

Professional Development Module

Facilitator's Guide

Title: Strategies for Modifying Existing Math Tasks to Increase Cognitive Demand

Targeted Audience: 6-12 Math Teachers

Description: This module provides participants with an opportunity to compare and contrast low-level mathematics tasks with versions of the tasks that have been modified to increase the cognitive demand and rigor. Teachers are asked to note modifications that have been made to tasks and to determine how the modifications require students to think differently about the underlying mathematical ideas. Via the analysis of a set of modified tasks, participants identify strategies they can use when modifying their own tasks to increase the cognitive demand and rigor of the tasks.

Outcomes and Success Indicators

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| <i>Outcome #1 Understand and classify the levels of cognitive demand in mathematics tasks</i> |
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| <i>Success Indicator: Identify the difference between tasks of low cognitive demand and high cognitive demand</i> |
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| <i>Outcome #2 Classify tasks for the levels of cognitive demand in order to identify rich and rigorous mathematics tasks</i> |
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| <i>Success Indicator: Accurately compare tasks according to levels of cognitive demand</i> |
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| <i>Outcome #3 Un-structure or redesign structured mathematics tasks from existing curriculum materials</i> |
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| <i>Success Indicator: Restructure, reflect, and receive feedback on an individually-modified mathematics task which increases cognitive demand to a higher level</i> |
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This module starts with an activity designed to acquaint PD participants while illustrating the idea of rigor (Red Solo Cup). This is followed by readings that explain and provide examples of rigor and cognitive demand in mathematical tasks (Activity 1). In Activity 2 participants further their understanding of the nuances of levels of cognitive demand through a card sort activity and discussion. Finally, strategies for modifying traditional textbook problems to increase cognitive demand and rigor. Examples of revised tasks are provided and participants are asked to modify tasks from their current curriculum (Activity 3).

Time Frame: 3 hours

Agenda:

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| <p>Minutes</p> | <p style="text-align: center;">Activity and Procedure for the Activity</p> <p>Place posters of “I Can” Statements around the room prior to attendees arriving.</p> <p>Red dot stickers for participants should placed on the table for participants</p> <p>NOTE: Participants need to bring appropriate curriculum for use during session</p> | <p style="text-align: center;">Materials:</p> <p>Equipment for projecting and presenting the Powerpoint</p> <ul style="list-style-type: none"> ● I Can Statements Posters- print 11x17 - download as an excel to print correctly | | |
| <p>20 min.</p> | <p><u>Welcome, Task, Introductions, Review Outcomes</u></p> <p>1. Red Solo Cup - Refer to the Solo Cup Document to the right. - <i>You will need 4 participants for each group. Give each participant in each group one of the four assignments - reminding them that ONLY THEY can read and see their card. Do the first challenge on the cards. Have them raise their hands when done. Next hand them the 4th challenge from the sheet.</i></p> <p>2. Introductions- introduce yourselves in the small group.</p> <p>3. Do the first task within Solo Cup Team Builder on the cards. Raise hands when done.</p> <p>4. Move to the rigorous version #4 of the Team Builder. Raise hand when done.</p> <p>5. Debrief:</p> <ul style="list-style-type: none"> a. What are the possible solution pathways for the task? b. What particular challenges did the task present? c. How did the complexity change? <p>6. State Outcomes to participants (on PowerPoint).</p> <p>7. Pre-Assessment:</p> <ul style="list-style-type: none"> a. Have “I Can” Statements posted around the room. <ul style="list-style-type: none"> i. “I can define and use examples of rigor in my classroom.” ii. “I can describe/apply the levels of cognitive demand.” iii. “I can use questioning techniques to increase the rigor and cognitive demand of lessons.” iv. “I can un-structure tasks to raise level of cognitive demand and rigor.” b. Red dots should be placed each table participants. c. The “1-4 rating” below should be explained. Participants will evaluate their level of understanding and place the red dot on the appropriate level of each “I Can” statement poster. (1 - know nothing..., 4 - I could teach others about this): - Walk to a poster and model how to place the red dot on the line corresponding to your level of understanding. | <ul style="list-style-type: none"> ● Red Solo Cup Directions ● Red Solo Cup Activity ● Solo Cups ● Rubber bands ● Red dot stickers ● Chart Paper/Posters | | |
| | <table border="1" style="width: 100%;"> <tr> <td style="width: 10%; text-align: center;">1</td> <td>I don't know anything about how...</td> </tr> </table> | 1 | I don't know anything about how... | |
| 1 | I don't know anything about how... | | | |

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| | <table border="1"> <tr> <td data-bbox="220 94 394 162">2</td> <td data-bbox="394 94 1470 162">I know a little bit about how...</td> </tr> <tr> <td data-bbox="220 162 394 230">3</td> <td data-bbox="394 162 1470 230">I am comfortable with how...</td> </tr> <tr> <td data-bbox="220 230 394 298">4</td> <td data-bbox="394 230 1470 298">I could teach others about how...</td> </tr> </table> <p data-bbox="220 324 1470 402">Note: If a participant(s) has more content knowledge at the beginning, move the participant directly on to Activity #3 (this is optional).</p> | 2 | I know a little bit about how... | 3 | I am comfortable with how... | 4 | I could teach others about how... | |
| 2 | I know a little bit about how... | | | | | | | |
| 3 | I am comfortable with how... | | | | | | | |
| 4 | I could teach others about how... | | | | | | | |
| 20 min. | <p data-bbox="220 402 1470 438"><u>Activity #1 - Understand and classify the levels of cognitive demand in mathematics tasks</u></p> <p data-bbox="220 438 1470 511">(As you go through this section, refer back to the Red Solo Cup Activity throughout Jigsaw Activity.)</p> <p data-bbox="220 511 1470 592">1. Assign each table one topic from below. Discuss and develop meaning of your topic. Be ready to take your topic summary to your jigsaw group of 3.</p> <ol data-bbox="273 592 1470 828" style="list-style-type: none"> a. Define Rigor - (<i>CCSS-Math Key Shifts, Rigor: What It Is and Is Not and Hess Cognitive Rigor Matrix</i> documents) b. Define Cognitive Demand (<i>DOK Levels and Roles and Cognitive Demand Levels & Examples</i>) c. Define Questioning to Promote Higher Level Thinking (<i>Math Practices Question Stems, pages 1 and 2 and Questioning pg. 4-6</i>) <p data-bbox="220 828 1470 909">2. Jigsaw - form a group of three making sure you have a person from each topic (1, 2, 3); Round Robin sharing of the three topics to build understanding.</p> | <ul data-bbox="1470 402 1915 1096" style="list-style-type: none"> ● CCSS – Math Key Shifts ● Rigor: What It Is and Is Not ● DOK Level Roles ● Hess Cognitive Rigor Matrix Curricular ● Mathematical Practices Question Stems ● Cognitive Demand Levels – 8 Tasks ● Cognitive Demand – 8 Tasks Categorizations ● Learning Through Questioning - MARS (use pp. 4-6) ● Chart paper ● Markers | | | | | | |
| 20 min. | <p data-bbox="220 1096 1470 1177"><u>Activity #2 - Classify tasks for the levels of cognitive demand to identify rich and rigorous mathematics tasks</u></p> <p data-bbox="220 1177 1470 1218"><i>(Optional according to group understanding and time)</i> Analyzing Cognitive Demand Activity:</p> <p data-bbox="220 1218 1470 1258">Part 1 - pages 1 and 2</p> <p data-bbox="220 1258 1470 1331">1. Group formation based on number of total participants - select from one of the options below:</p> <ol data-bbox="273 1331 1470 1523" style="list-style-type: none"> a. Pairs b. Groups of three or four c. Table groups | <ul data-bbox="1470 1096 1915 1523" style="list-style-type: none"> ● Features of Cognitive Demand of Tasks ● Task Analysis Guide ● Task Card Sort – Grades 3-5 ● Optional Task Analysis – High School ● Task Card Sort - HS ● Necessary printed copies of task cards, etc. | | | | | | |

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| <p>30 min.</p> | <p>2. Do two math problems (<i>Features of Cognitive Demand of Tasks</i>) individually and silently:</p> <ol style="list-style-type: none"> Martha's Carpeting Fencing Optional Task Analysis – High School alternative tasks on the right <p>3. Table group discussion following completion of Martha's Carpeting Task and Fencing Task:</p> <ol style="list-style-type: none"> Identify strategies and mathematical process standards Identify math concepts Identify similarities and differences <p>4. Whole group share — pick from up to three groups to share how they solved the problems.</p> <p>Analyzing Cognitive Demand Activity: Part 2</p> <p>1. Participants will sort the Tasks using categories of their choosing (the purpose is to get them to become familiar with the sixteen task cards -- you may use less than 16 cards depending on group size and timing) and are <i>not reflective of secondary math tasks</i>. (There is a high school algebra and geometry tasks card sort attached on the right if you would like to use them instead for higher grade-level groups.)</p> <p>2. Groups share sorting schemes.</p> <ol style="list-style-type: none"> Facilitator should eavesdrop and select pairs to share if there's not time for all groups to share. <p>3. Explain <i>Task Analysis Guide</i> - page 3:</p> <ol style="list-style-type: none"> Memorization Procedures without connections to understanding, meaning, or concepts Procedures with connections to understanding, meaning, or concepts Doing Math <p>4. For Low Level Tasks:</p> <ol style="list-style-type: none"> What is the rule or procedure you would use to solve the task? What have you memorized that you are being asked to recall? | |
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| | <p>5. For High Level Tasks:</p> <ul style="list-style-type: none"> a. What is it you have to think about in order to solve the task? b. What decisions or judgments do you have to make? <p>6. Use <i>Task Analysis Guide</i> to fine tune participants' categorization based on the four categories of cognitive effort.</p> <ul style="list-style-type: none"> a. Record the features of each task on the <i>Features of Cognitive Demand Recording Chart</i>. b. Use questions above to help distinguish the different levels of rigor. <p>7. Group share (still in small groups)</p> <ul style="list-style-type: none"> a. Share a task that was identified as "Memorization". <ul style="list-style-type: none"> i. What were the features that made it so? ii. What adaptation(s) could be made to increase the level of cognitive demand? b. Share a task that was identified as "Procedures without connections to understanding, meaning, or concepts". <ul style="list-style-type: none"> i. What were the features that made it so? ii. What adaptation(s) could be made to increase the level of cognitive demand? c. Share a task that was identified as "Procedures with connections to understanding, meaning, or concepts". <ul style="list-style-type: none"> i. What were the features that made it so? d. Share a task that was identified as "Doing Math". <ul style="list-style-type: none"> i. What were the features that made it so? <p>8. Summarize</p> <ul style="list-style-type: none"> a. Does a particular feature indicate that a task has a particular level of cognitive demand? b. Is there a difference between "level of cognitive demand" and "difficulty?"; how does this relate to "rigor"? c. What effect does context (e.g., setting in which the task is used, students' prior experience/knowledge, grade level) have on the level of cognitive demand and rigor required by the task? | |
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| 10 min. | Ten Minute Break | |

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| <p>30 min. for parts 1-3</p> | <p><u>Activity #3 - “Un-structure” or redesign structured mathematics tasks from your existing curriculum materials</u></p> <ol style="list-style-type: none"> 1. Watch the Dan Meyer Video. 2. Discuss what Dan did to un-structure a structured problem: whole group. 3. Group according to each problem (Hand out structured version of problems to groups - pages 2-4). <ol style="list-style-type: none"> a. Discuss the problem. b. List all of the decisions that are being made for students. c. Revise the structured problem. d. Think about how to hand back some of the decisions to the students for transfer. 4. Compare structured and unstructured problems (hand out the unstructured version of problems - pages 5-8). <ol style="list-style-type: none"> a. What decisions have been left for the students? b. What pedagogical issues will arise when you start to use unstructured problems like this? | <ul style="list-style-type: none"> ● Strategies for Modifying Tasks ● Problem Solving Handout - MARS (Structured problems pp. 2-4) ● Problem Solving Handout - MARS (Unstructured problems pp. 5-8) ● Identify Strategies to Modify Tasks - Examples ● MARS Math Problem Solving ● Dan Meyers Resources ● Andrew Stadel ● Fawn Nguyen ● Worthwhile Task Evaluation ● Sources for Higher Level Cognitive Demand Tasks |
| <p>15 min.</p> | <ol style="list-style-type: none"> 5. Observe and analyze a lesson - Video http://map.mathshell.org/pd/modules/3_Problem_Solving/html/videos_d1.htm <ol style="list-style-type: none"> a. As you watch the video, consider these questions: <ol style="list-style-type: none"> i. What do you observe the teacher saying and doing? ii. How are the results of this task different from the traditional structured tasks in your classroom? iii. What do you hear and see from the students? b. Large group Share Out - provide the full <i>MARS Math Problem Solving</i> link with the participants. | |
| <p>30 min. for parts 5 and 6</p> | <ol style="list-style-type: none"> 6. Un-structure (modify) one of your existing lessons to increase cognitive demand and rigor - utilize the <i>Strategies for Modifying Tasks</i> to assist you. OR provide additional examples from <i>Identify Strategies to Modify Tasks – Examples</i>. 7. Exchange with a participant you have not partnered with today for feedback. 8. Share list of modified or unstructured task resources from other sites - Dan Meyers, Andrew Stadel, Fawn Nyugen, and Source document on right with participants. <p>Optional extensions for online or other professional learning:</p> <ol style="list-style-type: none"> 1. Activity E (see <i>MARS Math Problem Solving</i>) was saved from the Problem Solving lesson for online continuation. 2. Use your unstructured lesson/task with your students. | |

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| | <ul style="list-style-type: none"> a. Share student work. b. Reflect on the difference between the original lesson and the new task. <p>3. Try one of the unstructured tasks from the provided links and reflect on the student outcomes.</p> | |
| 5 min. | <p><u>Wrap-up & Evaluation</u></p> <p>Post-Assessment - Have "I Can" Statement Posters posted around the room - Hand out green sticker dots to participants and have them use the "1-4 rating" (1 - know nothing..., 4 - I could teach others about this).</p> <p>Self-reflection: How have I grown through this professional learning experience?</p> <p>Evaluation: Was I able to meet the outcomes of today?</p> <ul style="list-style-type: none"> a. "I can define and use examples of rigor in my classroom." b. "I can describe and apply the levels of cognitive demand." c. "I can use questioning techniques to increase the rigor and cognitive demand of lessons." d. "I can un-structure tasks to raise the level of cognitive demand and rigor." | Green dot stickers |