

Promoting a Positive Math Identity

Module 2b – Building the Math Environment - Part 2

Facilitator's Guide

Time: 90 minutes

Facilitators: Instructional coaches or teacher leaders who work with secondary math teachers

Audience: Secondary math teachers

Session outcomes:

By the end of the session participants will be able to:

- Reflect on their math attitudes and beliefs
- Understand how to create a classroom climate that is identity-affirming for all students and promotes math learning
- Develop instructional practices that foster positive math attitudes

Materials and supplies

- PowerPoint slides
- Chart paper and markers
- Handout: Math fluency activities (1 copy per group of 3 participants)
- Internet access
- Pre-loaded videos:
 1. Inside Mathematics. (n.d.-b). *Tuesday Group Work- Part A* [Video] (Licensed under Creative Commons 3.0). Retrieved from <http://www.insidemathematics.org/classroom-videos/public-lessons/9th-10th-grade-math-properties-of-quadrilaterals/tuesday-group-work-part-a>
 2. Mathematical Agency Improvement Community. (n.d.). *Status & Mindset Interventions* [Video] [Licensed under Creative Commons 3.0]. Retrieved from <https://www.mathagency.org/status-mindset-resources>

Note. These materials were produced for the Idaho State Department of Education and the Idaho Regional Mathematics Centers and were presented on August 13, 2019 at the Idaho Council of Teachers of Mathematics conference.

Session at a Glance

Timing	Segment	Key Activities
10 minutes	Welcome and overview	Facilitator introduces self, reviews learning objectives, and provides a summary of math identity and agency from module 1.
5 minutes	Icebreaker activity	Facilitator leads participants in an icebreaker activity designed to prompt participants to think about the content that will be covered.
65 minutes	Evidence-based strategies to promote positive math identities in students (Part 2)	Facilitator summarizes and describes several evidence-based strategies that promote positive math identities in students, including the following: Time pressures; make math collaborative; messaging; and process feedback.
10 minutes	Closing	Participants reflect on what they learned in the session and plan for how they will apply it.

Timing	Topic/Steps/Activities	Facilitator Notes	Resources/ Materials
	 <p>Key Talking Points</p> <ul style="list-style-type: none"> • Slide 4 <ul style="list-style-type: none"> ➤ Math success depends on many factors. Of course, procedural skills and fluency, conceptual understanding of math topics, and mathematical reasoning are all important. ➤ But if we were able to peek behind the curtain of math success, we would see a more complicated process involving more than just math skills. In this training we will focus on the equally important contributors of math identity and math agency, as well as the surrounding math environment. • Slide 5 <ul style="list-style-type: none"> ➤ As educators we care deeply about academic outcomes. We ask ourselves: Are our students mathematically proficient? Are our students ready for college-level math? ➤ When we attend to the math environment and support students in promoting a positive math identity, we are doing the groundwork to achieve our ultimate goal of making sure all students reach their potential in math. ➤ The research we have reviewed in this training series shows that math identity and math agency are precursors for positive academic outcomes. Students with a positive math identity are more agentic about their math learning. Agentic students take more ownership of their learning and they engage in the types of behaviors that facilitate better outcomes—things like studying harder, seeking out assistance, and persevering when things get challenging. • Slide 6 <ul style="list-style-type: none"> ➤ Math identity is a complex topic. We will focus on these four aspects, which are distinct concepts but also interrelated. ➤ The previous module in this training covered the importance of these factors, how they are related to success in math, and why some students are less likely than others to develop a strong math identity. 		<p>Slides 4-7: Elements of math success; Math identity and agency critical for math success; Key aspects of math identity; Connections with the Standards for Math Practice (4 slides)</p>

Timing	Topic/Steps/Activities	Facilitator Notes	Resources/ Materials
	<ul style="list-style-type: none"> ➤ Today’s session is the second of two that focus on evidence-based classroom practices and strategies you can use to create a classroom environment that supports students in developing a positive math identity. In this training we will review ways to promote these aspects of math identity. We expect that actively promoting one can also benefit the others. ➤ The final session will focus on shorter, more targeted strategies, or “kernels”, to promote positive math identities. <ul style="list-style-type: none"> • Slide 7 <ul style="list-style-type: none"> ➤ One way to situate the importance of math identity and agency is by considering them in relation to the Common Core State Standard (CCSS) Standards for Math Practice (SMP). The CCSS SMPs are meant to articulate the way mathematicians work and approach problems. These are the ways effective math students think and act when problem-solving in math. In other words, one way of framing the SMPs is that this is what math agency looks like in practice. ➤ You may be familiar with the framework presented by Kelemanik, Lucenta, & Creighton (2016) in <i>Routines for Reasoning</i>. This framework shows relationships between the SMPs. The authors of the framework make the case that not all math practices are equal. They frame SMP 1 as an overarching goal. SMPs 2, 7, and 8 are different “avenues of thinking” that promote SMP 1. SMPs 3, 4, 5, and 6 are the “supporting actors.” ➤ Because a positive math identity is at the root of math agency, math identity is related to all the SMPs and can also be thought of as a supporting actor. Without a strong math identity, students have little motivation to engage with math and persevere when they face challenges. <p>6. Show the slide with the summary of evidence-based strategies (slide 8). Note that the first four strategies for promoting a positive math identity in students were covered in the first part of the module 2 training (Part 1). In this second part of module 2</p>		<p>Slide 8: Summary of evidence-based strategies</p>

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	<p>training, participants will explore a second set of four evidence-based strategies.</p> <p>7. Pause for questions before proceeding.</p>		
5 minutes	 <p>Icebreaker</p> <ol style="list-style-type: none"> 1. Display the icebreaker slide (slide 9). 2. Tell participants they will warm-up by completing some math problems. They will solve a set of four math problems. They will have only 10 seconds to complete each problem. 3. Walk through the four slides providing math problems. As each slide is displayed, a 10-second countdown timer will start. When the countdown timer gets to “0”, click to advance to the next slide. 4. Display the slide with the solutions to the math problems and the discussion prompt (slide 14). Ask participants to share their responses to the prompt with a partner at their tables. 		<p>Slide 9: Icebreaker</p> <p>Slides 10-13: Problem (4 slides)</p> <p>Slide 14: How’d you do?</p>
65 minutes	 <p>Evidence-Based Strategies to Promote Positive Math Identities in Students (Part 2)</p> <p><i>Time pressures—15 min</i></p> <ol style="list-style-type: none"> 1. Display the slide with the list of evidence-based strategies with “Time pressures” highlighted (slide 15). 2. Tell participants that as they might have guessed from the warm-up exercise, we will begin by discussing how time pressures can affect the classroom culture. 3. Display the first of two slides on timed drills and number sense and make the following key points.  <p>Key Talking Points</p> <ul style="list-style-type: none"> • Slide 16 <ul style="list-style-type: none"> ➤ How did the warm-up exercise feel for you? How do you think it would have been different without that countdown timer? 		<p>Slide 15: Summary of evidence-based strategies: Time pressures</p> <p>Slides 16-17: Timed drills and number sense (2 slides)</p>

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	<ul style="list-style-type: none"> ➤ As a way to alleviate math anxiety, recent research urges teachers to avoid unnecessary time pressures (e.g., timed drills) in math class. ➤ However, cognitive science shows us that developing fluency in foundational math concepts is a precursor to success, especially in mastering high-level math concepts. ➤ Fluency is often thought of as speed and accuracy with simple calculations. It is often equated with memorization, repetition, and timed drills. <ul style="list-style-type: none"> • Slide 17 <ul style="list-style-type: none"> ➤ But fluency is much more than speed and accuracy with math facts. Fluency develops in tandem with students developing their number sense, which is the understanding of numbers and the ways they relate to each other. ➤ Students understand more complex mathematical concepts when they have number sense, more so than with memorization and fast recall of facts. ➤ While automatic recall of facts is useful in math, it is better to reach automaticity through understanding the relations between numbers and strategies, rather than relying only on memorization (Delazer et al, 2005). ➤ Next you will learn about alternatives to timed drills as we discuss some different strategies for developing fluency. <ol style="list-style-type: none"> 4. Display the third of the three slides on timed drills and number sense that provides the instructions for the jigsaw activity (slide 18). 5. Split the participants into groups of three and distribute the handout on the math fluency strategies (one handout per group). 6. Give each group five minutes to think about how to implement their assigned strategy. They will then explain how their strategy helps students develop number sense. Participants may use additional online resources to build their expertise in one of the three strategies listed in the handout, if desired. 7. Next, have the groups rotate members and re-arrange, so each person in the group is an “expert” on one of the three strategies. Each member of the new group then demonstrates their strategy 	<p><i>This as an opportunity to introduce the jigsaw method, which will be described as a strategy later in the module.</i></p>	<p>Slide 18: Timed drills and number sense</p> <p>Materials: Math fluency activities handout</p>

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	<p>to the other members and explains how it helps students develop number sense. Give about 3 minutes for the discussion of each strategy, for a total of 9 minutes.</p> <p>8. Display the slide with the discussion questions (slide 19) and have groups discuss them at their tables. If time permits, ask a few volunteers to share their tables' responses.</p> <p>9. Pause for questions before proceeding.</p> <p><i>Make math collaborative-20 minutes</i></p> <p>10. Display the slide with the list of evidence-based strategies with "Make math collaborative" highlighted (slide 20).</p> <p>11. Display the first of the "Make math collaborative" slides and provide the following key points.</p> <p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 21 <ul style="list-style-type: none"> ➤ Evidence suggests that educators might be able to boost students' motivation by creating classroom group identities tied to learning activities, such as math. ➤ Several studies have found that children persist and perform better on individual math and spatial tasks when they are primed using social cues to feel like part of a group. ➤ When children develop socially shared motivations, it may forge a sense of common purpose and reinforce the feeling of group identity—a sense that, "This is who we are and this is what we do." ➤ Evidence suggests that outcomes improve only if children identify with their group. An experimental study found that young children who completed a math or spatial task as part of a group: a) persisted longer in the task; b) correctly completed more pieces of the task; c) thought they were better at the task; and d) were more interested in the task. ➤ Groups can be created in a variety of ways, such as color groups, groups with a specific purpose, or groups named after mathematical functions, such as the multiplication 		<p>Slide 19: Discussion</p> <p>Slide 20: Summary of evidence-based strategies: Make math collaborative</p> <p>Slide 21: Make math collaborative</p>

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	<p>group.</p> <ul style="list-style-type: none"> ➤ The key with this strategy is not just to use group work, but to structure the group work in such a way that students come to identify with their group. <p>12. Display the second of the “Make math collaborative” slides that shows the still image from the first pre-recorded video and the set of SMPs (slide 22).</p> <p>13. Tell participants that they are going to watch a video of students working in groups of four. The groups are investigating the properties of quadrilaterals. Encourage them to pay attention to ways in which they see the collaborative nature of the math activity supporting and building on the SMPs.</p> <p>14. Play video showing students working together in math class (up to 3:45).</p> <p>15. Ask participants to share the connections they saw in the video to the SMPs. Chart a few responses.</p> <p>16. Display the third of the “Make math collaborative” slides with several of the SMPs highlighted. Use the following key points to show connections to the SMPs to support and add to the connections the participants made.</p> <p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 23 <ul style="list-style-type: none"> ➤ SMP 1: (0:59-2:18) → Relationship skills help students make sense of problems. Instead of jumping into their own solution attempts, the students discuss the problem together before deciding to approach it. They expand upon and clarify each other’s questions and comments, ask follow-up questions, and clarify their own questions when they recognize that their question has not been fully addressed. ➤ SMP 3: (2:33-3:45) → The girl shown in this clip is unsure of the exact shape of one of her sketches. She recognizes and expresses her uncertainty to her group members when she says, “I’m not sure if this is a kite,” which provides the group with the opportunity to construct arguments and critique one another’s reasoning. 		<p>Slide 22: Make math collaborative</p> <p>Materials: Pre-loaded video #1 (See “Materials and supplies”), chart paper, and markers</p> <p>Slide 23: Make math collaborative</p>

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	<ul style="list-style-type: none"> ➤ SMP 6: (full clip) As students in the clip work together, they try to communicate precisely and use clear definitions. ➤ SMP 7: (2:55-3:45) The boy in this clip has a misunderstanding that is called out by the other members of his group. Instead of becoming defensive or angry, the student acknowledges his error, readily accepts his peers' correction, and continues to contribute to the group discussion. Because of these self-management efforts, the group is able to continue the discussion in a constructive way that leads them to discern a subtle structural aspect in the manipulatives they are using to create quadrilaterals. <p>17. Display the final “Make math collaborative” slides that describe the jigsaw activity (slide 24) and make the following key points.</p> <p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 24 <ul style="list-style-type: none"> ➤ One way of promoting group membership in the classroom and to make learning math more collaborative is by using the jigsaw classroom technique. ➤ In this technique, students learn different content and then rotate within the space to share their knowledge with their classmates. This gives each student expert status, and every group member then becomes integral to the success of the group. • Slide 25 <ul style="list-style-type: none"> ➤ For example, in a lesson about measures of central tendency, you could divide students into three groups: one group to learn about the mean and how to calculate it; another group to learn about the median; and a third group to learn about the mode. ➤ After students become experts, they reconfigure into new groups with one expert for each topic. Students must then teach the other group members about their expert topic. ➤ The jigsaw classroom was initially designed to reduce racial conflict, but it has also been shown to increase positive education outcomes, including: a) social relatedness and 	<p><i>Point out to participants that they participated in a jigsaw earlier in the training when they discussed strategies to improve fluency.</i></p>	<p>Slides 24-25: Make math collaborative: The jigsaw classroom; How-to: Jigsaw classroom (2 slides)</p>

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	<p>which can help build belonging.</p> <ul style="list-style-type: none"> ➤ In this instructional strategy, students are first given time to think and formulate a response. This extra processing time is important for special populations (e.g., English language learners, or students with learning difficulties). It also means that the class is less dominated by students who are quick to call out an answer. ➤ Individual think time is followed by partner work where students are given the opportunity to explain their thinking and discuss each other's ideas. ➤ Finally, the class discusses a task or problem as a whole. Having an opportunity to process and develop their thinking prior to the whole-group discussion means students are better prepared to share with the group and be an engaged participant in classroom discussion. ➤ This technique is also effective at building math identity, because it prioritizes the development of students' thought process about how to approach problems over simply arriving at correct solutions. The emphasis on making all students' thinking visible communicates that teachers value all modes of thinking, and that all voices matter. This also builds a classroom culture where struggling and making mistakes become a normal and expected part of the process. <p>20. Display the slide with the still image from the second prerecorded video (slide 28).</p> <p>21. Play the video of students describing their experiences with think-pair-share techniques.</p> <p>22. Ask participants to identify dialog or actions in the video that highlight or support collaboration. The following are selected quotes to add to or expand on what participants share.</p> <ul style="list-style-type: none"> • "That's where all the magic happens... when we skepticize each other" • "Then after we work with our groups, going around sharing our ideas with each other... that's the best thing about 	<p><i>Skip the video – or start it at 2:06 -- if time is limited.</i></p>	<p>Slide 28: What do students say about think-pair-share techniques in the math classroom?</p> <p>Materials: Pre-loaded video #2 (See "Materials and supplies")</p>

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	<p>math class. (Our teacher) understands we can't do it alone."</p> <ul style="list-style-type: none"> • "The way I feel in math is that I'm always rejoiced to get in through that door and start a new thing. It's just that every day is a new adventure. New co-operations with your partners and peers." • "This year it's more how'd you get there, why'd you do this, and how'd you think. Yes, you got the answer, but we're not computers. Why did you get this?" • "I made a tiny mistake, I thought everyone would hate me, because I made that mistake, but no. Actually it seemed that others made that mistake and therefore all the class got to learn from that mistake. It really touched my heart." <ul style="list-style-type: none"> • <p>23. Display the brainstorm slide (slide 29) and have participants discuss the prompts provided among themselves at their tables. After a few minutes, invite a few volunteers to share what their tables discussed.</p> <p>24. Pause for questions before proceeding.</p> <p><i>Messaging-15 minutes</i></p> <p>25. Display the slide with the list of evidence-based strategies with "Messaging" highlighted (slide 30).</p> <p>26. Display the slides about being conscious about messaging, then share the following key points</p> <p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 31 <ul style="list-style-type: none"> ➤ Be careful about how you speak to students who are struggling. Consolation (e.g., "Not everyone is good at this kind of problem" and "Don't worry—I was never good at math") sends a message that validates a student's opinion that they are not good at math and never will be. A better message would be "This is challenging, but I know that if you stick with it, you can do it." 		<p>Slide 29: Brainstorm</p> <p>Slide 30: Summary of evidence-based strategies: Messaging</p> <p>Slides 31-32: Be conscious of messages (2 slides)</p>

Timing	Topic/Steps/Activities	Facilitator Notes	Resources/ Materials
	<ul style="list-style-type: none"> • Slide 32 <ul style="list-style-type: none"> ➤ Math students who received "comforting" feedback often believed that the teacher had low expectations for them in math. As a result, these students had lower motivation and lower expectations for their own success in math. ➤ Next we'll do an activity to give you an opportunity to review common adult responses to children's math-related struggles and successes. We'll also think about more empowering and confidence-boosting alternative responses. <ol style="list-style-type: none"> 27. Display the first mixed-messages slide (slide 33). Note that these are statements a parent or teacher might make in response to a child saying they do not understand a math problem. 28. Ask participants to consider whether the statements might inadvertently transmit disempowering messages. 29. Ask participants to discuss with someone at their table what they think students might hear when a parent or teacher uses the statements. 30. After a couple of minutes, display the second mixed-messages slide (slide 34), which shows how students might negatively interpret each of the statements. 31. Using the third and fourth mixed-messages slides (slides 35 and 36), repeat Steps 28-30 above for a second set of mixed messages. 32. Display the final mixed-messages slide (slide 37). 33. Place participants into groups with others sitting near them. Assign a message to each table group. 34. Ask the groups to replace the unhelpful messages with helpful ones. 35. Have each table share out their revised messages. 36. Display the first of two slides connecting messaging to the SMPs. 37. Invite a handful of volunteers to share how they think teacher messaging supports and builds on the SMPs. 38. Show the second of the two slides connecting messaging to the SMPs and make the following key points. 		<p>Slides 33-37: Mixed messages (5 slides)</p> <p>Slides 38-39: Be conscious of messages (2 slides)</p>

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	<p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 38 <ul style="list-style-type: none"> ➤ There is a strong connection between SMP 1 and the types of messaging teachers provide to students. Rather than messages of consolation (<i>It's okay if you can't do this- it's pretty hard</i>), teachers should provide messages that encourage perseverance and engagement in productive struggle. ➤ What other connections do you see between the SMPs and teacher messaging to students? • Slide 39 <ul style="list-style-type: none"> ➤ In addition to providing messages that encourage students and promote perseverance, it is also important to provide students with specific strategies for success. ➤ The strategies that you provide as a teacher come from the SMPs. All the SMPs build and support the idea of conscious messaging in the classroom. ➤ For example, when a student is struggling, you can suggest an alternate strategy the student can use to approach the problem, such as looking for and making use of structure or modeling. ➤ When a student is struggling, consolation is not effective. It is better to use the standards to provide the student with support and to reshape their thinking. <p>39. Pause for questions before proceeding.</p> <p><i>Process Feedback-15 minutes</i></p> <p>40. Display the slide with the list of evidence-based strategies with “Process feedback” highlighted (slide 40).</p> <p>41. Display the slides about growth mindset and equity, then share the following key points.</p>		<p>Slide 40: Summary of evidence-based strategies: Process feedback</p> <p>Slides 41-42: Growth mindset and equity (2 slides)</p>

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	<p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 41 <ul style="list-style-type: none"> ➤ Teacher feedback can have a big effect on how students perceive their abilities, but the style and content of the feedback are very important and contribute to students' math identity development. ➤ Too often, growth mindset is oversimplified to be only about working harder. ➤ It is imperative to understand that encouraging a growth mindset is not about telling students they need to work harder when they are struggling. ➤ Hard work on the part of students from traditionally marginalized communities is not enough to overcome systemic racial, gender, and economic oppression. ➤ Telling students to “just try harder” places the burden of effort only on their shoulders. ➤ Praising effort when students aren't learning sends the message that learning isn't the objective—effort is. • Slide 42 <ul style="list-style-type: none"> ➤ Keep the focus on effort <i>in the service of learning</i>. ➤ Encourage students to seek out and try new strategies, or seek assistance from others when they're stuck. ➤ When students are trying, but not learning, appreciate their work so far. Then talk about what they can try next. <p>42. Display the first of the “Process-related feedback” slides and share the following key points.</p> <p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 43 <ul style="list-style-type: none"> ➤ As a review from module 1, praise for intelligence/ability promotes a fixed mindset and praise for process/effort promotes a growth mindset. ➤ To promote a growth mindset as opposed to a fixed 		<p>Slide 43: Process-related feedback</p>

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	<p>mindset, provide feedback on the process the student used to solve the problem and/or the effort the student put forth.</p> <ul style="list-style-type: none"> ➤ Process-related feedback supports SMP 1 (making sense of problems and perseverance in solving them). Supporting students' growth mindset and perseverance go hand in hand, as students with a growth mindset believe that their math ability can be developed over time through perseverance and effort. <p>43. Display the second of the “Process-related feedback” slides (slide 44) and briefly distinguish between “people praise” and “process praise.”</p> <p>44. Point out to participants that on the left side of the screen are some common examples of person praise.</p> <p>45. Ask participants to describe how they might rephrase the first phrase into praise that emphasizes the students process or effort.</p> <p>46. After soliciting answers from participants, click to have the slide animation reveal the answer.</p> <p>47. Ask participants to describe how they might rephrase the second phrase.</p> <p>48. After soliciting answers from participants, click to have the slide animation reveal the answer.</p> <p>49. Ask participants to describe how they might rephrase the third phrase.</p> <p>50. After soliciting answers from participants, click to have the slide animation reveal the answer.</p> <p>51. Display the remaining three “Process-related feedback” slides and make the following key points.</p> <p> Key Talking Points</p> <ul style="list-style-type: none"> • Slide 45 <ul style="list-style-type: none"> ➤ In addition to focusing feedback on students' process, it is important that feedback relates to specific approaches the student made to get to the end result. • Slide 46 <ul style="list-style-type: none"> ➤ Teachers should also be realistic and honest. 	<p><i>This activity uses slide animations to provide a “click and reveal” interaction.</i></p>	<p>Slide 44: Process-related feedback</p> <p>Slides 45-47: Process-related feedback (3 slides)</p>

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	<ul style="list-style-type: none"> ➤ Undeserved or insincere praise is not helpful. Don't pretend setbacks haven't happened. ➤ Instead, acknowledge the struggle and identify specific strengths that could help a student cope with the struggle. <ul style="list-style-type: none"> • Slide 47 <ul style="list-style-type: none"> ➤ Teachers should also point out negative self-talk and challenge it. <p>52. Display the slide describing the Growth mindset feedback frames (slide 48). Click through the slide animation and share the following key points.</p> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 10px 0;">  </div> <p>Key Talking Points</p> <ul style="list-style-type: none"> • Slide 48 <ul style="list-style-type: none"> ➤ The process feedback you provide should also vary based on the situation. For example, the feedback you provide a student who is trying really hard but still struggling will be different than the feedback you provide to a student who easily solved a problem without needing much effort. ➤ Carol Dweck and her colleagues at Mindset Works have created feedback frames to help guide your feedback in various situations. ➤ The first frames are for when students struggle despite putting forth strong effort. ➤ The second set of frames are for when students struggle and need help with strategies. ➤ The third set of frames are for when students succeed with strong effort. ➤ And the fourth set of frames are for when students succeed easily without strong effort. <p>53. Pause for questions before proceeding.</p>		<p>Slide 48: Growth mindset feedback frames.</p>

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10 minutes	 Closing <ol style="list-style-type: none"> 1. Display the Reflection slide (slide 49). 2. Ask participants to think of responses to the discussion prompts on the slide for a moment, then ask them to share with a partner. 3. Ask a few volunteers to share their responses with the larger group. 4. Display the slides providing information about REL Northwest and the references used to prepare this module. 5. Take any final questions from participants. 6. Thank participants for their time and contributions. 		<p>Slide 49: Reflection</p> <p>Slides 50-53: About REL Northwest; Contact us; Content References (4 slides)</p>