coordination of the two when they are attending. For the PTMT-ESP modules, attending to students' thinking always involves their engagement with technology, thus this coordination is needed whenever the teachers are noticing.<br><br>


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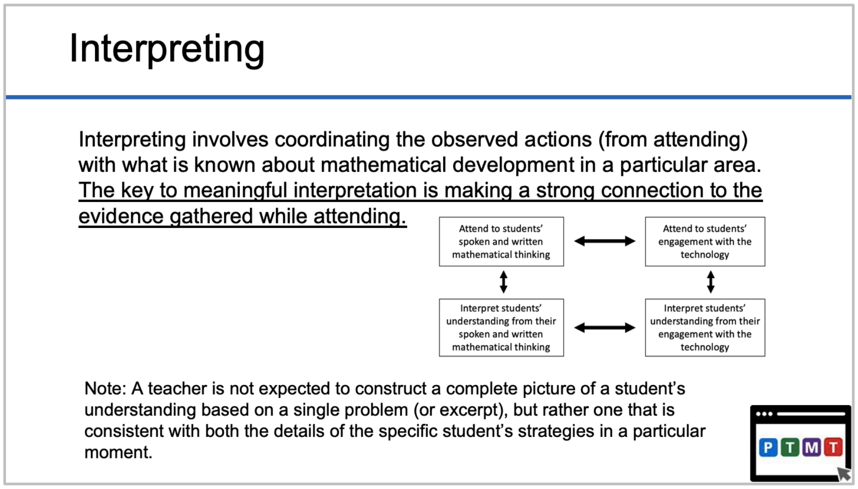
<tr>
<td>5</td>
<td>Similar to attending, for the PTMT-ESP modules, interpreting students’ thinking always involves their engagement with technology. A major component of evidence is how the students’ engage with the technology. Thus, coordinating the students’ written and spoken work, and their technological engagement is needed when noticing.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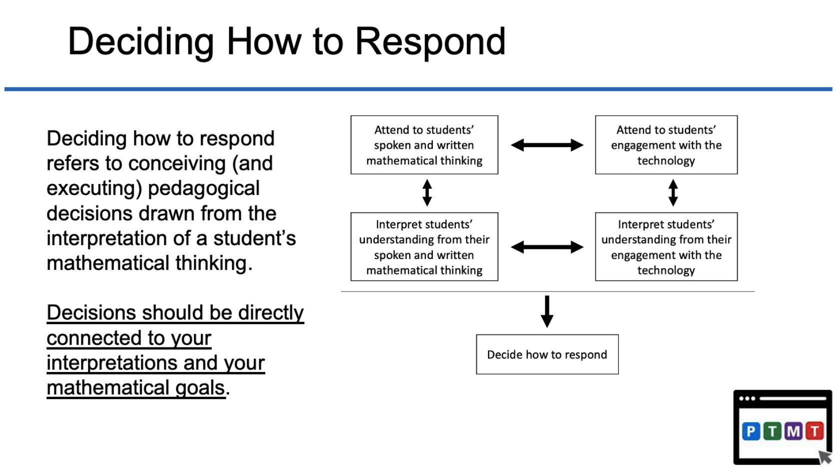
<td>6</td>
<td>We have separated decide how to respond from the other components of noticing to balance the importance of focusing on both spoken and written mathematical thinking, and tool-engagement prior to making instructional decisions; if a teacher focuses on one more than the other, then they may not be fully informed when making an instructional decision. In addition, when deciding how to respond to a student working in a tool-mediated environment, the teacher must consider how to position the tool (or not) in their response to support the student in moving forward. For this reason, deciding how to respond does not necessarily include students’ engagement with a tool.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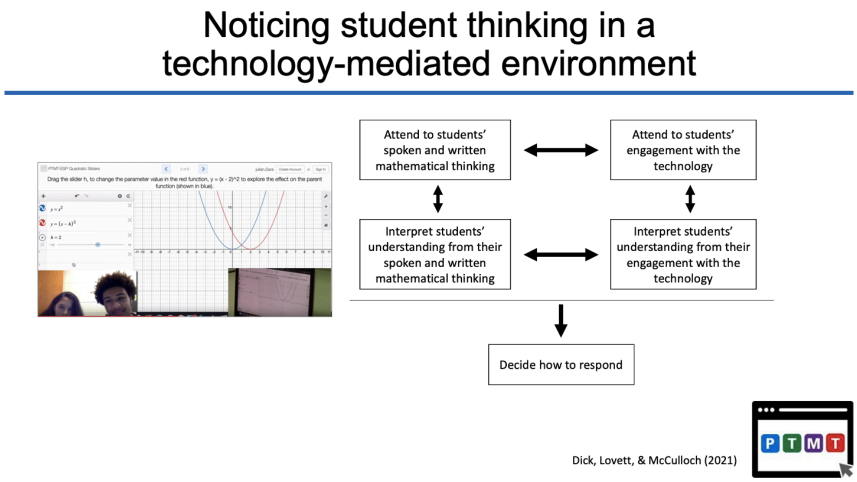
<tr><td>7</td><td>

Here ask teachers look back at their ***attend*** and ***interpret*** responses from earlier. How do they think they did? What would they notice differently if they were to watch the video again?

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<tr><td>8</td><td>

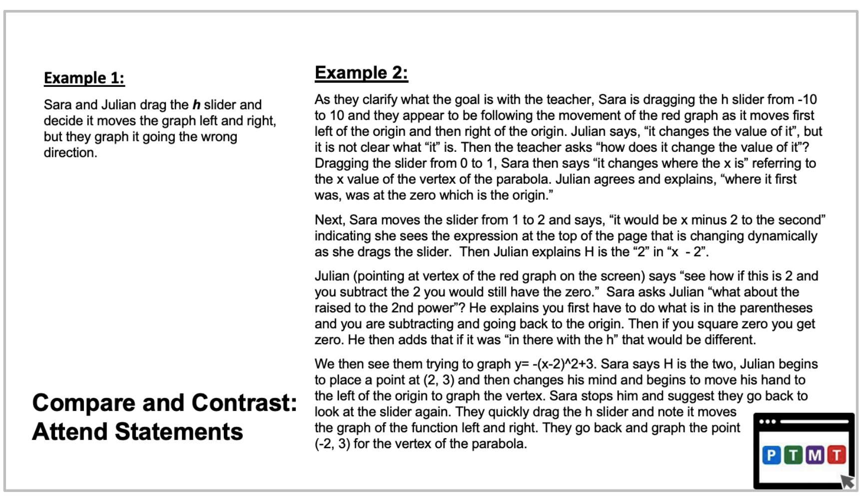
Transition Slide

In the following slide teachers are going to compare and contrast two different ***attend*** statements - the second one being guided by the framework. It might be helpful to watch the video again, as a reminder, prior to this comparison.

</td></tr>
<tr><td>9</td><td>

Ask teachers to compare/contrast the two attend statements. Record what they note on the board.

If it does not come out in their comparison, point out that in example 2 you can clearly envision the students as they work on the task (i.e., a play by play). The important mathematical “moves” they made verbally, in writing, and with the technology tool are described.

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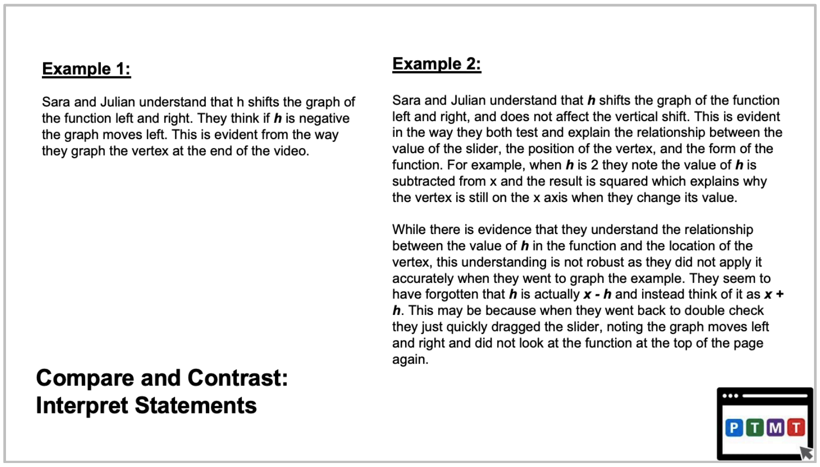
<tr><td>10</td><td>Transition Slide<br><br>In the following slide teachers are going to compare and contrast two different interpret statements—the second one being guided by the framework.</td></tr>
<tr><td>11</td><td>Ask teachers to compare/contrast the two interpret statements. Record what they note on the board.<br><br>

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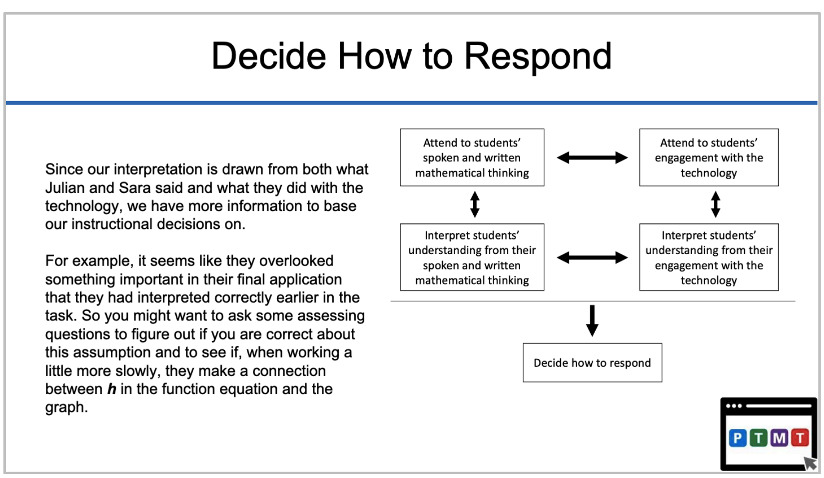
<tr><td>12</td><td>Emphasize that the “decide how to respond” component does not need to include the use of technology, and decisions should be directly connected to their attend and interpret components.<br><br>Ask for other possible ways to respond to the students. Remind them that responding to students does not have to include using the technology and responding is NOT telling students right/wrong, but rather making a strategic pedagogical move. Note: We will spend a lot of time practicing attending and interpreting because it is a very important precursor to making instructional decisions based on students’ thinking.<br><br>

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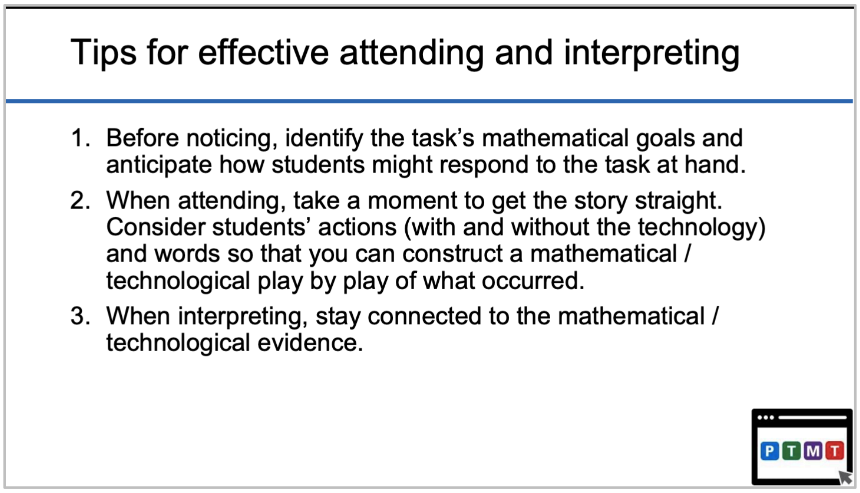
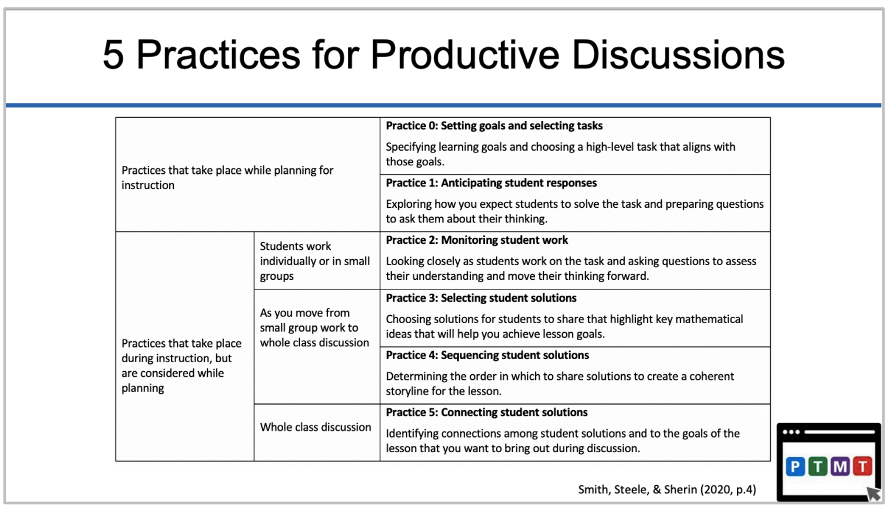
13 Discuss the tips with the teachers. Answer any questions they may have.




14 The purpose of this slide is to introduce teachers to the language of The 5 Practices for Productive Discussions. (Connect to the reading if they did it prior to this lesson. If not assign it after this for more detail.)

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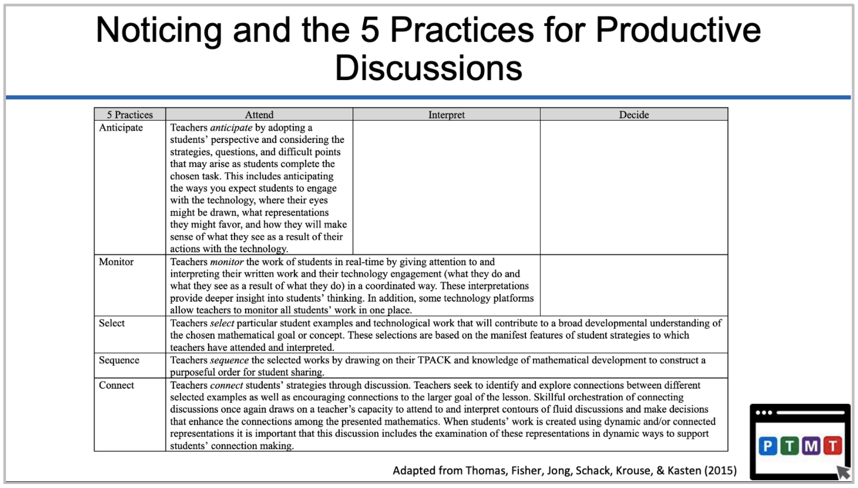
|---|---|---|
| Practices that take place while planning for instruction | | **Practice 0: Setting goals and selecting tasks** Specifying learning goals and choosing a high-level task that aligns with those goals. |
| | | **Practice 1: Anticipating student responses** Exploring how you expect students to solve the task and preparing questions to ask them about their thinking. |
| Practices that take place during instruction, but are considered while planning | Students work individually or in small groups | **Practice 2: Monitoring student work** Looking closely as students work on the task and asking questions to assess their understanding and move their thinking forward. |
| | As you move from small group work to whole class discussion | **Practice 3: Selecting student solutions** Choosing solutions for students to share that highlight key mathematical ideas that will help you achieve lesson goals. |
| | | **Practice 4: Sequencing student solutions** Determining the order in which to share solutions to create a coherent storyline for the lesson. |
| | Whole class discussion | **Practice 5: Connecting student solutions** Identifying connections among student solutions and to the goals of the lesson that you want to bring out during discussion. |

<table>
<tr><td>15</td><td>The purpose of this slide is to show the connection between the skills of Professional Noticing of Students’ Mathematical Thinking and those involved with Orchestrating Productive Discussions. This is to foreshadow the skills they will be working on in the PTMT-ESP modules and the connections among them.<br><br>
<br>
Noticing and the 5 Practices for Productive Discussions<br>
<table>
<tr><th>5 Practices</th><th>Attend</th><th>Interpret</th><th>Decide</th></tr>
<tr><td>Anticipate</td><td>Teachers anticipate by adopting a students’ perspective and considering the strategies, questions, and difficult points that may arise as students complete the chosen task. This includes anticipating the ways you expect students to engage with the technology, where their eyes might be drawn, what representations they might favor, and how they will make sense of what they see as a result of their actions with the technology.</td><td></td><td></td></tr>
<tr><td>Monitor</td><td colspan="2">Teachers monitor the work of students in real-time by giving attention to and interpreting their written work and their technology engagement (what they do and what they see as a result of what they do) in a coordinated way. These interpretations provide deeper insight into students’ thinking. In addition, some technology platforms allow teachers to monitor all students’ work in one place.</td><td></td></tr>
<tr><td>Select</td><td colspan="3">Teachers select particular student examples and technological work that will contribute to a broad developmental understanding of the chosen mathematical goal or concept. These selections are based on the manifest features of student strategies to which teachers have attended and interpreted.</td></tr>
<tr><td>Sequence</td><td colspan="3">Teachers sequence the selected works by drawing on their TPACK and knowledge of mathematical development to construct a purposeful order for student sharing.</td></tr>
<tr><td>Connect</td><td colspan="3">Teachers connect students’ strategies through discussion. Teachers seek to identify and explore connections between different selected examples as well as encouraging connections to the larger goal of the lesson. Skillful orchestration of connecting discussions once again draws on a teacher’s capacity to attend to and interpret contours of fluid discussions and make decisions that enhance the connections among the presented mathematics. When students’ work is created using dynamic and/or connected representations it is important that this discussion includes the examination of these representations in dynamic ways to support students’ connection making.</td></tr>
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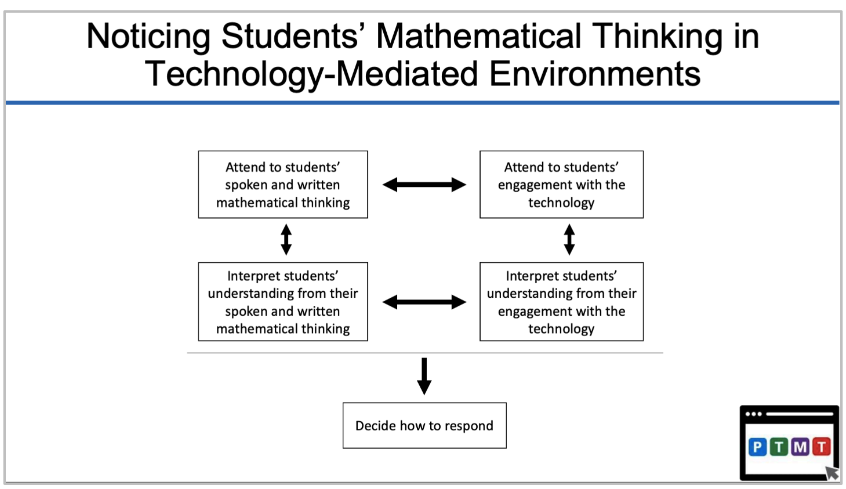
Adapted from Thomas, Fisher, Jong, Schack, Krouse, & Kasten (2015)</td></tr>
<tr><td>16</td><td>This final slide is a reminder of the framework. Point out that when they are asked to attend to or interpret student thinking with technology they should think about this framework (maybe even pull it out) and make sure they are paying attention to what students say, write, and the ways they engage with the technology (i.e., what they do and what they see when they do it).<br><br>

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<tr><td>17</td><td>Closing Slide</td></tr>
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Finally, we recommend as a follow up to this discussion having teachers read and reflect on

Dick et al. (2021) When students use technology tools, what are you noticing?

This article includes additional examples of using the NITE framework to notice student thinking in technology-mediated learning environments. The examples cut across age groups, content strands, and use a variety of technology tools. Direct links to each of the videos in the article are included here.

Video 1

Video 2

Video 3

Video 4