

Mathematical Explanation Task

Task: Your goal in this assignment is to craft a mathematically precise explanation of a skill, as if you were explaining this skill to a student who has been having trouble with it.

Description: Explaining a math concept is different from (and harder than) learning the math concept itself/ only for your own learning. To help you brainstorm and plan your explanation, we've included a rubric that lists features of effective mathematical explanations. We've also included a sample explanation and shown how it scores on the rubric as an example. Your task will be to use the rubric below to draft a narrative of a mathematical explanation that you will record. You will submit both your completed rubric (see table below) and your recorded video to your instructor.

Math Concept: The mathematical focus for this task will be "simple" forms of distribution, possibly with a variable (but no exponents). An example problem of this type is $2(x+3) \Rightarrow 2x+6$.

Mathematical Explanation Rubric

The rubric below will serve two purposes. First, as a guide to help you plan your work on this task and second, as a grading rubric that will be used by your instructor to evaluate your work.

Guide: The table below is designed to support you with drafting a mathematical explanation that is precise, interesting and relevant to the students you will teach one day. The table below includes the names and descriptions of 7 different features central to high quality mathematical explanations. Please feel free to use the far left column to draft out your own words and ideas that will help you develop a script that you can use for your mathematical explanation performance.

Features of Mathematical Explanation	Description	Work Area: Feel free to use the space below to draft parts of your explanation
Example math problem(s) [20 points]	<p>Provide an example math problem when you are explaining how to solve the problem.</p> <p>Consider whether a mix of straightforward and tricky examples might help make the concept clearer.</p>	
Real world example [20 points]	<p>Use a real-world example that would help a learner understand the math.</p> <p>It is most important that the example is <i>clear</i> and helps a student use their intuition about the real world to solve problems. However, it is also nice to find examples that are culturally relevant, interesting, or even funny.</p>	
Picture or diagram explaining how the math works [15 points]	<p>Find a visual that could help make the problem solving process clearer, or illustrates part of the explanation.</p>	
Show how to check your work [15 points]	<p>After coming up with an answer, provide a way to check your work to make sure that the answer is correct.</p> <p>Ideally, this method of checking work is simple to do, works in a broad range of cases, and catches as many common errors as possible.</p>	
Use specific math vocabulary [10 points]	<p>Explain the important terminology a student should know to be able to have conversations about this skill.</p> <p>Even if they don't fully understand your explanation, knowing the terminology should help them understand other explanations or be able to ask for more specific help.</p>	
Explain common errors [10 points]	<p>Describe common errors students should watch out for.</p>	
Relation to other math skills [10 points]	<p>Describe important relations to other skills the student might already know.</p> <p>For example, multiplication can be thought of as repeated addition.</p>	
Additional (new) features that you choose to use:		

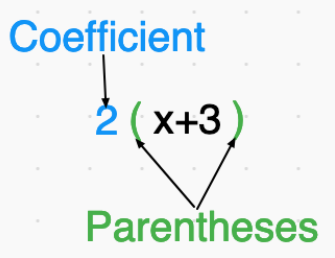
Sample explanation and rubric grading: Sample Script for skill:- $2(x+3) \Rightarrow 2x+6$

Imagine you're making a gift box for a friend. You buy a whole bag of milk chocolate Hershey's kisses and pour them in the gift box. Then you add three special mint kisses. You're not really sure how many chocolates are in the bag; let's call that number "x". You do know there are three mint chocolates, though, so the total number of kisses in the box is "x+3."

Now $2(x+3)$ is saying that you make two of these boxes. So how many total chocolates do you have? If you open both boxes and take the chocolates out, you should have two bags of Hershey's kisses ($2x$) and six total mint kisses ($2*3=6$), so all in all you should have $2x+6$ chocolates.

When you're doing the math, you can remember that you take whatever's in front, called the coefficient, and multiply all the terms that are being added inside the parentheses. So you would go from $2(x+3) \Rightarrow 2*x + 2*3 \Rightarrow 2x+6$, the answer we got before. This is called distribution because you're "distributing," i.e. "giving out", the 2 to both the x and the 3.

If you ever forget the rule, one way you can check your answer is to try plugging in something for x and seeing if the numbers before and after match. Say we start with $3(4-x)$, and I forgot to multiply the 3 and the -x. So I got $3(4-x) \Rightarrow 3*4-x \Rightarrow 12-x$. If I want to check my work, I can pick a number for x, like 1, and plug it in to the original problem and my answer. $3(4-1) = 3(3) = 9$, but in my answer I got $12-1 = 11$, so that means I did something wrong.

Features of Mathematical Explanation	Description of the feature	Grade for sample explanation
Example math problem(s) [20 points]	<p>Provide an example math problem when you are explaining how to solve the problem.</p> <p>Consider whether a mix of straightforward and tricky examples might help make the concept clearer.</p>	<p>[17/20]</p> <p>Uses a straightforward, simple-to-explain problem to explain the concept [+10]</p> <p>Uses a second example with a negative number when checking work [+10]</p> <p>Doesn't show the correct answer for the negative number example [-3]</p>
Real world example [20 points]	<p>Use a real-world example that would help a learner understand the math.</p> <p>It is most important that the example is <i>clear</i> and helps a student use their intuition about the real world to solve problems. However, it is also nice to find examples that are culturally relevant, interesting, or even funny, not standard dry textbook problems.</p>	<p>[18/20]</p> <p>The candy box example shows 2 "grouped" objects, so it captures the essence of $2*(\underline{\quad})$ [+15 for capturing essential feature of distribution, i.e. multiple copies of a group of objects]</p> <p>The boxes contain an unknown representing "x" (the candy bags) [+5 for using a quantity it makes sense to represent as a variable]</p> <p>It is not obvious at all that different bags contain the same number of candies, so this more accurately represents the scenario $(x+3) + (y+3)$ [-2 for mathematical precision that the groups being added be the same]</p> <p>Kind of a strange gift box to be making...just a single bag of candy and some loose kisses? [no points, just a comment]</p>
Picture or diagram explaining how the math works [15 points]	<p>Find a visual that could help make the problem solving process clearer.</p>	<p>[0/15]</p> <p>No visual was included. A visual labelling the math terminology, or showing the process of distribution, or a drawing of the gift boxes, would have been nice.</p> <p>An example for terminology:</p> 
Show how to check your work [15 points]	<p>After coming up with an answer, provide a way to check your work to make sure that the answer is correct.</p> <p>Ideally, this method of checking work is simple to do, works in a broad range of cases, and catches as many common errors as possible.</p>	<p>[15/15]</p> <p>The suggested method for checking work is easy [+5], mathematically sound [+5], and catches nearly every type of common distribution error [+5]. The only way it could be stronger is to suggest plugging in two numbers, since it is possible (though unlikely) to plug in a number and get the same result even if two linear expressions are different.</p>
Use specific math vocabulary [10 points]	<p>Explain the important terminology a student should know to be able to have conversations about this skill.</p> <p>Even if they don't fully understand your explanation, knowing the terminology should</p>	<p>[10/10]</p> <p>Coefficient [+4 - fully defined]</p> <p>Parentheses [+2 - only used in passing]</p> <p>Distribution [+5 - fully defined and linked to definition of word]</p> <p>Variable [+0 - never used]</p>

	help them understand other explanations or be able to ask for more specific help.	Note the maximum score is 10 - we're not expecting every explanation to define every term
Explain common errors [10 points]	Describe common errors students should watch out for.	[5/10] Forgetting to multiply the coefficient by the second term [+5, present in the checking work section] Could earn more points for the following errors: <ul style="list-style-type: none"> - Double negative multiplication mistakes (negative coefficient and inner term) - Not recognizing a subtraction as actually a distribution problem, e.g. $4-(x-3) \Rightarrow 4-x-3$ - Attempting to add unlike terms inside, e.g. $4(3+2x) \Rightarrow 4(5x) \Rightarrow 20x$
Relation to other math skills [10 points]	Describe important relations to other skills the student might already know. For example, multiplication can be thought of as repeated addition.	[5/10] Implicit reference to the idea that distribution is the same thing as multiplication but with more complicated expressions [+5, more points for explicitly stating the connection] Could also earn other points for: <ul style="list-style-type: none"> - Distribution is the opposite of factoring - Distribution is compatible with order of operations even though it seems to be out of order (i.e. $2(3+4) = 6+8$ seems like we are violating PEMDAS but still works) Note that the maximum score is 10 - we're not expecting an explanation to include all possible mathematical links