MSDE-MCAP Mathematics, Grades 3-5, Assessing Modeling
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Welcome to the MCAP Mathematics webinar on Assessing Mathematical Reasoning in Grades three through five. My name is Linda Schoenbrodt and I am the Elementary Mathematics Specialist at MSDE.

In our session today, we will focus on these outcomes. To deepen our understanding about mathematical reasoning, What is it and why do we assess it? To develop an understanding of how mathematical reasoning will be assessed on the MCAP assessment, To develop an understanding of the MCAP reasoning evidence statements In addition, to learn ways to implement instructional practices that promote reasoning.

What is mathematical reasoning?

There are many different ways that reasoning has been described. Here are just a few. Reasoning is when we, critique the thinking of others. Or when we identify if claims or a statement are mathematically true or false. Or when we have to prove or disprove a claim or statement using mathematics. Reasoning is when we explain mathematics or when we make sense of the mathematics in a problem. Reasoning has been defined as when we justify our thinking or our answers using mathematical concepts. It is the act of thinking in a logical sensible way. To form a conclusion or judgment or when we reflect on solutions to problems And determine if they make sense. Reasoning is included in the standards of mathematical practice. Let us take a look at what the standards say about reasoning.

This is one of the two standards of mathematical practice for reasoning. SMP 2- To reason abstractly and quantitatively. Students make sense of the quantities and their relationships, They are able to decontextualize and contextualize quantitative relationships, They understand the meaning of quantities and are able to determine which operations and their properties can be used to find a solution. They are able to create a logical representation of the problem.

When students decontextualize and contextualize a problem, they are going through a reasoning process. What does it mean to contextualize and decontextualize a problem? When students read and make sense of the problem, they decontextualize it. They are able to take the context of the problem and represent it abstractly using Mathematical representations. When students interpret the context of the problem, they understand the situation and the problem, as well as what the quantities in the problem mean.and any relationships between them. This also helps to determine the operations that may be needed to solve the problem and to create a solution that represent it.

Once students have created their solution and represented it, they need to contextualize the situation. They take the abstract mathematical representation and look back at the context to make sure that the problem includes the correct meaning of the quantities, uses the correct operations, and is a correct interpretation of context of the problem.

The second SMP that focuses on reasoning is SMP 3-To construct viable arguments and critique the reasoning of others. Students are able to analyze problems and use stated mathematical assumptions, definitions, and established results in constructing arguments, They justify conclusions with mathematical ideas, They listen to the arguments of others and ask useful questions to determine If an argument makes sense, They can compare two arguments and determine correct or flawed logic.

Now that we've thought a little bit about what's the meaning of mathematical reasoning, Let's take a look how reasoning will be assessed on the MCAP assessment, for grades three through five. In the MCAP assessment, there are two kinds of reasoning items. The first one we will discuss is a one-
point item for reasoning. This is something different from the PARCC assessment .The PARCC assessment did not have one-point reasoning items. The Type 1 items are machine scored. These may have the same format as a content item. The items could be multiple choice, multiple select, or inline choice, or one of the many technology enhanced features. Reasoning items are composed of two evidence statements.
The first evidence statement will be one of the MCAP reasoning evidence statements, and the second will be a content standard from the Maryland College and Career Ready Standards for the grade.

The Type 2 reasoning item, is very similar to the ones that we have seen in PARCC assessment. These are all constructed response items. Each of these items will be worth either 3 or 4 points per task. In grades 3 and 4, they will see constructive response items, worth three points. In grade five, they will see constructive response items that are either three or four points. The items are also composed of two evidence statements- one reasoning MCAP evidence statement and one content evidence statement that is aligned to the Maryland College and Career Ready Standards for the grade. Since these items are human scored, there is a committee of educators who will meet to review the student answers and decide on a score using the holistic rubric.

Here is a copy of the holistic rubric that will be used to score the constructed response items. You can find a copy of this rubric on the same web page where you found the link to this webinar. You may want to consider using this (rubric) to score your students' work. In addition, MSDE is offering a webinar on using the holistic rubric. It can also
be found on the same website where you found this webinar.

Another new feature of the MCAP mathematics assessment is that all students in grades three through five, will have access to an online calculator to do the computations for reasoning and

modeling items. There are two versions of the online calculator Students will be able to select the online calculator that they would like to use. Both models are displayed on the screen. Both calculators are called five function calculators. This means that they have the four basic operations, addition, subtraction, multiplication, and division, and a percent and square root key. You can help students prepare for using the calculator, during the assessment, by providing them with an online calculator for them to use during instruction.
Desmos, the calculator on the right, offers free access to their five-function calculator. Desmos also offers a braille version. The links on the screen provide direct access to both calculators.

We know that it is important for the students to feel comfortable with using the calculator online. It might be a good advantage to introduce the online calculators to students, so they are familiar with how to use them, when calculating their answers.(on the assessment) Here are a few tips to consider. One of the first things students need to get used to Is reading their item but then solving it on another piece of paper. They should Include all the steps to their work as well as their solution path, and then use the calculator to do the computations, Then students need to transfer their work and solutions to the online assessment format. A MCAP practice test could be available for your students to practice this. The other thing that is important is for students to develop the habit of really checking and analyzing their solution on the calculator to make sure that the answer on the calculator is reasonable and correct based on the item.

In this section, we will learn about the MCAP evidence statements for grades three through five. We will also view an example of an item for each of the evidence statements. Please keep in mind, that example items should not be considered a template for all reasoning items. They are used to clarify the meaning of the evidence statements.

On this slide, you will see the four reasoning evidence statements for grades three through five. All the wording of the evidence are the same for all grades, three through five. The differences will be the content item, the content standards that are used along with these evidence statements. Let us look at the coding of the evidence statements.
You will notice that there is an R.1, R. 2, R.3, and R.4. The R stands for reasoning
In addition, the numbers one through four are just a way to identify each of the different reasoning evidence statements. You are able to access all of the evidence statements for content, reasoning, and modeling, on our Maryland website. if you go to the reasoning evidence statements, you'll see the grade level in front of the R, For example if you are a third grade teacher and you open the evidence statements for grade three, your reasoning evidence statements would be coded 3.R.1,3.R.2, etc.

Let us go through them, so in an R.1, students are going to be asked to base their reasoning or explanations using a given pictorial representation and explain how the pictorial model represents a mathematical concept.

R.2 students will be asked to identify flawed reasoning and explain how to correct the thinking or work.
R.3- To prove or disprove a statement conjecture or generalization with correct mathematical examples.R.4 -To reason mathematically to create or analyze a correct and precise solution to a real-world problem, and be able to explain why the answer is mathematically correct. This is where contextualizing comes in.

What we are going to do now is to just go through each evidence statement and explain it in a little bit more in detail, as well as show you a sample item for this evidence statement. Therefore, for R.1- To base explanations using a given pictorial representation there are three possible ways that this particular evidence statement could be assessed. Students could be asked to explain how the pictorial models represent a mathematical concept. Or, they may be asked to explain how the representation could be used to justify or refute a statement with or without flaws. And a third way, to explain how the representation can be used to make a generalization This is just one of these are three different ways the writers could create an item that' aligned to R.1.

Let us look at a sample item for this evidence statement. Here is R.1, this is the type one. This is a one-point item. You will notice that this item is showing a representation of a number line /open number line. The student is asked to use the number line to find the value of 269 minus 234. How did they use the number line to get to that answer? The number line lists all the numbers from 234 to 269 that corresponds to the hops for each of those numbers. The question asks which expression represents how the student used the number line to find the value of 269 minus 234. The students need to read the four answer choices and select the expression that does that. Answer choice A. The hops represent 10 plus 10 plus 10 plus 10 plus 10. Or B. - 10 plus 10 plus 10 plus 10 plus 1. Answer C. - four plus ten plus ten plus ten plus one or D- one plus ten plus ten plus ten plus four. Students are going to identify the expression that that explains how they solved the problem.

This item is an example of an R.1, but this is a three-point constructed response item. In this item, students are shown a pictorial representation of an area model. Students are asked to explain how the model could be used to find 54 times 78, and provide the correct answer. Students are asked to enter their answer and explanation in the space provided. What you are seeing here, is the equation editor, also under the equation editor will be a drawing tool box. Students are going to be able to put their answers in either or both the equation editor or the drawing tool box. The directions, the students are given is to enter your answer and your explanation in the space provided. You may also use the drawing tool to explain and support your answer. When these items are scored, the scorers will look at any student answers that are in either or both of the equation editor and drawing tool boxes.

Here are some instructional tips for R.1.It is important that students are introduced to, and use a variety of representations for your grade level, such as. number lines, either opened or closed, area models, bar models, tape diagrams base 10 blocks, etc. To build their conceptual understanding but also as a way for them to communicate their understanding. It would also

be important to provide problems that include visual representations and ask the students to explain the mathematics that the model is representing. This is something that we do not want to keep this as just work, but it could be included in your math talks and number routines. Then finally, to provide opportunities for students to communicate their thinking and writing using precise representations. I cannot emphasize enough that our students really need time to do some writing in mathematics. The students need to be able to communicate their thinking in writing so that the readers and the scorers can understand what they are saying as well as we really need those precise representations, so they can receive full credit for their answers.

Our next reasoning evidence statement is R.2- To identify flawed thinking /reasoning and explain how to correct the thinking or work. In R.2, the items will prompt students to identify the flaw in thinking or reasoning and explain how to correct the thinking or the work shown. A Type one, one- point item, would ask students to do one of the two. Either identify the flaw or correct it. This is a one-point item, so we do not need students to do both. However in a Type 2 item, a constructive response item, that item would ask students to do both, identify the flaw and explain how to correct it. Students will use this direction line, Use words, work and /or the drawing tool to support or further explain their reasoning.

Here is an example of one point, Type one item. The student is asked to identify the error. So here is an example of the students needing to identify the error. Here is the problem- An artist drew a rectangle. (And there is a drawing of rectangle) the longest side is labeled with the number seven and the shorter side is labeled with the number three. The artist said, the area of the rectangle shown is found by adding three plus seven plus three plus seven to equal twenty. The artist made a mistake. Which statement explains the artist's mistake? The answer choices are A.The artist used the incorrect side lengths. B. The artist added these side length incorrectly. C. The artist calculated the final answer incorrectly. D.The artist calculated the perimeter of the rectangle. You can see this item is identifying only identifying the error. They are not being asked to correct it.

However, in this next example, this is still an R.2, Type one item. This time we are only going to ask the student to correct the mistake. The item says, A student said the value of eleven tens eight ones and two hundreds is one thousand one hundred eighty-two. The student made a mistake. What is the correct value? Students would be using the equation editor to be able to enter their own answer in the space provided.

Here is an example of an R.2, three-point, a constructed response item. For this one, we kind of took the context of the item that we just viewed, but we expanded it to be a three-point constructed response item, so you could kind of see the difference between a one point and a three-point item. Let us read this one. What number does eleven tens eight ones and two hundreds make? Margot said the value is one thousand one hundred and eighty two. What error did Margot make in her reasoning? How would you correct the error that Margot made? Then we have the direction lines. Because it is a three-point item, we are asking students to identify the error and correct it.

Some instructional tips for R.2. We want to make sure that we provide many opportunities for students to practice determining if the thinking of others is flawed or not flawed. So math talks and number of routines can really can help with this. We want to have students really practice explaining how to correct the mistake. This something we saw students really have trouble with. Often, when students are identifying the error, they are identifying how to correct it. These are two different things. We just want them to tell us what he error is and then secondly how to correct it. And again, I want to come back to and emphasize for students to be able to demonstrate their mathematics precision in their daily work. Really, be firm with the students to make sure, when they write their equations, they write them correctly and they are using the right, correct representations.

Our third evidence statement is to prove and disprove a statement, conjecture, or generalization, using correct and precise mathematical examples. For these items, tasks are going to state a conjecture based on a grade appropriate mathematical concept that is either true or false. What do we mean by an appropriate mathematical concept? We're looking at the big ideas that we find in number sense, in fraction concepts, in properties of operations, the relationship between operation, place value concepts,etc. Then, what students will need to do is identify what has asked and then select an example/ a mathematical example to prove or disprove the conjecture. Answer choices can be any visual representations, expressions or equations.

Here is an example of a Type 1, R.3 item. Notice that the students need to select the representation that proves that the student's thinking is correct. A student makes a generalization that two fractions can be compared using the benchmark fraction one-half. Students will select the two correct answers that prove the student statement is correct. Students are asked which two comparisons use the benchmark fraction one-half to compare them? You will notice in the direction line, it says, Select the two correct answers. The word two is in bold font. This is a multiple select item .In multiple select items, there's more than one correct answer. In the elementary grades three through five,we will always tell the students how many answers they need to select. We do not leave it up to being a guessing game.

Here is an example of an R.3, a Type 2constructed response item. Students need to decide, in this problem, if the statement is true or false. They are asked to provide an answer to the question, What happens to the sum if each addend is multiplied by two? Then students need to provide two examples to support their answer. I will read the problem for you. Your teacher gives you this problem to solve. What happens to the sum in an addition problem if two multiplies each addend? What is the answer to the problem that the teacher gave? Explain how you found the answer and provide two examples that support your answer.

A few instructional tips for the R.3 evidence statement. We really want to provide many opportunities for students to use what they know about mathematics to prove or disprove a statement, conjecture, or generalization. In addition, they need to be able to support these

mathematical concepts with examples /true examples. They should be able to explain why a concept is true or false by providing these mathematical examples. It is helpful for them to know how to call on a variety of multiple representations. Student examples could be symbols, words, numbers, words and drawings

Our last evidence statement is R.-4 Reason mathematically to create a correct or analyze a solution path to a real world problem and be able to explain why the answer is mathematically correct. For one-point items, students have to make a selection. There are two kinds of ideas that we will use to assess this evidence statement. An item could ask students to identify or select steps to justify why the solution is true, or it could provide a variety of solutions paths, that describe commonly, used reasoning strategies and ask them to identify the correct one.

Here is an example of R.4, Type 1 (item).Students need to select the answer choice that explains the correct procedure for adding fractions. This item shows two rectangles partitioned into eights. Both rectangles show six eighths shaded. The question is which statement explains the correct reasoning for the sum of the shaded parts. Students need to read through and determine which is the best procedure for adding these two fractions.

Here is an R.4, Type 2, constructed response item.
A contract /contractor measured the length and width of two rectangular pieces of land. The two pieces of land are adjacent and share the same width of 17 yards. The first piece of land has a length of 32 and one-third yards. The second piece of land has a length of 25 and one-fourth yards. Find the total area of both pieces of land in square yards. Analyze your work. Explain how your work correctly represents the problem. So in this constructive response item the students are going to need to go through the problem, make sure that they include all of the quantities, and then solve the problem, and present a solution path. Sometimes the students are going to provide the solution, and other times there might be a solution path that is given to them to analyze. Here, students really need to contextualize the solution by creating their solution path and then explaining how it correctly represents the problem; by going back to the problem's context to explain what those different quantities mean;, and why are they using the operations that they did based on the context of the problem.

Some instructional tips for R.4. We want to provide opportunities for students to look at a solution and compare it to the problem, to make sure it correctly represents the problem. Students are very used to going through the problem and solving it themselves, but you also want to give them some time to read a problem with a solution and just focus on how to contextualize it. How does this representation represent the problem that we just solved? Another thought would be, to have them solve a given problem and represent their thinking by using maybe using one or more representation or explain how the drawing relates to the information in the problem. The other thing that they could do is have them work through a problem and solve it, and then with a partner share their solutions and then have the partner look at the solution to see how it connects to the problem. They can see if they (both partners) agree that the solution represents the problem.

I would like to close with this slide. I want us to think about this. That reasoning is not something we are teaching in our classrooms because of this assessment. We teach it because it is a critical skill that enables students to make use of all other mathematical skills. With reasoning students recognize that mathematics makes sense and can be understood. They learn how to evaluate situations, to select problem-solving strategies.to draw logical conclusions, develop and describe solutions, and recognize how those solutions can be applied.

Thank you for spending the time to watch this webinar. I also want to thank you for everything that you are doing for your students; and how you are helping them to become productive mathematical thinkers. If you have any questions, please feel free to email me at the address that you see on the screen. Linda.schoenbrodt@maryland.gov The second URL is a direct link to all the MCAP resources that we have been able to publish. Thanks for coming!