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Module 3: Workshop 8

Lesson Plan

Overall Learning Goals	**Lesson Topic**
Strategies for Developing Common Core Skills in Content Areas (Math & Science): to train administrators and adult educators *to develop instructional strategies* for developing Common Core skills in content areas to better serve their ESOL, ABE, and pre-HSE student constituency.	Continuing on unpacking the 8 standards of mathematical practice and depth of knowledge & cognitive complexity, with a focus on coherent instruction involving questioning strategies in problem-solving classrooms.
Curriculum Developer Tyler Holzer **Workshop Trainer**	**Date** **Location**

Intended Audience

- **Instructors** (content was designed as a workshop for Instructors).
- Note: Sample student material is included for Instructors to analyze during the workshop. Instructors may also use sample student materials in their classes.

Standards Alignment

The CCSS Mathematics Standards for Mathematical Practice:

- MP1: Make sense of problems and persevere in solving them
- MP2: Reason abstractly and quantitatively
- MP3: Construct viable arguments and critique the reasoning of others
- MP4: Model with Mathematics
- MP5: Use appropriate tools strategically
- MP6: Attend to precision
- MP7: Look for and make use of structure
- MP8: Look for and express regularity in repeated reasoning

Goals and Objectives (SWBAT)

- Participants will know the components of a cognitively demanding mathematical task.
- Participants will know how to use effective questioning strategies that promote the Standards for Mathematical Practice and Depth of Knowledge.
- Participants will know how to anticipate student responses and prepare for effective problem-solving activities
- Participants will know how to use student work as a resource for classroom instruction.
- Participants will know how to encourage their students to reflect on their own work and the work of their peers.
- Participants will become familiar with Webb's DOKs in mathematics, and they will be able to use these levels in choosing effective math problems and developing lessons.
    - Participants will also learn how to guide students through problem-solving activities, and they will feel comfortable supporting their students' chosen solution method.
    - To help students process their work, participants will learn how to structure discussions about mathematically rich problems and their solutions.
    - They will use whole-class discussions effectively so that students can begin to think creatively about problem-solving, analyze and apply the reasoning of others, and develop a toolkit of strategies that they can use on the TASC and in real-world mathematical situations.

Warm-Up/Review

- Participants will review the Standards for Mathematical Practice and Webb's DOK, and they will review the characteristics of good math student enumerated in Workshop 7.
    - Questions for review: "What are the 8 Standards for Mathematical Practice? Can we list them all?"

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- The facilitator should help participants to fill in gaps if need be.
- For the facilitator: The 8 Standards for Mathematical Practice are:
  - MP1: Make sense of problems and persevere in solving them
  - MP2: Reason abstractly and quantitatively
  - MP3: Construct viable arguments and critique the reasoning of others
  - MP4: Model with mathematics
  - MP5: Use appropriate tools strategically
  - MP6: Attend to precision
  - MP7: Look for and make use of structure
  - MP8: Look for and express regularity in repeated reasoning

- After the review, the facilitator will introduce the following questions for discussion: "What does it mean to teach problem-solving? What can we do to support problem-solving in our classrooms?"
  - The facilitator will draw upon the following list of sample responses but should also be prepared to talk about the challenges of developing and teaching problem-solving activities within the constraints of an ABE/HSE class, which may meet for as little as six to eight weeks.
    - Some sample responses from previous workshops: "emphasis on process over the answer; needs to be a goal so that the process isn't random; teaching students to ask why; value the practice and the process; errors are important because that's where learning happens; problem-solving is an element of executive functions; ordering steps and following through; accessing prior knowledge; picking the problem apart and exploring possibilities; using evidence to justify processes."
    - Good problem-solvers can: "identify the problem; persevere; think outside the box; organize information; analyze similarities and differences; talk about math; be efficient; enjoy being challenged; feel okay about being wrong."

References (APA Style)

- Chapin, S. H., O'Connor, C., and Anderson, N. C. (2009). *Classroom discussions: Using math talk to help students learn*. Sausalito, CA: Math Solutions.
- Driscoll, M., and Moyer J. (2001). Using students' work as a lens on algebraic thinking. *Mathematics Teaching in the Middle School*, *6*, 282–87.
- Hiebert, J. and Stiegler, J. W. (2004). A world of difference: Classrooms abroad provide lessons in teaching math and science. *Journal of Staff Development*, *25*(4), 10-15.
- Smith, M. K., Hughes, E. K., Engle, R. A., Stein, M. K. (2009). Orchestrating discussions. *Mathematics Teaching in the Middle School*, *14*, 548–56.
- Stein, M. K., and Smith, M. S. (1998). Mathematical tasks as a framework for reflection. *Mathematics Teaching in the Middle School*, *3*, 268–75.
- Stein, M. K., Smith, M., Henningson, M., and Silver, E. (2009). *Implementing Standards-Based Mathematics Instruction*, New York, Teachers College Press.

Technology and Handouts

Technology Needs

- AV cart with projector, laptop, and speakers will be provided.
- Laptop or tablet computer for each student with access to Internet.
- Latest version of Adobe Flash installed on laptops.

Presentation Needs & Handouts

- Chart Paper.
- Markers.

Each item listed below will be available in PDF format.

- A World of Difference.
- DOK Rubric Handout.
- Effective Questions.
- How Cognitively Demanding Am I.
- Levels of Cognitive Demand in Mathematics.
- Orchestrating Discussions.
- Reflecting on Effective Questioning.
- Supporting Productive Struggle through Questioning.
- Student Work on the Movie Theater Problem.
- The Five Practices Model.
- The Movie Theater Problem.
- The Movie Theater Problem Lesson

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	• Using Students' Work As a Lens on Algebraic Thinking.

Lesson Plan Activities

Part 1: What is Cognitive Complexity?

Lesson Content

The facilitator will lead participants in a discussion and activity that introduce the Levels of Cognitive Demand in Mathematics. Participants will analyze sample problems and locate them within the Levels of Cognitive Demand rubric.

Lesson Materials

- Handout detailing the Levels of Cognitive Demand.
- Handout on Webb's DOK.
- Four sample problems for analysis and discussion.

Questions to Answer

- What are the Levels of Cognitive Demand in Mathematics?
- What are the characteristics of a cognitively demanding task?
- How does this connect to Webb's DOK?
- How cognitively demanding are the math problems that I use in my classroom?

Opening/Background

- The facilitator will distribute handout of Levels of Cognitive Demand in Mathematics. The levels of cognitive demand complement Webb's Depth of Knowledge by categorizing mathematical tasks into low- or high demand. Thinking about the Levels of Cognitive Demand in tandem with Webb's DOK will help participants to develop their ability to assess mathematical tasks and reflect on the cognitive demand required by the activities they use in their classroom.
  - The group will read through the levels of cognitive complexity, while the facilitator periodically stops to discuss the meanings of certain criteria. Possible questions for discussion while reading:
    - "In Procedures without Connections, what does it mean for a procedure to have no connection to the concepts underlying it? Can you think of an example problem that does this?"
    - "Why does the rubric place such high emphasis on multiple representations, particularly in Procedures with Connections?"
    - "How can a student self-monitor or self-regulate their cognitive process?"
  - For discussion: "What are some of the general trends you notice as we move up from low to high cognitive demand? Can we generalize anything?"
  - The facilitator will ask participants to briefly reflect on the activities they use in their classrooms, which may be from workbooks or may be generated by the instructor. The facilitator should pose the discussion question to the group: "When you reflect on the problems that you teach and use in your classroom, what level of cognitive complexity do the majority of them fall under?"
- If participants do not have the Webb's DOK handout from Workshop 7, it should be distributed to the participants at this time. The facilitator should instruct participants to explore connections between the levels of cognitive demand and Webb's DOK.
  - Question for discussion: "What are some similarities you notice between Webb's DOK and the levels of cognitive demand?"
    - For example, a DOK 1 task involves memorizing and repeating. Based on the cognitive demand rubric, this would fall squarely under memorization—a lower-level demand.
    - DOK 3 and 4 questions could fall under either of the categories for higher-level demands in that they ask students to explore connections and make conclusions on their own.

Lesson Activities

- Activity 1: Participants will be given the handout How Cognitively Demanding Am I. The facilitator should direct participants to solve each problem, and then analyze it in terms of the Levels of Cognitive Demand. Participants should reflect on their own solution process and the skills they needed to employ in order to successfully answer the question.
  - **Problem 1**: This is a lower-level problem, and it falls under Procedures without Connections. It is algorithmic, unambiguous, and requires no explanation. Participants could make a case that it is closer to a Memorization task, in that it is unambiguous and has little or no connection to the concepts underlying it.
  - **Problem 2**: This is a higher-level problem that falls either under Procedures with Connections or Doing Mathematics. The general solution pathway and content domain are explicit, but this problem is actually much more complicated than it looks. Upon first working it out, participants might think that since there are 11 possible sums, the answer is 1/11. But actually, there are several ways of rolling a 7 but only three ways of rolling a 10. Altogether, there are 36

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possible combinations for the two dice, and only 3 of them have a sum of 10. Therefore, the probability is 1/12.
  - **Problem 3**: This is a memorization task.
  - **Problem 4**: This is a lower-level task that probably fits best under Procedures without Connections.
  - **Problem 5**: This problem fits best under Procedures with Connection. The solution pathway is suggested, but there are multiple approaches and representations that could help students arrive at the answer. Students could create a T table and find points on the graph, or they could put the equation into slope-intercept form and use the slope and *y*-intercept to solve. The problem makes connections between equations and graphs.
- Activity 2: After groups have had time to work, the facilitator will lead a whole-group discussion based on the activity. The facilitator should allow each group to give their reasoning for why they assigned the level of cognitive demand that they chose for each problem. Other groups and participants should comment or add feedback, and the facilitator should encourage all groups to point to specific evidence from the rubric to support their choice.
  - The facilitator will also bring the discussion back to the Standards of Mathematical Practice.
  - For discussion: "How do we see the Standards for Mathematical Practice reflected in these sample questions?"
    - Participants should notice that the higher-demand tasks promote more of the MP standards than the lower-demand tasks.

Wrap Up/Assessment

- Facilitator will lead a closing discussion on cognitive complexity as it relates to the TASC.
  - Question for discussion: "Based on what you have seen on the Readiness Assessments and other TASC preparation materials, where do most of the problems fall in terms of cognitive demand?"
    - Most problems on the Readiness Assessments involve low levels of cognitive demand, though some do fall under the Procedures with Connections category. Participants may not completely agree on the cognitive demand of these assessment questions, and time should be allowed for participants to discuss a problem or two in detail.
  - Question for discussion: "What implications do the Levels of Cognitive Demand have on our teaching, and what can we do to make sure that we are using high-demand tasks effectively?"
    - Like Webb's DOK, the Levels of Cognitive Demand help teachers to analyze their classroom tasks and make sure that they are engaging learners in higher-demand tasks.
- For assessment, participants should write a short reflection based on the following prompt:
  - "Look back to problem 2 from the handout. What skills would a student develop by solving this problem rather than a simpler probability problem about rolling a single die? Think about the levels of cognitive demand and the Standards for Mathematical Practice as you write your response."
  - Participants will write individually for five to ten minutes. The facilitator will go around the room and ask each participant to share something that they thought about while writing. Successful responses will talk about at least one of the Standards for Mathematical Practice and/or the levels of cognitive demand.
- Participants should also try this problem in class. It will allow the participants to practice skills like effective questioning and orchestrating whole-class discussions, which will be addressed in the remainder of the workshop.

Part 2: Solving the Movie Theater Problem

Lesson Content

Participants will spend the duration of this lesson working on a cognitively demanding problem and exploring multiple solution pathways.

Lesson Materials

Participants will be given the Movie Theater Problem.

Questions to Answer

- Where does this problem fall on the rubric for cognitive complexity?
- What might a student experience while solving a cognitively demanding problem like this one?

Opening/Background

- The facilitator will distribute the Movie Theater Problem handout and introduce side one (Going to a Movie). Participants will be given a few minutes to solve the problem.
  - Question for discussion: "How cognitively demanding as this problem? What would its DOK level be?"
    - They will notice that this problem is not cognitively complex and can be solved using a routine procedure. It is DOK 1 question and falls into the Procedures without Connections category on the cognitive demand Rubric.
  - Question for discussion: "What was your experience like working on this problem? Did you struggle with anything?

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What did you learn from working on this problem?"

- The facilitator will ask participants to turn the page over and work on the more demanding version of the problem.

Lesson Activities

- Activity 1: Participants will engage with the Movie Theater Problem on their own and think about possible ways that they might approach the problem.
  - Participants should be given time to solve the problem on their own. This will likely take 15 to 20 minutes, though the facilitator should allow more time if participants need it. If participants find the solution quickly, the facilitator will ask them to try to find other approaches to the problem.
  - During this activity, the facilitator should act as the teacher, and the participants will play the role of students. The facilitator should take extra care to will model the effective questioning strategies that will be discussed in the next lesson. The facilitator should not guide participants toward a particular solution method unless they are absolutely stuck; instead, he or she should ask questions and help participants clarify their thinking.
  - The facilitator should also take notes on different participants' solution strategies, mistakes, and other evidence of thinking. All of this will be useful in the
  - Some possible problems and misconceptions that participants may have while solving the Movie Theater Problem:
    - Participants will try unsuccessfully to use algebra. In this case, the facilitator can either help them to clarify their use of variables, or the participant could be directed toward another method.
    - Participants will find a possible price of a child's ticket and an adult's ticket so that the five tickets have the correct total amount, but they may not have the prices set so that a child's ticket costs half of an adult's ticket.
    - Participants may not know where to start. In this case, the facilitator may ask the participant what the price of an adult's ticket *might* be. And if this were the price of an adult's ticket, what would the price of a child's ticket have to be.
    - If participants feel that guessing and checking is too sloppy, the facilitator may ask them how they could better organize all of the information on the page.
    - Participants might notice that two children's tickets cost the same as one adult's ticket. Is there a way they might replace the adults with children and think about the problem again?
- Activity 2: Once all or most of the participants have arrived at an answer, the facilitator should ask everyone to stop working, and the facilitator should lead the group in processing the solutions. After the sharing of work, participants should have a firm grasp on the problem and the multiple approaches used to solve it.
  - Ideally, at least two or three different solution methods will appear. One participant will likely use guess-and-check to solve the problem. The facilitator should ask this participant to show their work on chart paper or on a whiteboard.
  - While the participant is sharing their solution strategy, the facilitator should ask clarifying questions of the group. Among them:
    - Did anyone else try this strategy?
    - What do you like about this way of approaching the problem?
    - What does everyone think? Do you agree with this answer?
    - Can someone explain what he/she did in this step?
  - Another participant will likely take a more structured approach to organizing their work. They may have made a simple chart or organized their work in columns. This participant should be asked to share next. The facilitator should repeat the same line of questioning, but this time add:
    - How is this method similar to the first one we saw? How is it different?
  - One or two participants might figure out the problem algebraically. This solution should be shared last.
    - In this case, the facilitator should ask several clarifying questions of the participant who is sharing work in order to ensure that all other participants are able to follow this solution method.

Wrap-Up/Assessment

- The facilitator will lead a discussion about the cognitive complexity of the problem.
  - For discussion: "What was your experience like working on this problem? How was it different from the experience of working on the first version of the problem?"
- The facilitator will ask participants for specific aspects of the problem that made it more cognitively complex and promoted the Standards for Mathematical Practice.
  - For discussion: "What did you struggle with while you were working on this problem? What did you do when you were struggling? Which of the Standards for Mathematical Practice did you have to use in order to solve this problem?"

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- For assessment before break, the facilitator will ask participants to think about how students would interact with this problem.
  - Question for assessment: "When solving the Movie Theater problem, I anticipate that my students will struggle with _____. Some of the mistakes I think they will make are _____. I will _____ to support them while they struggle.
    - This prompt will encourage participants to start thinking about how they would support students in a problem-solving environment, and it will also help them to anticipate areas where students will struggle. Both of these ideas will be discussed in the next workshop.

Part 3: Using Effective Questions to Support Problem-Solving

Lesson Content

Participants will analyze and discuss effective questioning strategies that can be used to reveal student thinking support productive struggle during a problem-solving activity.

Lesson Materials

- Handout on Supporting Productive Struggle through Questioning.
- Handout on Effective Questioning Strategies and how they support the Standards for Mathematical Practice

Questions to Answer

- Why is it important to ask the right questions while students are solving a difficult problem?
- How can we use effective questioning to draw out student thinking?
- Why might students learn more—and learn better—if instructors ask the right questions rather than provide them with a solution pathway?

Opening/Background

- The facilitator will begin this activity by inviting participants to think back on their work with the Movie Theater Problem.
  - The facilitator will ask the group to share the aspects of the problem that students will struggle with the most. (Participants should already have responses to this question from the end of the previous activity.) The facilitator will record responses on chart paper so that the group can refer back to them throughout the activity.
  - The group will discuss how they would support students, and the facilitator will direct participants to think specifically about questions they would ask their students to promote productive struggle.

Lesson Activities

- Activity 1: The facilitator will distribute the handout Supporting Productive Struggle through Questioning.
  - Individually, participants will work to think about questions they would ask students that help students understand the problem, support students while the struggle, encourage students to think about their work, and draw out student thinking during a whole-class discussion.
  - Participants should be given about ten minutes to write their questions on the handout.
- Activity 2: After participants have had time to think about questioning strategies individually, they will share their thinking in a pair share or in small groups.
  - After each pair has had time to discuss and refine their questioning strategies, the facilitator will lead the group in a discussion of effective questions.
  - The facilitator should use chart paper or a whiteboard, with one sheet/section for each topic, and should record the questions developed by the participants. The four topics are:
    - Helping students understand the problem
    - Supporting students when they get stuck
    - Getting students to think about their process and their answer
    - Sharing solution strategies in a whole-class discussion
- Activity 3: After participants have shared the questions that they wrote, the facilitator will distribute the handout Effective Questioning Strategies.
  - The facilitator will give participants a short time to read through the questions from the handout.
  - For discussion: "Are there any questions we came up with that are not on this handout? What questions would we like to add to the list?"

Wrap Up/Assessment

- The facilitator will lead a discussion about the questions in the handout, asking participants which questions they have used with students before and which ones they would like to try in the future.
  - Question for discussion: "How can effective questioning strategies help to promote the Standards for Mathematical Practice in our math classrooms?"

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- For assessment, participants should be directed to look back at the Effective Questioning Strategies handout and answer the question: "Choose two questions from the list that you haven't used in class before but would like to add to try. Why did you choose these questions, and how can they support students in productive struggle?" Participants should be given five to ten minutes to write.
    - The facilitator will go around the room, and each participant will talk about one of the questions that they wrote down.
- Participants should try an extended problem-solving activity in their own classes and reflect on how they used the questioning strategies discussed during this lesson.
    - The facilitator may choose to distribute the handout Reflecting on Effective Questioning for participants to use for reflection on their own.
    - After participants have had a chance to try the problem-solving activity and complete the reflection, they can share their experience with other participants in a follow-up meeting or during a subsequent workshop.

Part 4: Structuring Whole-Class Discussions of Problem-Solving Activities

Lesson Content

Participants will analyze the Five Practices Model and learn how to structure whole-class discussions when students finish working on a complex mathematical task.

Lesson Materials

Participants will be given handout on the Five Practices Model for Whole-Class Discussions.

Questions to Answer

- What is the Five Practices Model for whole-class discussions?
- What are the benefits of asking students to talk about their work and the work of their peers?
- Why is it important to give students the time to process different solution strategies and analyze the work of their peers?
- How can this help them to become better problem solvers?

Opening/Background

- For the last part of the workshop, the facilitator will ask participants to think back to the discussion of work that took place after everyone finished working on the Movie Theater Problem.
    - Question for discussion: "What did you notice about the way that the discussion of work was structured?"
        - Participants should be encouraged to point to specific questions asked by the facilitator during the processing of solutions.
        - Participants should notice that the facilitator made a choice about which solution method to discuss first, and the ordering of subsequent solution methods.
    - The facilitator should reveal his/her decisions about the presentation of student work to the group and why the discussion was sequenced in the way that it was.
        - In the case of the Movie Theater Problem, the presentation of student work usually starts with a solution that involved guessing and checking. This shows other students that guess-and-check is an acceptable way of solving a problem, but that it has limitations and can feel too uncertain and unstructured to some students. In short, it can feel random. Students often feel that guessing and checking isn't really "doing math." However, the facilitator should point out that guessing and checking can be strategic; that is, after we've tried a guess and it didn't work out, how can we adjust our guess to get us closer to the desired result?
        - The presentation of work will then usually move toward something more structured. In the classroom, some students will structure their guesses using a table or chart. These students should be asked to present next.
        - Other students might try to draw pictures to make sense of the problem. With this particular problem, drawing pictures might not seem like the best approach, but it is worth discussing if a student tries it.
        - In some cases, an algebraic approach to the problem will be used. Because this might seem to students to be the most "elegant" approach, it is a good idea to discuss the algebraic solution last, if at all. The teacher may determine that the class isn't ready to talk about this approach yet.
    - After the group has talked about the facilitator's choices in the discussion of student work, they should talk about other possibilities for structuring the discussion.
        - Question for discussion: "Is there another way we could have structured the presentations of student work? Would anyone have done it differently?
- The facilitator will distribute the handout on the Five Practices Model for Whole-Class Discussions.
    - The facilitator will lead the group in a discussion of each step in the model.
    - The facilitator will point out that the Five Practices Model is built on the idea that students need time to process a

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problem after they have finished solving it, and time spent discussing solution methods and analyzing reasoning helps our students to become more effective and efficient problem solvers.

- **Anticipating**: To structure the most effective whole-class discussion, the teacher needs to first solve the problem in as many ways as possible. Anticipating student responses ensure that the teacher will be able to ask effective questions and support the strategy chosen by the student, rather than simply providing their own pathway to the solution.
- **Monitoring**: This practice requires the teacher to take on the role of an active observer while students are solving problems. The teacher should take notes of which strategies students are using so in order to begin planning the whole-class discussion.
- **Selecting**: At this step, the teacher may notice that some students are using the same approach and will have to make a decision about which student to select. Sometimes, there may be a particular mistake that the instructor wants to point out to the group. The instructor may also choose a student whose work gestures toward another solution method.
- **Sequencing**: Here, the teacher makes decisions about the order in which work will be presented. It is important for the facilitator to point out that there is no one correct way to sequence the work. The teacher will have to make decisions on the fly about the order in which students will present their solutions.
- **Connecting**: As the students are discussing their solution methods, the teacher should be asking questions of the presenter, and also asking other students about the presenter's method. The primary goal here is to help students see connections between the various solution methods and to help them add new problem-solving strategies to their toolkit.

- Questions for discussion: "What are the benefits of using the Five Practices Model in the ABE/HSE classroom? What would be some of the challenges?"

Lesson Activities

- Activity 1: In the last part of the workshop, the facilitator will distribute the handout Student Work on the Movie Theater Problem.
  - The facilitator will ask participants to spend about five minutes individually looking through each of the four samples of work.
- Activity 2: The facilitator will then organize the participants into small groups. Each group will think about how they would structure the discussion of student work, how they would order the presentation of student solutions, and how they would use questioning strategies that will draw out student thinking and help students make connections during the whole-class discussion.
  - Participants may have questions about the different approaches. The facilitator can provide some background or clarification for each but should not share the order in which the teacher originally asked these students to present their work.
    - **Feliciano:** Feliciano had very little trouble with this problem and finished it in a very short time. His sheet has very little work on it because he did most of the work in his notebook and copied this strategy onto the handout. Feliciano's solution reflects an algebraic understanding that uses pictures rather than variables to arrive at the answer. Feliciano's classmates were really amazed by this solution, and it brought up a lot of interesting questions.
    - **Crystal:** Crystal had a hard time getting started with this problem. She is a very gifted student but lacks confidence in her ability to solve problems like this one. Her teacher encouraged her to just try a few things to get started, which is how she came up with the operations in the top half of the page. She tried these out using a calculator but wasn't getting anywhere and shut down again. Her teacher talked to her about taking a guess for what an adult's ticket might cost, and Crystal started with $15.00. She and her teacher talked about how to organize her work, which is how she came up with the table on the bottom left. Crystal still had trouble understanding what was happening in the problem, which is reflected in the first table she made. In trying to keep everything organized, she forgot that there were two adults and three children. She corrected this in the second table and solved the problem successfully.
    - **William:** William's work was all over the place at first, but he settled into guessing and checking and, by the end, had found the correct answer. William started out by using numbers somewhat randomly, and he eventually found a systematic approach for guessing.
    - **Stephanie:** Stephanie's approach is a combination of Crystal's and William's. She starts by taking some guesses and trying a few things, and then, with some prompting, she starts organizing her work into a table. Her table isn't quite as organized or clear as Crystal's, but it still got her to the correct answer.
    - When these students did the activity in class, the teacher asked William to present his strategy first, then

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Stephanie, then Crystal, and finally Feliciano. The problem was done very early on in the cycle, and the teacher wanted to illustrate that guess-and-check is a perfectly acceptable way of getting started with a math problem. He asked Stephanie to present next, because her solution was similar to William's but introduced an element of organization. Crystal presented her tables next because the instructor wanted her to talk about her initial mistake in creating her table and how she corrected it the next time. Feliciano presented last because his solution is very different from the other three and gestures toward algebraic thinking and processes.

- Activity 3: Each group will share its decisions for orchestrating the discussion.
  - As the groups present, the facilitator should ask questions to clarify the reasons behind each group's decision. Participants should be directed to point out specific elements of the student work that led them to make their decision.

Wrap Up/Assessment

- Participants will be given "Orchestrating Discussions" for further reading.
  - Participants should be instructed to read the article and then try the Five Practices Model in their classrooms. Participants can share their experiences via email or another online platform, or they could talk about their experiences during a follow-up meeting.
  - For this activity, the participants may choose to use the lesson plan based around the Movie Theater Problem, or they may develop a problem-solving activity of their own.
- For final assessment, participants will take a short time to write about how the Five Practices Model supports the Standards for Mathematical Practice. In particular, they should think about how the Five Practices Model support coherent mathematics instruction.
  - The facilitator will ask participants to take five to ten minutes to free write based on the following questions:
    - "How does the Five Practices Model support the Standards for Mathematical Practice?"
    - "How can the Five Practices Model make lessons more coherent?" (This question will gesture toward Workshop 13, in which participants will analyze the Instructional Shifts in Mathematics, one of which is coherence.)
  - In their responses, participants will demonstrate their understanding of the material covered in this module by writing about the Standards for Mathematical Practice, and mentioning specific elements of the Five Practices Model. Successful responses will also talk about mathematical tasks in terms of Webb's DOK or the Levels of Cognitive Demand in Mathematics.

Overall Wrap Up

Note: this part will be done in a discussion format.

- How will you use these tools in your own teaching practice?
- What does it mean to have a "student-centered classroom?"
- What are the benefits of asking students to take on teaching roles in the classroom?
- What are some other aspects of this workshop that you would like to explore in the future?

Project/Homework

- Participants will read Smith, Hughes, Engle, and Stein's "Orchestrating Discussions."
- Participants will read Driscoll and Moyer's "Using Students' Work as a Lens on Algebraic Thinking."
- Participants will develop/try a rigorous problem-solving activity in their classroom. They may choose to use the Movie Theater Problem from this workshop.
  - After doing the activity in class, participants should reflect on the experience and share it with other participants after the workshop.

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