Project INSPIRE Course 6, Lesson 2: Symbols for Advanced Math, Part 2

SPEAKER: Nemeth Code Symbols Used in High School and Strategies for Supporting Math Learning. This is "Lesson 2: Symbols for Advanced Math, Part 2."

Slide 2 has the objectives. You are going to be able to read and write problems containing large grouping symbols, piecewise functions, systems of equation, matrices, determinants.

Also, set theory notation; for example, empty set, subset, union, and intersection. Also, you're going to be able to determine when enlarged grouping symbols are or are not to be used.

Let's get started on slide 3 by looking at the way we braille enlarged grouping symbols. And folks, you're going to see a pattern here. We're taking symbols that we've already learned and we're putting a dot 6 with them.

So for example, my opening or left parentheses is dot 6, dots 1-2-3-5-6, that closing, or right parentheses, dot 6, 2-3-4-5-6. My opening left bracket is dot 4, then dot 6, then 1-2-3-5-6. That closing, or right bracket is dot 4, dot 6, 2-3-4-5-6. Opening brace is dots 4-6, dot 6, 1-2-3-5-6, and that closing, or right brace, is 4-6, dot 6, 2-3-4-5-6. And then finally that vertical bar is dot 6, 1-2-5-6.

You're going to be using these enlarged grouping symbols when a grouping symbol groups two or more print lines. So that's how we know when we use these enlarged grouping symbols. And as I said as we went over the actual symbols, it's that dot 6 that indicates to the braille reader that the symbol is enlarged. Let's go on to slide 4 and talk about some general rules for enlarged grouping symbols. So my first rule is the arrangement is considered to be spatial and blank lines must be left both above and below that set of material in the arrangement. At least one enlarged sign of grouping must appear on each line of the arrangement, and we're going to look at several examples where you'll see what I mean by this.

All other materials, and this includes problem number, signs of operation, signs of comparison, punctuation, need to be shown on the top line in braille, even though this type of material is centered in print. This is one place where we're going to be very consistent on where we braille these other materials. Then you're going to place that dot 6 before each symbol.

So that could be my open parentheses, or my closing parentheses, or my right parentheses, or my vertical bar. So with that dot 6, that's going to let me know that I'm enlarging, and I also need to make sure I line up those grouping symbols vertically. That is really, really important for the braille readers, folks, and we'll, again, look at a lot of examples here in just a minute.

Let's go on to slide 5 and talk about a couple more rules. If only the opening or closing grouping symbol is shown in print, and you're only going to show this in braille. So this is a case of, remember, we follow the imprint. When it comes to the variables in piecewise functions and systems of equation, you have to line them up the way they are lined up in print. So again we're following the imprint here.

Now all these examples using enlarged grouping symbols could be read many different ways. Hey, doesn't that make our life easier? So it's really important that you consult with your student's math teacher to find out how they're actually reading the problems so that you're consistent as the teacher or students with visual impairment, or if you're in another supporting role, such as the paraprofessional, and how you read the problems. We do not want to confuse the student by having the problem read two different ways. Let's go on to slide 6 and talk about piecewise functions. And here, I have an unaligned piecewise function with a left brace, or an opening brace. Now when I take-- and I'm going to go ahead and read this in a moment. Remember, there are multiple ways that you can read this. And as our team was developing these materials, folks, we talked about all the different ways that this could be read.

I want to point out a couple of things that stood out to me as I was going to braille this. First, on that top line, I have f of x space equals space. That's really important. That information is on that top line, even though in print, it's in the center.

Now how would I actually read this? I would read, "When x is less than zero, comma, f of x is equal to negative x. When x is greater than or equal to 0, comma, f of x is equal to x."

Now when I'm going to braille this unaligned piecewise function, I do have some things I need to pay attention to. Remember, that content that is in the center goes on the top line. I need to make sure that I line up those left braces.

Let's go ahead and go on to slide 7 where we're going to look at systems of equations that have aligned system of equation with a left and a right brace. So here, I have two lines. And in my first line, again, my left braces and my right braces are lined up.

And so what I might say here is, "We have a system of two equations. The first equation is negative x plus y equals 2. The second equation is x minus 4y equals negative 8." I want you to really pay attention as you look at this example that my left and right braces and my equal signs are lined up.

Now let's look at an unaligned system of equation with a left brace. Here I have those two lines again. Those left braces are aligned. And so I would read this as, "We have a system of two equations. The first equation is x plus y equals 6. The second equation is y equals 3x."

I'm going to go ahead and go on to slide 8. We're going to get into matrices and determinants. Ooh, this is getting very exciting. Now when I'm doing a matrices or a determinant, each entry must be moved as far left as possible in its column. Very important. One column of blank cells must be left between the columns of the arrangement. This also is very important.

And I know this is going to look funny to you, because boy, it sure looks funny to me. Our friend, the numeric indicator, has to be used with entries and determinants, or a matrix. And that I know isn't quite what we're used to seeing, but this is different. So you have to know that you're brailling a determinant or a matrix because you are going to be using the numeric indicator.

So what I have here in my example is matrix A is two by two matrix with the numbers 1, 0 in row one, and the number is 0, 1 in row two. So I want you to look at my row with me. Capital A space equals space, then I've got that left bracket, then I have numeric indicator one, space, numeric indicator zero, and then that closing right bracket. Right underneath lining up that left bracket, numeric indicator 0, space, numeric indicator one, and then that closing or right bracket.

Slide 9 continues our discussion on matrices and determinants, but now we're going to really focus on how to braille determinants. Notice that a determinant uses an enlarged vertical bar. So if we take a quick look at the braille, I have an enlarged vertical bar, then my content on line one, and then an enlarged vertical bar.

In line two, it's really important, I'm lining up my enlarged vertical bars. And I want you to notice where my space is because I'm also lining up my numbers. So take a look here and then let's talk about how this is read.

So I will read this determinant. This is a two-by-two determinant with the numbers 3, -2 in row one, and the numbers -6, 4 in row two. Again, I want you to notice how I lined up my numbers in this determinant. Now let's look at adding matrices. And I really want you to notice in this particular example where I have the plus sign. And this could be a different sign of operation. But the key here, my friends, is that that plus sign, or that sign of operation, is on the first line, even though in print it's in the middle between the two matrices.

So how would I read this? Wow, this is a lot to read here. I could possibly read it, "Two 2 by 2 matrices have been added together. The first matrix has numbers of -6, 3 in the first row, and -9, 5 in the second row. Plus, the second matrices has -2, 0 in the first row, and 4, -1 in the second row." I want you to notice, again, how everything is aligned with those opening and closing brackets.

So as we finish up looking at an example of adding two matrices, I want you to really pay attention to how the brackets for both the opening and the closing brackets are lined up in this matrices. And again, remember that sign of operation, in this case plus, is always on the first line.

Let's go ahead and go on to slide 10, and it's time for you to work folks. I need you to braille the following items. Pay close attention to what you're brailling.

Slide 11 is the answer key for activity 2A. How did you do getting everything brailled properly and aligned? And slide 12 is the second part of the answer key. If you have any questions about what you brailled, go back and review the previous slides before we move on to slide 13.

Slide 13 talks about non-use of enlarged grouping symbols. So you are not going to use enlarged grouping symbols when grouping symbols haven't been enlarged in print to do several things. The first is to cover a fraction. So in my example here, you're going to notice that I have opening and closing parentheses.

Even though in print they look enlarged, I'm just using my regular old opening and closing parentheses. So I would read this example, "Open parentheses, open fraction, 1/x + 2, close fraction, close parentheses. Open parentheses, open fraction, 1/x - 2, close fraction, close parentheses." We've done a lot of brailling like this, so that shouldn't be too hard.

Now I might be writing a binomial coefficient. And so again, I'm using my regular parentheses, and then do my binomial coefficient, and then my regular closing parentheses, even though in print, it looks enlarged. So the way I would read my example here is, "8 choose 5".

Slide 14 has some more examples of when I'm not going to use enlarged grouping symbols. So I'm not going to use them when grouping symbols have been enlarged in print to do material occupying a large amount of vertical space. So even though I have this large square root, I'm going to still just use my regular square root symbols.

So for my example here, I'm going to read, "The square root of the square root of 16, end root, end root." So because I have two opening square root symbols, dots 3-4-5, 4-6, dots 3-4-5. It looks enlarged in print, but that's the way I'm going to do it in braille. The same thing with my end root. I'm going to 4-6, and then dots 1-2-4-5-6 for that first end root, and dots 1-2-4-5-6 for that second end root.

Let's go on to slide 15. And now it's time for you to look at four problems here in activity 2B. And for each one, I want you to determine if you do or do not use enlarged grouping symbols. So take a moment, figure out what you're going to need, and then when you're ready, come on back.

Alright. Slide 16, let's see how you did. For our first one, you do need enlarged grouping symbols. For our second one, no enlarged grouping symbols, no enlarged grouping symbols for the third one, and you're back to enlarged grouping symbols for the fourth one. Now what I want you to do is I want you to braille these four problems. And when you're ready, you're going to come back and check your answer key for activity 2B.

Let's go on to slide 17 and look at the answer key for how you braille activity 2B. Now I want to point out the use of blank lines. In my first problem, I have a system of equation. I need to have a blank line following it.

Then I have my binomial coefficient. No need for a blank line. Then I have my fractions, no need for a blank line. But I do need a blank line above and below my determinant. So make sure you understand where you're going to need blank lines.

Let's go on to slide 18. Slide 18 talks about set theory, specifically the empty set and signs of operation. Now I can use my braces to represent the empty set, so dots 4-6, 1-2-3-5-6 opens my empty set. Dots 4-6, 2-3-4-5-6 would be closing my empty set. I also can represent the empty set with a symbol, which is dots 4-5-6 and dots 3-5-6. We also call this the null set.

I have two signs of operation. One is union, and the other one is intersection. So the union symbol is a sign of operation, so there's no space on either side of it, the same with the intersection symbol. To braille the union symbol, it's dots 4-6, 3-4-6, and to braille the intersection symbol, it's 4-6, dots 1-4-6.

And we have a little note here to point out to you that sometimes it's helpful for students for us to give them ways to remember. So with my union symbol, I'm adding on my two sets together. And in that union symbol, I use dots 3-4-6, which is my addition sign. Another way you can think about it is the union symbol in print points up, and my symbol here in braille is pointing up with that dot 4 at the top of the cell. For the intersection symbol, it's dots 1-4-6, or the "sh" contraction. And I can think about the word "share," because when I'm sharing, it starts with "sh," I'm sharing between my first and my second set. Also, as I said, that intersection symbol points down, so the dot 6 is pointing down.

Some of these things work for our students, some of these things work for us. But it's always great if you can help students remember the symbols by some type of mnemonic. How do I read my two examples here?

Well, my first one is A union B. So I have capital A, my union symbol, 4-6, 3-4-6 capital B. And my second one is C intersection D. So capital C, dots 4-6, 1-4-6 capital D. In set theory, you're always going to use capital letters.

Let's go on to slide 19. And now we're going to talk about signs of comparison in set theory. So I have two symbols that we're going to use. There'll always be a space on either side of these symbols.

The first one is a subset of, and this takes four cells to braille, folks. First cell dots 4-5-6, then dot 5, dot 4-6, and then dots 1-5-6. "Is an element of" takes two cells, dot 4, and then dots 1-5, which is an E. I tend to remember E in "element," so E in my symbol.

My first example is, "E is a subset of F," so capital E, space, my subset symbol is a subset of symbol, space, capital F. My second one is, "3 is an element of the set containing 1, 3, and 5." So numeric indicator 3, space, is an element of, space, open brace, 1, comma, 3, comma, 5, with spaces after those commas. No new numeric indicators here because it's just a basic enclosed list.

Let's go on to slide 20, and we have three examples to look at. The first one is read, "A union B equals a set containing -1, 0, and 1." So I'm going to do capital A, my union symbol, capital B, space, my equal sign, space, my opening brace, -1, comma, space, 0, comma, space, 1, my closing brace.

My second example uses names. So I want you to take a second here and look at this and see what kind of comma I used. Ah, did you see I use the UEB comma? So this one is read, "The set containing the elements Mary and Sally is a subset of C." I also want to point out to you that there's no contraction in the word Mary, because I'm here in Nemeth Code.

So I have in my second example is read, "The set containing the elements Mary and Sally is a subset of C." So I'm going to have my opening brace, capital indicator, M-a-r-y spelled out, comma, space, capital indicator, S-a-l-l-y spelled out, then my closing brace, space, is a subset of, that four-cell symbol, space, capital C.

My last example on slide 20 is, "The intersection of the set containing 1 and 3, and the set containing 2 and 5 is the empty set." I start with my brace opening on the left, 1, comma, 3, my closing, or right brace, then I have my intersection of symbol, another space on either side of that right into the opening, or left brace, 2, comma, 5, closing brace, space, equals, space, and then my empty set symbol.

Let's go on to slide 21. We're getting near the end here. I'd like you to braille the four problems in activity 2C. When you're ready, please come back and check your work.

Slide 22 is the answer key to activity 2C. Ensure that you've brailled everything properly.

Congratulations! You've reached the end of Lesson 2. And I know we have gone over a lot of information. I want to make sure to remind you that it's so important that you speak with your student's math teacher to ensure that the way that you're talking about the symbols and reading the problem is the way that the math teacher is as well.

We don't want to add to our student's confusion by taking a different approach than that math teacher. Thank you for taking part in this lesson. We look forward to seeing you in Lesson 3.