Project INSPIRE: Connecting Middle School Literature to Math Concepts and Symbols; Course 5, Lesson 6

REBECCA PEEK: Welcome, everyone to Lesson 6: Connecting Middle School Literature to Math Concepts and Symbols. My name is Becky Peek. I'm a teacher of students with vision impairment in Fairfax County Public Schools. I'm also a literacy specialist. I'm here with my sister, Amy Roth McDuffie.
AMY ROTH MCDUFFIE: Hello. I am a professor of mathematics education at Washington State University, and I've done a lot of work with pre-service teachers and practicing teachers, especially with mathematics and trade books. And between Becky and me, we have expertise in three key areas contributing to this lesson. Literacy education and vision impairment are Becky's area of expertise, and mathematics education and trade books for math our mine. So hopefully the merging of our backgrounds contributes to this presentation for you.
REBECCA PEEK: We're on slide number 2: Learning Objectives. So what we hope you get out of this today is that we're hoping that you'll be able to select trade books to support your students' learning of math. And when we talk about trade books, that's really books that are available to the general audience. And in our case, that's through Bookshare, through YouTube, through the library, through book sellers-- so with books that are widely available to a wide audience.
We want to be able to implement the approaches and strategies to make these books meaningful to our students, and we want to generate ideas for using trade books with individual students. We want to individualize those to our middle school students.
AMY ROTH MCDUFFIE: So next, on slide 3, we're going to talk about, why do we use trade books? And children's literature, we've found in research-- and Becky and I have found in our own experiences-- really has the potential to enhance mathematics learning in a number of ways. And I'm going to highlight some of these key areas of where trade books contribute to learning, but you can also, if you're interested in this, look at the book called Deepening Students' Mathematical Understanding with Literature by Eula Monroe and Terrell Young. And I actually have two chapters in that book, and it has a nice background both for the research base and additional book ideas and activities that you might want to use.
But children's literature really has the potential to build students' interests and positive attitudes for learning, because children tend to love books. It also serves as a great vehicle to get kids to talk and share their ideas. And books have-- and especially when they're well-selected books-- can connect to students' lives and experience, and in that, they connect to students' lives. Children have the opportunity to see how math connects to their lives, and deepen these understandings of the mathematics represented in the book.
Again, well-selected books can provide meaningful and engaging context for learning. They also have the opportunity to build mathematics vocabulary in a really natural way, because these terms can come up in the context of the story that brings meaning to the terms in ways that textbook learning might not. And then finally, we find that teachers often prefer teaching English language arts. And so for teachers, their joy of books is spread to the students as they're teaching math with books.

Next, we'd like to discuss, on slide 4, how we selected the books. First off, we really just said, we're going to start with high-quality children's trade books. And our easiest way to say, where are the high-quality books, is to look at award lists that come out. And then we look at those lists and say, what of these books has the potential to teach math? Where is math embedded?

And is it naturally embedded in the book, whether it's nonfiction or fiction? And we'll have examples of both of those today. Do we see that it's naturally embedded in the story or in the information conveyed in the book, versus a book that might look more workbook-like, where it's almost forced? And that probably isn't going to be high-quality children's literature to begin with.

But sometimes we can say, oh, here's a math book, because it looks-- math is in the foreground, and it turns out to be just like a workbook that's not that engaging. The third of our criteria is that we ensure that the mathematics represented in the book is aligned in two ways. First, is it aligned with the conventions of mathematics from a disciplinary perspective? And another way of saying that is, is the math correct?

Once in a while, we'll find books where there are errors in the way that math is represented. And an example might be that a term is not defined in a way that we define it in mathematics, or it might not be defined that way in our standards or represented that way in our state tests. If it's a good book, and it just has this one problem, we might use that as a teaching opportunity. So this might not fully eliminate the book from selection, but we want to be aware of it and address that with our students.

The other area with-- in terms of alignment is, are the standards addressed in the book aligned with the grade level of the learner? So for example, there might be a book that's really rich for middle school contexts and engaging for middle schoolers, but the math in it is just about addition and subtraction with whole numbers, which would be like a first, second grade topic. That's not going to actually help teach grade-appropriate math. So we want to think about that. It might be a good book for other purposes, but it's not necessarily a good book for teaching math.

And finally, the fourth of our criteria is we consider the potential for the book and the mathematics to meaningfully connect to the students, to children's lives and interests. And we'll provide some examples of that today. But if it can meaningfully connect to a context in children's lives, then it also has the potential to teach math meaningfully and help students to see, oh, math is important in my life, and I am a mathematician.

So in this next section, we provided one-page overview for each of the books that we're going to discuss today. And we want to make sure you understand that the books we're discussing today are intended as examples. You might find you want to use them with your students, but if the books themselves seem like they might not be the best choices for your students, we hope that they at least serve as examples for the ways you can think about using other trade books and selecting other trade books that would be better choices for your students.

Now we're on slide 6. This book is our first example. It's called Tiger Math. And as we go through these books, we're going to provide a summary and also provide some ideas and activities for each book. And as you look at your one-pager, you'll see there are more ideas here that we might not discuss explicitly, but we'd like you to just refer to the one-pager for some of those details.

And that would include that fourth bullet that's on the slide here of the mathematics standards. I'll certainly be referencing those as I describe the book, but I might not explicitly list each standard. I'll just refer you to the one-pager to look at those. We are using language from the Common Core State Standards for mathematics. Most states have adopted these standards in some form.

If your state's a non-Common Core state, I think you'll find that the phrasing we use on the one-pager is similar to what most states use, so you'll probably be able to figure out which standards they align with. And these are just ideas. Often these books will align with many more standards than what we have listed, but we want to just start you off with some ideas.

So Tiger Math-- we have here a picture of the cover and Tiger Math shows an actual photograph of TJ the tiger cub, who's the main character of this book. It's a nonfiction book about TJ the tiger, who was born in a Denver Zoo. And we track data throughout his first year of life and compare it to other tigers and other adult Tigers as we watch him grow.

This is engaging for students. Middle school students in particular tend to really enjoy animals, and baby animals in particular. And they might, in science, be exploring ideas of life and growth, and so it could connect to other subject areas. The book is particularly interesting in its format, in that the left-facing pages show data and graphs, such as picture graphs, circle and pie graphs, bar graphs, and line graphs. And that vocabulary comes up in the book naturally, as they're looking at these graphs.

The right-facing pages really just are a narrative of telling the story of TJ's life. And so one of the things you might do with this book is actually just take a couple of pages a day even following TJ's life, where you read the narrative and then really look closely at the bar graphs, circle graphs-- whichever is represented for that page.

And one of the things that middle school students can really use this book to understand is that graphs are not just a product where you show data, but they also are a tool to really interpret data and analyze data. And students might look at these graphs and then generate more questions about what's going on in TJ's life right now, or why is TJ growing so fast now or in the first few months, and then that levels off as he gets older-- and connect that to their own experiences of how animals grow. Next, Becky's going to share, on slide 7, some of the activities that you might consider using for Tiger Math.

REBECCA PEEK: Okay, great-- we're on slide 7. And what you can think about when you're looking at some of these activities is the Expanded Core Curriculum. This is an opportunity to kind of interject some of those ideas as you're learning math kind of side by side. I like this book because it's what we talk about as being a high/low book. The content is still at a middle school level and is still relatable to middle school students. However, the sentence structure, the-- some of the vocabulary, the length of the sentences-- they're all a little bit shorter, so that puts the reading level at about a second or third grade reading level. So this is great for your students who are struggling readers, but still need to get that core content. So that's one reason I really like this book. Another reason is that it starts getting the student thinking about a career. Not only does it go through how TJ is growing, but it refers to the zookeeper a lot, and the zookeeper is the one keeping the data.

So you get to know TJ and the zookeeper, and you get an insight into the job of what a zookeeper entails, which is really-- touches a lot of students who like to work with animals. We are incorporating some orientation and mobility when we talk about visiting a zoo or an animal shelter. And I've actually had students visit an animal shelter recently, where we collected blankets and food, and we looked at how these animals are adopted. And we interviewed the animal shelter worker while we were there.

Another idea is to look at a student's own growth, and they get the data from their family and make a graph about their own first years. We know that middle school students are very motivated by their own histories, and this is something that ties it into their own interests. So you can take a look at these activities and decide if any of them kind of resonate with your students.

And we're going to pause now so that you can take that time. We want you to be looking at providing a meaningful context to engage your student through these books. We want you to look at how the content aligns with what your student needs to be learning, and we want you to look at the activity list, and maybe even create some of your own, to see what might be interesting and motivating for your students. So we'll do that now.

AMY ROTH MCDUFFIE: Slide 8 shows these props. Okay, welcome back. And hopefully you came up with some ideas. And you'll have a chance in the follow-up assignment to actually expand maybe on some of the ideas that you jotted down at the pause, or develop new ideas.

So here we are on to our second example, and this one is called Lines, Bars, and Circles: How William Playfair Invented Graphs. And this is slide 9. And the cover on this book shows William Playfair as a cartoon-like drawing, and he's actually leaning back and resting on a line graph, which is kind of cute and funny. And above his head is a thought bubble with that title, Lines, Bars, and Circles.

So the image creates this idea that he's really thinking about lines, bars, and circles, which is true to the story. And then, in the background, we see a bar graph or a histogram, and that's a good foreshadowing of all that's contained in this book. So this is actually a picture book biography of the actual person William Playfair. And it tells the story, including referencing back to his childhood, so again, it resonates with middle school students thinking about their lives.

And all throughout his childhood and adulthood, he was interested in patterns, and creating graphs, and how data appears in the world and could be represented. And while he turned out to be, as an adult, a scientist and inventor, as a younger student, he was often ostracized and thought to have really outlandish ideas. And this can connect well with middle school students who often feel socially marginalized or like they don't fit in.

And here's a great example of a person who didn't fit while they were in school, yet they turned out to be really successful and contributing in mathematics that we now use today. The vocabulary includes the names of all these graphs that he actually invented. Scientific method is mentioned-- inventions, line graph, bar graph, and pie chart.

And one of the things I also like about this book is it shows mathematics as a creative endeavor and that humans create mathematics-- that these graphs that we use and learn about today were actually created by a human being. They don't exist separate from humanity. We come up with ways to represent mathematics and think about mathematics.

REBECCA PEEK: All right, we're on slide 10, and we're going to look at some activities for this book. What I liked about this book, as with Tiger Math, is it gives you an opportunity to compare the different tactile graphics and how they show different things in different ways. So this gives you a chance to examine the data in different ways and ask the student, why does it work better to show the information in this way versus this way?

It also gives your student a lot of opportunities to practice reading bars, lines, and circle graphs in different ways. You could use thermoform if you have one. You could use a PIAF machine, like we have in our department. Or you can simply use the draftsman that we often take into the class with us. So you can begin to show your student that these things can all be represented in different ways.

I also like to use this book to show-- to give students practice in how they will be seeing graphs in standardized tests. While, of course, we aren't teaching to the test, we do want to give students plenty of practice in the method that they'll be reading the graphs in testing. So you can do that with this book

pretty easily. You can recreate some of these charts and graphs in the way that they'll be seeing in the testing environment.

Again, I've given you an idea of how to incorporate orientation and mobility by walking through the school and looking at different information that's presented in the school. I had a student recently who researched through social media-- it was on the school's underground social media site-- the different bathroom cleanliness information. So she was able to look at this information and see what days and what time of the day different bathrooms were the cleanest, which somebody in the school had put on social media.

So I think we didn't graph it, but afterwards I thought that would have been a fun, kind of interesting, individualized way to use an information and put it into a graphic form. So think about your individual student-- what information they have available, and opportunities for practice. And again, we're going to pause right now. This is slide 11. We're going to pause right now so you can have the opportunity to think about some of these activities, think about the book and how it might be meaningful for your student.

AMY ROTH MCDUFFIE: Welcome back. I hope you came up with some more ideas about graphs. Our third example-- and this is our final example-- is a favorite of mine. We have this on slide 12. And the book is called Unusual Chickens for the Exceptional Poultry Farmer. And the cover is really, again, quite cute. It's a sketch of Sophie-- of our main character-- and various chickens and eggs are scattered about the page with hand-drawn block letters for the title.

And it sort of shows the whimsy that actually comes out in the story as well. So this one is our first fiction, yet it has some actual information, some content knowledge about chickens in it. So we now have shown two examples of nonfiction and one example of fiction for middle school students.

So the story here is that Sophie and her family moved from Los Angeles-- so a large urban metropolitan area-- to a rural farm that they inherited from a great uncle. And the story is actually told through multiple forms of text, including personal letters and Sophie's own chronicles of her experiences dealing with cranky, and unusual, and in one case, a kind of magical chicken.

So it's a very engaging context for middle school students just in the way the story hooks them in, especially with this one sort of unusual and magical chicken. It also connects to mathematics-- and in particular, the mathematical practice number three of constructing viable arguments and critiquing the reasoning of others-- in a really age-appropriate way, because Sophie wants to keep these chickens that are on the farm, and her parents say, no, it's too much. We can't take care of them-- so that classic middle school dilemma of Sophie wanting to be like an adult and accept responsibility and the parents saying, no, we can't handle that.

So she has to convince her parents that she can handle this job, and one of the ways she does it is through mathematics. She actually calculates sort of time needed, schedules, and costs of feeding these chickens, and how she's going to be able to manage that. And in these calculations, she's dealing with fractions, whole numbers, decimals, multiplying and dividing these numbers, and rates-- such as, how long is a 50-pound bag of feed going to last her flock of chickens?

And in fact, on page 7 in the book, there's sort of a worksheet page that Sophie uses. That page has some fill-in-the-blank problems, but it would be a great launching point to come up with a much deeper, more open-ended task that students might want to take on, and that you could pose with students. And it could be in the context of Sophie and chickens, or maybe they're wanting to have a family pet and they're going to create an argument for their family as to why they could handle this.

One other point that's actually not a mathematics connection, but sort of a racial/cultural connection, is Sophie and her family are Latinx, and they turn out to be the only brown family in this new community. And we see Sophie's experience both culturally shifting from an urban life to a rural life and also racially, with some racial bias and stereotype coming up with being that first Latinx family in the community. But it's very naturally embedded in the story from Sophie's perspective. So if those are some topics that you might want to discuss about with your middle schoolers, or perhaps ways that your students are being marginalized, the book affords those opportunities as well.

REBECCA PEEK: Alright, we're on slide 13, and we're going to look at some more activities. Like Amy said, this whole book is told through letters. And Sophie is pretty quirky, and most of her letters she's writing are to her deceased grandmother. So throughout the book, there's this middle school type humor going through it, and you do kind of chuckle along with some of the things she says and does. And the idea that these chickens are so grumpy and cranky is just kind of funny too.

So we think about, like Amy said, middle schoolers kind of liking to challenge adults around them, liking to debate, liking to come up with reasons why they should get what they want. And this book lends itself perfectly for our students who want to write a letter to a teacher or a family member explaining why they should get a pet or something else that they want.

This lends itself to-- for students who are thinking about a dog guide. This is about the time that students start thinking about that, and they could actually look into the cost with maintaining a dog and everything that's involved with that. And they could use a worksheet like Sophie uses to accomplish that.

If you've got any students who are interested in farming or the idea of growing things, they can calculate the area and perimeter of a pen or garden plot and actually do that. A lot of schools do have school gardens, so that would be an excellent opportunity to get outside and do that. And then, along with TJ and the Tiger Math, you can visit a zoo or a farm and interview a farm worker or zookeeper about raising animals that goes to that whole career connection.

Slide 14 gives us the chance to sit and think again about your own ideas about this book or any other math book, and align it with your own student. So take a look at what we've suggested and see what you think about how these might be used with your student.

Alright, welcome back. I hope you got a chance to think about a fictional book and how that might work with your student.

As we wind down here, I want you to look at slide 15, which is sentence frames, games, and flash cards. And this is just additional ways to practice some of the concepts that we looked at through these books. You can use a sentence frame that provides scaffolded learning by inserting blanks with symbols that might be used.

And I've seen in other lessons that teachers have used symbol lists, so that the student can refer back to that list as a reference and figure out which symbol might work well in each sentence. As a student's beginning to gain confidence in certain concepts and writing certain number sentences, you can leave more blanks in different places.

You can use the student's interest to create games. I had a colleague of mine create a map of a zoo and have the student progress through different areas of the zoo by answering correct questions. And then also, you can create flashcards that can be used to reinforce certain concepts that a student needs extra practice with. And with all of these things, I've used Anna's book-- Anna Swenson's book Beginning with

Braille. She has great ideas about how to format your flashcards and sentence frames, and wonderful games that you can adapt to any student's needs in any content area.

Lastly, we're looking at slide 16, and we're trying to figure out how to fit books in. Working with classroom teachers or working with math teachers in the middle school, you can be-- you still use these as read-alouds. Kids still like to be read to at all-- in all grade levels. You can ask the teacher to lead a whole class lesson based on these books. You can incorporate them during one-on-one time, if you just need a change in a lesson or a different way to present the information.

You can use it as a remediation activity, or you can conduct a small group or individual virtual lessons. And you can do this by dropping the book in hardcopy braille. You can access some of these books through Bookshare or through YouTube. And you can put individualized activities in a bag with your hardcopy braille so that the student can use it over and over again or just during your individualized lesson.

So I hope that this helps you figure out how to fit some of these books in, and that maybe today you've heard some things that you think, wow, yeah, I'd like to try that. So thank you for being with us today. We've enjoyed being here, and we hope that we've given you some ideas to think about.