Webinar Transcript

Using Questioning Strategies to Support Struggling Math Students

DAVID YANOSKI:

Again, hopefully you're all in the right place. This is Using Questioning Strategies to Support Struggling Math Students with our presenter Barb Dougherty of the University of Hawaii. I'll tell you a little bit more about Barb here in just a second.

But before we do that, just a quick reminder. This webinar is brought to you by Regional Education Laboratory, or REL Central, which is operated by Marzano Research here in Denver. And we serve the applied education research needs of a seven-state region. That includes Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, and Wyoming. And we're really excited to bring Barb to you here today.

Our objectives for the webinar today. First of all, participants will become familiar with the evidence levels used in the Helping Struggling Students practice guide. Barb will give you a lot more detail about that. We want you to become familiar with the eight recommendations of the practice guide. And then I think the key thing here—our key takeaway is—Barb is going to present a questioning framework that will help support student understanding.

Before we get into that I do want to gather a little bit of information about our audience here. So a poll should be coming up on the screen. And if you'd go ahead and just answer the poll questions. There are two of them. We want to know what grades you serve and what role you have in your district, and that just gives Barb a little bit of information about who's in the audience so that she can go ahead and respond to audience needs.

So about three or four more seconds here and then we'll go ahead and finish this up. Okay. I'm going to go ahead and end that poll right now and share the results. So it looks like we have, first of all, a really nice grade span of all the people of all the different grade levels, pretty evenly distributed. And then in terms of their role in the district, we have teachers and instructional coaches, some district administration, then a few others as well. But thank you again for giving us a little bit of information about who you are so that Barb can think about how she wants to— what examples to give.

So just a little bit about our presenter today. Our presenter is Dr. Barb Dougherty of the University of Hawaii at Manoa. And Barb is currently the director of the curriculum research and development group at the University of Hawaii Manoa, and she's considered a national leader in mathematics research. And her research really focuses on how we can best help

students who are struggling with mathematics in general, and more specifically with developing the foundations for algebra.

Barb has a background in special education as well as math instruction, and is the author of numerous books and journal articles. And so, with no further ado, I'm going to turn control here over to Barb and let her go ahead and get started.

BARBARA DOUGHERTY:

Thank you all so much for joining me this morning. I have to apologize for the last time. I woke up with laryngitis and I have an allergy to something here in Hawaii, and I guess that's just one of the problems we have since everything blooms all year round. I won't rub it in for people that are not experiencing that.

Today we're going to focus on having the opportunity to think very deeply about some of the practice guides that are available from the US Department of Education. This is a free resource. There are lots of different other practice guides that are available. But today, as we begin to focus on this, we're going to look very specifically at some of the recommendations and talk about how to interpret them and make them much more accessible for you as you're moving forward and having the opportunity to implement them in schools.

You'll notice that, if you have not downloaded yet the practice guide, you can do that free at the URL that's listed on this slide. And if you have downloaded it and you have it in front of you, you'll also notice that, as we're looking at the screen that's showing, there are four recommendations. And next to the recommendation there is a symbol that says "moderate evidence," "minimal evidence," and "strong evidence." We want to talk just a little bit about what that means so that we can interpret the information very clearly.

And David, I'm just going to let you know that all of my tools have left me. So I have no opportunity to advance the slides.

DAVID YANOSKI:

Okay, Barb. Well, I'll go ahead and take care of that for you at the moment, and if for some reason it comes back, then you can take it back.

BARBARA DOUGHERTY:

All right. Thanks. So would you go to the next slide then, please?

You'll notice that in "minimal" level of evidence a lot of times what we would think is that, if there's minimal evidence then that means that we probably shouldn't really pay much attention to that practice. But the reality is that oftentimes when we see the designation of minimal evidence in the practice guide it means that there is an issue in terms of— potentially the rigor of the research that was done and that, in fact, what they were studying may not even be able to be investigated or explored in a setting that would allow it to be generalized in a

particular way. So we're still going to say that this recommendation is important, and we'll place it in that context as we go forward.

Okay. David, if you would go to "moderate" level? In the moderate level, in this particular one it does have indication that some practice that was done within the study could be positively linked to some of the outcomes that they had. But it may not be the case that this evidence is generalizable. So you may have to take into account, as you're beginning to implement some of those recommendations, the context of a classroom in which the study was done and the way in which the particular intervention or strategy was implemented in the classroom.

If we look at the next slide for "strong" evidence— in "strong" evidence, this says that there is a very high likelihood that the intervention or the strategy brought about some very positive results in the classroom. And so we want to pay particular attention to that because this also indicates that it could be generalizable to multiple kinds of classrooms within different contexts.

I think it's really important, as we think about the research that's done in classrooms, that there are so many factors that can affect the way in which an intervention or a strategy plays out with students. Some of those we can't control. Some of those we can control very easily. But it's really important to place the context of the classroom within each of these interventions. So, as we move forward today, I'd like for you to think about the context that you work with in the different classrooms, whether it's particular student, type of population, or whatever.

And before we move on, I want to place a couple of caveats on what we're going to talk about in terms of the recommendations and the other information that I'm sharing. For the past six years I've been involved in two large-scale studies that have focused on the development of conceptual progress monitoring tools and the ability to look at how progress monitoring tools are used in the classroom, and how they help us to make instructional decisions.

The other project that I've been involved with is the development of intervention modules for middle school students to promote their accessibility and potential to achieve higher in algebra. Both of those projects were funded by the US Department of Education, the IES Group, and so throughout these different slides that we're going to talk about I'm going to be sharing some evidence that we got from our own studies, and I'm also going to link it to the practice base.

For the last four years I've been teaching in a charter school in Florida and using most of these techniques and tools that we're talking about. And so if you have any questions on implementation or how that works with children, I'm very happy to respond from that based on my own experience.

Okay. Let's take a look at the recommendations from the practice guide. There are eight recommendations in the entire practice guide for working with students who struggle. You notice that they're very broad in nature, and that they're— as you think about these within your own context, there are multiple things that we need to think about. We're not going to

spend time today on all of these different recommendations, but on the next slide you're going to see the five highlighted in red that we're going to focus on.

These five were selected because there's some major links across these, and the way in which they support each other is an important part as we think about enhancing student achievement and helping them develop into a strong mathematician.

So I'm going to take each one of these five. We're going to talk about them individually, and then we're going to also make links across some of those recommendations and see how they work together to support these students who struggle.

So let's start with screening tools. Good screening tools have three different characteristics. And each of these three are very important. And I know that a lot of schools use screening tools that are computer-based. Some, they're purchased by the district. And so teachers or districts—independent districts, or independent schools have no opportunity to really decide if it's a good screening tool or not. But as you're interpreting the results, it's important to think about these three characteristics and how they might impact student performance.

The first one is predictive validity. And this is really important because a lot of times when we purchase a screening tool, especially when it's delivered via technology, we're often not really sure what is that screening tool actually assessing. So it's really important to understand what aspects the screening tool focuses on. Is it looking primarily at a skill-based approach to the mathematics, is it looking at a conceptual base, or both?

And if a screening tool says that it's focusing on concepts or it's conceptual in nature. That's when it's really critical for anyone who is using that screening tool to look closely at the way in which concepts might be defined, and the way in which they're assessed in that particular tool. It's also important, in terms of the validity, to link with what you're teaching. And is the way in which you're teaching, and the teaching itself of the content, linked to that particular type of tool?

In terms of reliability we want to make sure that the instrument can give—or the assessment can give consistent and reliable results. This is most likely to be focused on a test-retest situation where you want to be able to see growth that the students are making. And so having that kind of a reliability in a screening tool obviously is really important because that affects a lot of the instructional decisions that we make about the students.

The third one is, is it efficient? Because screening tools should be very efficient. It should have consistent administration. It should be quick and easy to give to students, not take a lot of time. Because the more time it takes to do a screening tool, the less time we have in terms of doing high-quality instruction. That's about all I'm going to say about the screening tool part. We can come back to that if you have some questions, and I'm happy to address that in terms of how it relates also to progress monitoring.

The second recommendation has to do with important mathematical topics. And there are two mathematical topics that are identified in the practice guide. What's important about these

two— so there's whole number concepts and operations, and the second one is rational number concepts and operations. And you notice that these span K through 8.

A lot of people would say, well, that's obvious that those two are the most important because that's what we spend the most time teaching. But I think what we need to pay more closely attention to is not just the idea that it's the content of whole and rational number, but notice that it's concepts and operations.

So what I find really critical about this particular recommendation is that concepts and operations are equal within those recommendations themselves. It's as important to develop the ability to fluently and efficiently work with these numbers in terms of the operations. It's equally important to understand these numbers.

When we talk about understanding these numbers, our focus is on number sense and operation sense. Do children understand magnitude of numbers and how numbers relate to each other? Do they understand things about operation that help them to predict and to make sense of the answers that they get?

So, for example with whole numbers, if they're adding two three-digit numbers, do students have the ability to think about the type of sum that they should get when they're adding those two three-digit numbers? Would it make sense to get a five-digit number?

And for students who are struggling, that's really important for them to be able to make that prediction about the sense-making and the reasonableness of the answers that they get when they perform an operation. It also links them back to the concepts of working with those particular numbers. We'll talk a little bit more about this later when we're linking it with some other things. So I'm going to move to the next recommendation.

The next recommendation focuses on problem-solving. And you'll see that slide come up as soon as David advances to the next one. Focusing on keywords is one of the strategies that we often see in the classroom, especially when we're working with students who struggle, because we feel like it gives them a lifeline. But rather than focusing on keywords, the focus on structure and relationships are much more helpful. Keywords are not. And we'll say a little bit more about that in a minute.

The structure and relationships fit very well with the idea of visual representations, that are also another recommendation that we'll talk about in just a little bit. But what's important about the structure and relationship of word problems and having students focus on that, is that it allows them to compare and contrast word problems that are in a particular class. So having them be able to think about what's similar about these particular problems, what's different about these problems, what structurally can we make sense of as we read through the problems and think about.

There are times when—and I'm sure that some of you who are working in the classroom, or if you're going in classrooms a lot—you notice where students who struggle in math may also have issues in terms of reading. And when we think about the reading aspect, the reading

oftentimes will make them have difficulty in ferreting out the relationships among quantities within the word problem themselves.

I wish that there was some magic way that we could make that go away. There are some schema-based approaches to having students use particular diagrams to model problems and their relationships. We're not going to focus on that today, but I think that that's worthwhile in thinking about and understanding, does that actually give them a good tool, and does it help them to think about that in particular?

So if we think about keywords on the next slide, this is probably one of the areas where we see the most difficulty that students have. Because they really, really, really like having keywords. They like having words that they can find within a word problem, it gives them some kind of a structure that they feel is a good thing because it allows them to attack a problem.

The problem with that, however, is that once they move into that keyword approach, is that they have a really difficult time in making sense of what the problem is actually asking them to do. Oftentimes we see students stripping out the numbers, forgetting about the context and the problem, even though that context would help them think through how that problem might play out if they were to actually act it out or if they were to model with manipulatives and so on.

It's also difficult when they become very focused on keywords because they tend to apply them inappropriately. So a lot of the key words, sadly, are not really mathematical words, but they're words that we use in everyday conversation. So the problem with that then is that these words appear over and over again in problems that may have nothing to do with what they're actually working on.

I think the last bullet, however, is really critical because keywords might work effectively when there's only one operation involved, but because we want to generalize techniques that students use, the difficulty really hits when multi-step problems come into play. Because it doesn't help them or support them in thinking about how to attack the problem or how to think through that particular relationship that they might find in that problem.

And that's where the next recommendation on the next line comes in really important. Having students be able to use visual representations. In special education research we often see this called a CSA approach. Concrete, semi-concrete, and abstract. You'll notice that I have CRA in parentheses, because in mathematics we tend to think of the concrete, semi-concrete, and abstract as all being representational. And so we'll change that up and use CSA instead of the CRA that would often be used in that special education format.

What I want to mention about the different representations is that we have to understand that there are different types of representations that students should be using concurrently. And I think the "concurrent" part is something that's really quite different from what we typically see in the classroom. Many times what we see is that we start with some physical material or

concrete representation. Then we move to diagrammatic, or drawing out. And then we move to the symbolic form.

The problem becomes that, when we go to the symbolic form students oftentimes don't make connections between the symbolic and the physical materials that they used, so they don't see how those link together, and oftentimes will see the symbolic one as something completely different, something they've never seen before when, in fact, they've been spending a week or two weeks modeling it through physical and diagrammatic approach.

In some of the research that we've been doing we found that when any three forms of representations are presented together, a physical, a diagrammatic, or a semi-concrete, and a symbolic or abstract representation are created and developed at the same exact time, students have more opportunity to make connections across those representations.

So the different types of representations that we might talk about are natural language, which should always company any of these representations. Physical materials. That might include manipulatives. It might include some real-life objects. It might include a real-life situation. A diagrammatic approach where they might use a table, a chart, a representation that involves showing relationships like a part-whole diagram. And then finally symbolic, where they represent it using either numbers or variables, or some other symbol that might appropriately show that representation.

On the next sheet, one of the ways in which you can support having students make those links is to use what we call— Karen Karp and I call this a "link sheet." And in a link sheet there are four things that students do at the same time. You notice in the far— in the bottom right-hand corner, the "explain your thinking," always involves that natural language approach.

The equation would be the symbolic approach. The model or illustration might be the diagrammatic or it might be the physical materials that they actually put into that block. And then the word problems, placing all of those things within a context so that students have a context for the way in which they're thinking about mathematics.

So this might be an elementary one. On the next slide is one that might be used more in the middle school or high school levels. If you would like to have copies of those, if you get in touch with me I'm happy to send you the actual ones if you'd like to have some of those that you can manipulate yourself and create your own link tools.

We often note that the representations that students use are varied, and they're all connected. On the next slide I think this diagram shows how many different ways all of these different representations connect together. And I think what's really important is to focus on the middle rectangle, the demonstration of mathematical understanding.

Oftentimes when we're working with students we focus on the symbolic representation as a way of demonstrating understanding when, in fact, being able to show relationships across different representations or using a different representation in a certain way can often help to demonstrate understanding as well. So I hope that discussion about the representation part is

something that you can think about as you're moving toward classroom implementation, whether you're a coach or a teacher.

But I think the takeaway, for me, on the representation aspect— and one that we learned was really critical in the research we did in classrooms and as part of our teaching— is that the concurrent representations, presented all together at the same time and linked with the natural language of explaining how they're linked together, created a much more robust and solid understanding for students.

Okay. So we've shared some of the representations. So on the next slide what we'd like for you to do is to look at the topics that were covered that we just shared. There's a section in the practice guide called "How to Carry Out this Recommendation." Select one of the topics that we talked about and skim the section on carrying it out, and think about what kinds of issues does this raise for you.

And I'm apologizing that we can't give you a longer time to do that, but I'm going to give you about a minute to a minute and a half, and then we'll come back and ask you to share out with any questions.

So take some time now to do that. Review and skimming of one of those topics.

DAVID YANOSKI:
And just as a quick reminder, we'll use the Q&A section of the webinar platform in order to collect any questions that you might have. So as you're doing this quick skimming, think about any question that you might have about the first half of this presentation, and go ahead and put those in the Q&A box.

BARBARA DOUGHERTY:
All right. If you have some specific questions or issues that this raised for you, would you place those in the Q&A box?

DAVID YANOSKI:
And, Barb, while people are doing that I'm just going to go ahead and ask just a general question here. If you were going to only implement one of these strategies and just try with starting with one, which one of these do you think has the most, if you will, bang for the buck?

BARBARA DOUGHERTY:
I would focus on the visual representation one and the linkage of all of the different representations. That one, for me, is the one that generalizes across all mathematics. And when students get in the habit of being able to represent a mathematical idea in different ways, they're able to apply that across the mathematics. It makes them feel very powerful. They feel like they've got a tool that they can use. And especially when they're able to explain how the

different representations are linked together, that's where I see the most, as you called it, bang for the buck in terms of students.

DAVID YANOSKI:

All right. Thank Barb. We do have a couple of questions in here. So I will do my best to answer these with fidelity. So bear with me here.

So first question. "In our math intervention work we found CSA-CRA to be most effective with students who do not have this disabilities, so we moved that focus on CSA to the core, the general education classroom. Intervention, we found, was most effective with an emphasis on explicit and systematic instruction with aspects that control for attention and memory issues. Do you have any thoughts on that?"

BARBARA DOUGHERTY:

I do. Yeah. That's a really interesting question and comment, because I've heard that from teachers before. So I'll just tell you, from the work that we've done in one of our IES projects and the work in my own classroom, is that I found students were actually the ones who were most resistant to trying to use the different representations of mathematics. And, for a lot of the teachers that we were working with, they felt like they wanted to skip over and just give them exactly how to do a problem.

The difficulty with that was that, because that relies on a heavy dose of memory— and we're going to actually talk about that in explicit instruction coming up— I see that another person asked about explicit instruction. What we found was that the students' ability to retain and remember was definitely limited. And so it became, actually, more of training the students that this is something that is helpful and making it engaging for the students so that they actually engaged in it. So we had quite different results across a broad variety of students and in different contexts.

I don't think that that actually explicitly answers that question, but I would really enjoy engaging in a conversation with that person that asked that, if they'd like to, after the webinar.

DAVID YANOSKI:

Okay. Great. A couple more questions here. So this is a question about the idea of recommendation number four, the keyword myth. So what are the implications for annotation strategies then?

BARBARA DOUGHERTY:

I'm sorry, David. I couldn't hear the question.

DAVID YANOSKI:

So, what are the implications for annotation strategies, when you think about your conversations about keywords?

BARBARA DOUGHERTY:

That's a great question. Because kids like to have the keywords, because it's super easy to find those in the reading part. I think another strategy that we often see with the word problems is to have kids highlight important information. And I almost put a slide in about that. Because what kids typically do is, some of them will highlight almost everything and they can't determine which is which. But I think, in working with word problems, a great adaptation strategy that we've been using, having them to model the problem. And literally to restate the problem in their own words.

And right now what we're talking about are algorithmic or procedure-based problems that are typically solved with a computation. So having them to be able to model it in different ways or act it out and then diagram it at the same time and then think about those relationships and move forward.

Keywords are such an easy thing to do, and I've seen so many on Pinterest where they have charts of all the key words. But that problem just persists itself as they move forward. And I would recommend that— I'm not sure who asked that question, but Karen Karp, Sarah Bush, and I have three different articles that have appeared in Teaching Children Mathematics, Mathematics Teaching in the Middle School and Mathematics Teacher for the high school teachers, that have focused on rules that expire. And keywords are one of those rules that expire. If you haven't seen those articles, you might think about taking a look at those, because we also provide some other ways to think about how word problems might be approached in that. And I can also give some other articles that either I've authored or other people have authored that can provide some adaptation strategies, if you drop me a note.

DAVID YANOSKI:

Great, Barb. One more question for you before we move on. The question is this. "Can you say something about the healthy use of think-alouds in recommendation three? Is that a way to implement number one?"

BARBARA DOUGHERTY:

So recommendation three is actually the next one that we're going to talk about, so that— I couldn't even have given a better segue.

DAVID YANOSKI:

All right. So then we're going to go ahead and move on at this point in time. Thanks everyone for using that Q&A box. That worked perfectly. So the next time we have an opportunity for

questions—and don't hesitate to go ahead and put a question in as it comes up for you. I'll keep track of them and make sure that Barb has a chance to answer those. All right, next slide.

BARBARA DOUGHERTY:

See? Very perfect. So would you go to the next slide, David? Oftentimes when we think about explicit instruction we often think about this kind of an approach, where we say first the teacher is going to do it, then everybody's going to do it together, and then students are going to do it independently. It's very teacher-driven. Oftentimes we hear it called other names, like "gradual release of responsibility," "direct instruction," "explicit instruction."

So what we're going to try to do is to figure out what this looks like in some classrooms, and then figure out a different way of approaching it when we move into the classroom. So on the next slide what we see with a direct instruction approach— and sometimes an explicit instruction approach— is that students are given a major amount of examples, and the teacher talks about the steps in which these different processes or operations are done.

Very often there's a rule given, with very little sense about why it works that way, but students are given these rules that help them to keep track of the steps they need to do. This one may be very familiar. Keep, flip, change, or the KFC approach. Not one that we would advocate with students who struggle, especially when dividing fractions, because the common denominator method is just so much more intuitive. But this is often what students are faced with when we look at explicit instruction.

So why is that not a good thing? We call this example-based teaching. And when students are working with example-based teaching there are some things that happen that change the way in which students think about mathematics.

First of all, it requires these students to look at all of these different problems, these examples, and the steps that are used to solve those problems, and to try to make sense of how they're alike, what's the commonality of the problems themselves. That's an extremely high cognitive load for students who are struggling in mathematics.

In fact, a lot of times even adults have difficulty in figuring out how are all these problems alike. But for students who already have this struggle placed on them, asking them to figure out how they're all alike so that they can then apply that to smaller problems is an extremely high level of thought process that they must use. And many of them are not equipped to be able to do that. Not because they're not cognitively equipped, but they don't even know the process that you might go through to figure out how these problems are all alike.

The other thing about example-based instruction is that it assumes that every problem that students are going to have can be reduced to a series of steps. Now, the problem with that is that, that means then that our focus on the mathematics is almost entirely on skill problems.

Because problems that require a more conceptual approach to thinking about the mathematics can't be solved in just a series of prescribed steps.

And even though those prescribed steps will get students to an answer, it doesn't provide an opportunity for students to really engage with the mathematics and make sense of it. It oftentimes is just memorize how these steps are going to be applied, and then when I give you another problem that looks like this you're going to apply those steps as well.

So let's think about how we can change that type of teaching and move it to something that helps students make sense about that. So, first of all, let's be clear that explicit instruction is not direct instruction. It's not a teacher showing multiple examples. It's not a teacher giving students rules that they go through step by step by step.

There are five areas in explicit instruction that we want to think about. The first one is modeling and demonstration. And when we think about modeling and demonstration, that sort of has that feel that this is where it's going to be with giving lots of examples. And then, combined the second bullet—which is think-aloud—it sounds like teachers are going to talk through here's how you do a problem.

What we need to think about though here is not that it's the teacher giving particular steps to do, but it's helping students to understand how to think about a problem in more of a conceptual way. So rather than giving very explicit steps, the teacher might go through things like, "when I first saw this problem I thought about—" "and then I thought about—"

And so focusing on what's the thinking that's going on behind the teacher's thinking is really important. I think the other part of this that we need to also be aware of is that it's not just the teacher modeling and demonstrating and doing the think-aloud. It should also be the students. Students often times in these classes need to hear themselves think.

I love it when I'm in a classroom and I hear a student say suddenly, oh my gosh, they're saying what they think is going on in their head, and then they'll suddenly just sit back and say, wow, I disagree with myself. That's a real important part for students to be able to self-correct and self-monitor. And one of the ways they do that is to hear themselves articulate and explicate the thinking that's going on inside their heads.

So when we're working with teachers or when I'm doing my own teaching in the classroom and I'm using the modeling and demonstration approach with think-alouds, that it's really focusing on the thought process and not just the step part. Because we want students to see that the thought that you give in mathematics is really about making sense. And giving them steps is not about making sense of the problem.

The third piece of the explicit instruction is significant practice. And a lot of times that means, oh my gosh, we've got to give them fifty problems or thirty problems, and they have to practice on those. But what we've found in our work is that the practice part really encompasses more than just mathematical problems.

So, for example, they need practice with classroom procedures. They need practice in working in a group. They need practice in problem-solving that's real problem-solving and not a word that can be solved with a computation. So we don't want to get problem-solving with unique or engaging problems just on a Friday.

We want to have them practice talking mathematics. Because many students, as they come even into middle school and high school, have never really had a conversation with mathematical ideas. It's been primarily focused on, "what did I do next."

This significant practice idea also means that we have to give students time to learn. And that, for me, is one of the most critical aspects about working with students who struggle. Because a lot of times these are not kids that have major cognitive issues. It's the fact that they just need a little bit longer to learn something that somebody else got a little quicker.

In our research here at the University of Hawaii one of the things that we've found for several decades is that, for a student to move a concept to a skill and really understand the mathematics, it takes 8 to 15 days. And that's a lot longer than what we often see students having experience with in our mathematics classrooms. Many times it's, today we're going to learn this, and then tomorrow something new is added.

But when I mention the 8 to 15 days, it doesn't mean focusing only on one particular idea for 8 to 15 days. It means figuring out how to integrate different ideas together and connect them so that students see that each day that you're in a math class it's connecting to what came before— the day before, the week before, the month before, the year before. Many of these students categorized their information as small pieces of facts and little factoids that float around, but they're not really sure how anything connects together at all.

So we want significant practice not just to be about computational problems, but also to give them problems that are engaging and even smaller in numbers. We've found that— in our work— giving students five to seven problems a night that are good problems, that are not just computational problems, actually increase their achievement, rather than giving them a lot of problems all at one time. And we're going to talk about that again in a second.

The fourth bullet is consistent feedback. And consistent feedback does not mean giving them a grade. Because oftentimes kids just look at, "I got four out of five on my homework, and they toss it to the side. But often the consistent feedback is to give them something that's very constructive that will help them think through the mathematics in a different way.

So when we're working in the classroom and we're rotating, listening to students have conversations, I make notes about different students' thoughts, and then sometimes I even have a private conversation with them about, here's something that I noticed, here's something that you might think about. And having that one-on-one where it's sometimes said directly to them rather than written on a piece of paper provides them with something that they can actually work with and move forward on.

The other part about consistent feedback is that, in a discourse-based classroom where students are doing a lot of discussing about mathematics, it's not uncommon to see a problem left and continued to be discussed in several days. In working with students who struggle, one of the things that we've learned is that students need to come to some fruition during a math class. So having the opportunity to tie together and pull together what happened in that math class, summarizing it at the end not just by the teacher but having students summarize.

What was one big idea that you left with today? What was one thing you noticed about the problems that we did today? What was one thing you noticed about the different strategies? Having them tie it together and leave with that one big idea is really important. And that's part of the feedback that we give them at the end of the class period.

The last part of explicit instruction as part of the practice guide is cumulative review. This one we have found as part of that 8 to 15 days learning process, is to give distributed practice rather than mass practice. So distributed practice means that students will be focused on doing problems that may have occurred over the last week, the last two weeks, as well as the new material that they're covering.

So you can imagine, if you're giving five to seven problems a night for homework, you want to think very carefully about what problems you give them. So often this means that you have to deconstruct the math book, in a sense. You have to move problems from one problem set to another to create these homework problem sets that they might work on. But it's important that they have distributive practice versus mass practice where they do all of the problems at one time.

When we think about explicit instruction, I think the big difference on this next slide that we see is that explicit instruction is not about giving them just steps, but it's focusing their attention on particular structures or ideas. We want to ask them questions that help them to really see the structure of the mathematics, and give them tasks that allow them to explore rather than be focused on just applying a step-by-step process.

I want to be clear that it's important that students know a step-by-step process, but oftentimes when we're working with students who are struggling, the focus is on the step-by-step because it allows them to get to an answer. Helping them to understand that math is messy, math requires some struggle, and that struggle can be productive because then when the problem

comes to fruition it's just like this awesome, most awesome thing that can happen, and that feeling you get when you get to that point is something that motivates them to move forward and do more problems like that.

So how do we implement explicit instruction? Let's think about what that means and how it might look. One of the things that's important when we're thinking about explicit instruction is the types of materials that we might use with students who are in an intervention class, say a Tier 2 mathematics class or a special education classroom. A lot of times these focus on a one-size-fits-all computer program where students are seated in front of a computer that's providing adaptive instruction. Other times it's giving tons and tons of worksheets. Neither of those two have long-lasting effects. They may provide very short-term effects, but they don't provide the long-term effects that we'd like to see with students who are struggling.

So choosing curriculum materials are really important. One of the things that we always focus on is having some kind of a metric or rubric by which we judge whether those materials are appropriate to work with students that struggle. We're going to look for multiple problem types that would also include and allow students to use appropriate and accurate representation.

I know that sounds like, well, yeah. That's what all materials should have. But what we often see in materials that are used with students who struggle is, they're given representations or they're focused on representations that students have to actually learn an algorithm in order to use that representation to solve a problem. We want these to be much more intuitive and to link really closely with the mathematics, and definitely having different types of problems that students can work on.

Another part of implementing explicit implementation is focusing on discourse. Students and teachers should both be verbalizing their thought process, and it should focus on their reasoning. How did you know to do that? What was it about the problem that told you this? If we look at multiple problems that have similarities, what similarities do you see in the way in which we solve the problem? What differences are there and why would there be a difference in that?

I think the second bullet, the oral presentation paired with written, is one of the ones that we've found to be extremely important. Excuse me just a second.

When students have a lot of talk going on around them—especially students who are struggling, and it's going very quickly, as we know it can happen in a mathematics classroom—they get lost in the discussion, and once they're lost they're completely disengaged. One of the ways to keep them focused and in that discussion is if students are presenting their idea or talking about a way in which they solve the problem, the teacher should be writing that student's thought process as they're sharing it. Not revised and not edited, but as they're saying

it, so that students are also focused on that part about how students are describing their thinking.

A good thing about that is that it helps students to see their thought process in word form. And that one change in the classroom can cause students who are disengaged to become engaged, because they're seeing that you value what they're saying and they're seeing that, here's actually their thought process being written down, and other people can read it, and that public sharing through writing looks very different than when it's just presented orally.

I think in the fourth bullet the verbalization of thinking is one that's really difficult in a classroom, not letting it become a one-to-one discussion. Sometimes when students start sharing a solution process or the way they were thinking about a problem it becomes a discussion between the teacher and student, and the rest of the class it's completely left out. So it's at this point that we'd want to institute in the classroom a very heavy routine of asking students to restate what someone else stated, or to comment on how their thinking was the same or different from another student's thinking, and making that a regular part of the classroom.

That's supported by having the written discussion available for students to see as well. When we talk about scaffolding public sharing, this means helping students become comfortable in sharing their work. So a technique that we use is we allow students, at the very beginning of implementing this particular process in the classroom, to bring another student with them to the front or to have the student's record their presentation or their ideas on an iPad. The iPad can sit between a pair or sit in a group, and they just hit the Record button and they can record it at their table, they can fix it up at their table, and then just share that recording when they go to the front. It's amazing though the amount of self-confidence that students begin to develop when we scaffold that public sharing of their work and allow them to become that confident person that talks about their own mathematics.

Another part of explicit instruction that we want to be sure happens in the classroom is to provide small-group problem-solving. In this we want to think about not giving problems that are not just routine problems or application problems that are solved with algorithm or a step-by-step process. We also want to focus on non-routine problems. Non-routine problems are problems for which there is no known solution pathway. In other words, students have to get very creative. They have to think through those problems and decide how they might solve it, and it may not involve a computation at all.

There are some great problems out that can be used that cause groups to work together in a co-operative way. There are older materials such as Get It Together or United We Solve. Both of those provide such a great context for kids to work together. In fact, in our classes we used those the very first week of school and that's all the kind of mathematics that we do, getting them used to talking in a group and working together. It's also important that the problems

that we give them in small groups are not always well-defined. Sometimes they might have information that's missing.

Sometimes they may not even have a solution, and that's also important for them to work with because they sometimes believe that every math problem is going to have one and only one answer. Sometimes they don't have any answer. Although I have had a couple of my students in my intervention class tell me that they were going to tackle Fermat's theory or some of the unsolvable problems and come up with something, because they think they're really on to something. That would be great if they could do that.

We also want problems to focus on relationships. How are quantities related in the problem? How are problems related in a particular task? So when we think about that there are four steps that we go through in implementing this in the classroom. First, we begin the year always with problem-solving using those co-operative tasks that I'm mentioning. That's really critical. Rather than starting with just a number task or number computations, starting with tasks where it might involve geometry. There are some great tasks in those two references that I mentioned that use a geometric approach to just getting kids talking about math and becoming engaged and making that part of their actual routine.

Another thing that we've found to be helpful in terms of small-group problem-solving, is to show kids videos of what it looks like for other students to be working in a group on problem-solving tasks. What's that look like? For many of these students, especially if they have been placed in classes where students of other like-types are, they may not have even seen good examples of what it looks like to work together, to talk together. Showing exemplar videos actually gives them a model that they can follow. So when we talk about that modeling and demonstration part, it doesn't always have to be the teacher talking about mathematics. It can actually be showing a video where students see other students like themselves working in a group and talking.

We also want to be sure that when we're using small-group problem-solving that we're really careful about which students' solution methods we put forward for public discussion, and how they're sequenced. So sometimes we want to start with a less-sophisticated method so that all students can engage in that conversation. And then, by carefully sequencing the types of solutions that are shared, get to a more sophisticated method that might have been used for solving the problem.

Lastly, another technique that's really important for these students is, they need cues to go back and be able to retrieve what they did for certain problems. So we always want to name problems and name a method. Now, that doesn't mean that it's a student name for the method or solution process, but the method needs to be named and the problem itself, if it's named, allows students to go back and retrieve what happened.

So if you said, remember when we did the handshake problem? Oh yeah. Students say, yeah. Or, remember when we did the handshake problem I solved it using a diagram and maybe that would be a method that would work on this problem? I think there's something alike between those two problems.

When we talk about a method, having that shared understanding in the class for the particular names that we've called the methods is equally important because it allows students to go back and retrieve that method and use it.

Finally, we want to provide feedback to students. And I think that that is really important as we begin to provide some validation for their thinking and the process that they use. Not all of the processes that they used are valid. They're not going to generalize across all problems, and they need to recognize that, that it worked on this one. It's not going to work on another problem of a similar type, and why that might be the reason.

We also want to give them feedback on publicly-presenting their work. One of the techniques that we found very effective in a classroom where students are learning to publicly present their work is that the teacher models first what a presentation looks like. And this goes back to that modeling and demonstration aspect. A teacher models talking through a problem, and then asks the students, how could I have made that better? What was good about the way in which I talked about the problem? And documenting what the students say.

The reason for documenting that is, then when students do their presentations you can go to some of the things that they said that were very effective or things that needed to be improved and have them compare their presentations to what was noted in the teacher presentation, the demonstration that the teacher gave. It's very important to be very specific and focused on what are the targets that you're looking for in their presentations.

After we've done some opportunities for students to share through public presentations—about six weeks of school, maybe up to eight weeks of school, because that acclimation time of getting students used to a classroom where there's a lot of conversation, where there's a lot of different kinds of problems—it takes time for them to acclimate to the classroom. After they've had that acclimation period we asked the students to create their own metric or rubric to be used in scoring some of their presentations. And I know we'd say, well, should we really grade their presentations? But we found that once it goes to this place where they're able to provide their own perception of what makes a good presentation, you're going to see a dramatic increase in the quality of what they talk about.

So the way that we implement that in the classroom is we give them, as a homework assignment, to give five things that you think students should be aware of and do in all of their public presentations in the classroom. They come back to school the next day with their five characteristics, they meet in their small group, they share what they did, they pick three from

each of the groups. So after they've listened to all four people in the group they pick three that they think are the most important, they share those out from the group perspective, they're placed on a chart paper, and for the next couple of days every time there's a public presentation that presentation's quality is compared to the characteristics that students have identified.

I have samples that we've created in our classes, if any of you are interested in seeing what the students created. I'm very happy to send those to you—just knowing that these were very specific and particular to our class. But we do see a lot of ideas coming from students that I would not have put on their own metric feedback sheet because they would have been too stringent. But what's amazing to me is that, even students who are struggling recognize that there needs to be high quality, and they're able to identify that.

Once they're at that level the quality of their own presentations just becomes dramatically different, and they actually want to present because they know what the targets are for those presentations themselves. So there were a lot of ideas that we gave for implementation in these last slides. I'd like for you to think about one implementation strategy that has not been— that you've not used before, that you think you might be able to use or think about in your classroom. I'll give you just a moment to think about that.

If you'd like to share any of that, please feel free to do that in the chat box.

Could you mute me for just a second, David? I'm going to step away and cough. I'll be right back.

Okay. All right. Now we're going to think more about how do we enhance instruction for students who struggle. And we're going to focus on the questioning aspect. Oh, I see a Q&A came up.

DAVID YANOSKI:

It's just a comment, Barb, so we can go ahead and move on.

BARBARA DOUGHERTY:

Okay. Thank you so much. And thank you, Lynn for noting that. I think that's a really important idea and I appreciate you sharing that, so thank you. I also apologize for having to step away and cough. I'm still struggling with the reason we had to reschedule from the last time. So thank you for putting up with that part.

The questioning aspect that we use in classrooms with students who struggle is really important. This notion that a lot of questions is good is true, but as you can see from some of the data that Anne Fagan and I— one of my really valued colleagues— some data that we

collected showed that within one school district in a 48-minute class period there were more than 145 questions asked.

When that happens there is a very rapid-fire— teacher's saying things like, what should I do next? What should I write down? What's 7 times 6? And for the students who are struggling, many of them need a lot more time, first of all, to think about that, and many of them will disengage because they know that someone else who thinks faster is going to be able to answer, and they're kind of out of the loop and they don't have to worry about it.

The other part is that, when they're allowed only about two seconds for responding before either the teacher would answer their own question is that there's just not enough time for thinking. So we want to change that questioning aspect and we want to think about, how can we change up the way in which we question students that allow them to think very deeply about the mathematics.

Giving them a problem like this is one that we would consider a very low-level problem. It's a computational problem. So I'd like for you to just do that problem on your paper, and I want you to think about your thinking as you do that. Probably by now you've already solved the problem. You got 9/4, and you did it so automatically that your thought process really didn't have to engage too far.

So we want to figure out ways that we can change this question or problem that forces students to think more deeply about the mathematics rather than just memorizing a particular procedure or algorithm. One of the ways is to change the way in which we ask questions. So I'm going to give you three different types of questions that come from a framework that we developed here at the University of Hawaii that was derived from the work that Krutetsky a Russian psychologist, did.

The first of these questions is a reversibility question. A reversibility question forces students to think about mathematics from a different sequence of ideas. Oftentimes students that are struggling students have memorized particular steps that are lock-step. First I do this, then I do this, and then I do this. When they're given a different type of problem they have a difficult time being flexible in their thinking because they're geared to this lockstep approach.

So what we want to do is open up the questioning so that, first of all, it forces a little bit longer time for students to think about it. Second, it allows access by every student in the classroom. That's something that we want to make sure students have accessibility to all the mathematics, and they're not on the sidelines because the entry point for that mathematics is too far.

So if you think about "find two fractions whose quotient is 2 and 1/2," students could think about, oh, I need a quotient of 5 ½ or 2 and 1/2, and it may be the simplest problem. It might

be 5 ½ divided by 1, and that certainly would answer that question. But it allowed that student to be participatory in that particular task. And oftentimes that doesn't happen.

So the way in which this task is implemented is, we would give the students a question like this. We would ask them to work independently for one and a half to two minutes. We always use a timer when we give them a time frame, because many students can't judge time, so they'll wait until the last five seconds, or be very surprised when you call time. So give them time to work on it.

You notice that they're asked not just to find one pair, but to find—when they solve this whole thing they would find five pairs. And there's a reason for that. These kinds of problems allow you to collect answers. So as you move through the student solutions you're able to record the problems that each of the students got for this particular question.

Now imagine. They're still doing computation, but the way of which that problem is presented forces them to think in a very different way. So I don't know if you tried this problem. If you want to challenge yourself, add in the restriction, "find two fractions with unlike denominators whose quotient is 2 and 1/2." That thought process that you have to go through to just solve that particular problem is quite different than the original problem that was given where two fractions are given and you just apply the algorithm.

So after we collect all of the answers from every student in the class, and if we go to a student who says, oh yeah, mine's already up there, we give them an opportunity to chat with someone next to them or to rethink and come up with another one, and then we remember to go back and get that solution from them so that everybody is accountable.

And I think one of the things that we've noticed when we've talked with students who are in intervention classes or who are struggling students, is that oftentimes they talk about the idea that if they just wait long enough somebody else will answer the question. So they don't ever have to be accountable for coming up with an answer.

So if we look at the characteristics of reversibility questions, we can see that it promotes the idea that students have to think in different ways. They're very easy to construct. We give students the answer and they create the problem. And that's a reversibility question. Very high success rate in the classroom, and very important for students to develop that flexibility of thinking.

The next type of question is a generalization question. And when we think about questions that give us that bang for the buck, these are those kinds of questions because they help students to focus on big ideas that promote operation sense, that promote number sense. And remember we said earlier, those are things that are really critical, not just the algorithms that they might

develop. So generalization questions allow you the opportunity to focus on big ideas that may not come from just doing skill problems.

They also link to the reversibility question. So, for example, if I wanted to think about the first one in the first bullet, "what do you notice about the quotient when you divide a fraction greater than 1 by a fraction that's less than 1/2?" So if I select problems that give students a fraction greater than 1 and divided by a fraction less than 1/2 and give them multiple examples of that to solve, now I can go back and ask them, what do you notice about the quotients?

For many students they're very surprised that you can get a quotient that's larger than either of the two numbers that made up the dividend or the divisor, because they've made generalizations that haven't been quite accurate based on their experience with whole number operations. So this gives us an opportunity to focus students' attention on structure—and remember, that was one of the recommendations that we talked about—and to have them think about relationships. And that builds towards the concept. I think it's really cool how these things link together, and you're able to see that you can accomplish some of the recommendations just by the way in which you change the way we ask the question.

Okay. So generalization questions are those questions where we ask them to find and describe patterns. And they really are reliant on giving them a good problem and one that those kinds of patterns are going to come out, and that we can move them to a generalization.

You notice in the Sophie problem—this was a problem that was actually given to some struggling students who were fourth grade, and we were working in multiplication. So we asked them this particular problem. We asked them, what do you notice? Or, what do you think Sophie noticed?

And they came up with some really awesome things that helped them then later as they were working with their own multiplication ideas, that they were able to apply those because they had thought about this patterning notion and the big generalizations. When we think about conceptual understanding, it's going to come from more of the generalization-type questions than any of the factual questions that we might ask students in the classroom.

The third type of question is one that we call "flexibility" questions. And there are two types of flexibility questions. One type of flexibility question is asking students to solve a problem in multiple ways. So in this case, "divide 3/4 by 1/3 using two different methods." So some students may use the reciprocal method. Some students may use the common denominator method. Some students may even try to do it using physical representations to show why you get the quotient you do when you do that division.

One of the things, though, that we always want to ask when we ask students to solve a problem using two different methods is, how are they alike and how are they different? And that's

oftentimes a place where we neglect to make that next move where we ask them to think about the similarities and the differences between methods. But this is the place where they're able to make those connections. And connections are so important for students in these struggling categories where they haven't thought about— it looks like people use just two different things, but they don't see how the two are alike or how they're different.

Okay. So flexibility questions are questions that you ask them to solve a problem in multiple ways or to use what they know about one problem to solve another problem. And again, always asking them when we use these different solution techniques, how are they alike and how are they different, and focusing on that particular part.

So I'd like for you to think just a moment about those three different question types. Which question type do you think would be the easiest for you to implement in a classroom or have the teachers that you're working with implement? And which do you think would be the most challenging? Let's take just a minute for you to think about that.

If you want to share any of your ideas, please feel free to do that.

All right.

DAVID YANOSKI:

So, Barb, for the second time I think I want to skip questions right now.

BARBARA DOUGHERTY:

Yes.

DAVID YANOSKI:

We'll go ahead and have the last question period available in a few minutes.

BARBARA DOUGHERTY:

I think that is terrific.

DAVID YANOSKI:

So all of you just make sure, if you have any questions, to put that in that Q&A box, and we can make sure that Barb answers it after the end.

BARBARA DOUGHERTY:

So, thinking about those kinds of questioning techniques, they're obviously different than what students are used to. So let's think about, then, how do we implement those and integrate those into instruction? The first strategy that we have found to be very effective is to actually name these kinds of questions and be very transparent about those questions.

Typically, with each of those three question types we've structured and created a routine or a procedure for sharing answers or collecting answers from students. We make that very transparent. We talk about, these are reversibility questions. You're going to notice that I'm going to give you the answer and you're going to create the question or the problem.

We asked students to talk about how these questions are alike or different from factual questions. I think it's really important that students, especially students who struggle, understand why we're teaching the way we teach. Because many of them think that we are just making stuff up, and they're not really clear what's going on in our head. So being very transparent and introducing the type of question and naming it is a very powerful strategy.

We had students visiting my class—or, we had a group of observers visiting my class last year in December, and the very first day they came in the students, every time I would ask a question, the students would turn around to our observers—and there were about twelve of them—and say, we don't know if you know or not, but she just asked a flexibility question, or she just asked a reversibility question.

And it made them feel very powerful to know that they understood what was happening in the class. They understood the process that was going to happen when I started to collect the answers. It greatly enhanced the quality of that discussion in the class, and it made students aware of the expectations for them, which are very clear when we talk about problem structure and types with them very explicitly.

The second strategy is one that we most often see in the classroom, and that's the think, pair, share strategy. We know that if we give students time to think without talking, even thinking sometimes without writing, but just think, that it gives them a better opportunity to be able to engage in a discussion with another person, with a group, and certainly with the whole class.

We oftentimes ask them to share out their responses. And again, the use of the iPad or having them document their discussion in a Google Doc where other students can see. We sometimes do a shared document in Google Doc. Because our classrooms were all Chromebook users, we could establish a place in our Google Doc folder where students could type their responses to questions rather than sharing out, and that's part of that scaffolding and getting used to speaking publicly. Oftentimes they feel much more comfortable if they write it. They feel a little bit more of the anonymous aspect. But that moves them closer then to being able to talk about it in the class themselves.

A third strategy that we use are group instruct— group discussions. Sorry. In a group discussion we have found that being very clear about the expectations of what the groups are going to talk about and how they're going to talk about it— sometimes groups have a facilitator identified so that they can manage that discussion. It's amazing when that responsibility is given to someone

in the group, how they actually accept that responsibility and become much more mature in making sure that they're able to manage that conversation.

Very important to set a specific amount of time and let students know how that time is playing out, so how much time they have left, and so they're aware of what's going to happen at the end of that time. Again, making use of notes. They can use their iPads or Chromebooks to take notes during their discussion to establish any kind of public sharing that they're going to do.

The next-to-the-last bullet, of randomly selecting someone to share, proves very beneficial when you're establishing accountability and setting expectations. When we're ready for a public sharing in a group discussion, we will sometimes give students four different colors of square tiles, and in my pocket I have the same four colors. They each take a color, I pull one out and whoever has that color is the person who is responsible for the presentation.

So that doesn't mean that they have to do it alone. They can often take someone with them, but they have to be responsible for doing the lion's share of the work. That places an expectation then and accountability on them participating in the discussion that preceded the public sharing.

We also want to make sure that we record their discussion points. So, as they're presenting their problems the teacher will record significant points that came from their discussion so that later we can go back and check the archive for that.

The last strategy is providing prompt or guiding questions. This one is pretty important when we're working with groups, especially when students who are struggling are involved. As a teacher we're really focused on making sure that students have a good experience, and we want them to be happy, we want it to be helpful, and that's why we went into teaching in the first place, is we enjoy helping people.

But what happens sometimes when we're working with students in groups is, the teacher will sit down with the group and then the students can disengage from the discussion because now the teacher is managing that discussion. So what we want to do instead is to think through the task that we're giving students and prepare some prompts or guiding questions. And what I do is I record them on a post-it note, and when I walk by a group that I think needs that I'll just lay the post-it note on their table and walk away.

If that doesn't seem to provide enough motivation or enough information for them to move forward, I'll come back to the table and I will ask them, what kind of information do you need in order to move forward? Once I know what that information is, I might write them something. I might type them something on a Google doc and send it to them. But I'm not going to sit and engage in the problem discussion and basically take over that solution process. So we want to

be very strategic in the kind of information we give students to help them move forward on their own. Because that's where they build that mathematical power.

And I think that that takes us to the last reflection question, thinking about implementation strategies and the types of questions that you might implement in your classroom. So if you have any questions or comments, I'd be happy to respond to those at this point. We have a few minutes left in our time.

DAVID YANOSKI:

Barb, I do want you to go ahead and respond to the comment from the earlier reflection period. And the comment is this, "the reversibility questions are a favorite. I have never thought about hooking the generalization to the pattern in the reversibility problem." And she commented that that's brilliant. Can use just talk a little bit more about that?

BARBARA DOUGHERTY:

Yeah. That actually is a really great technique because I find, myself personally, the hardest questions to create are the generalization questions because they require you to think really deeply and hard about the mathematical ideas that you want to have come out. And then how do you motivate kids to even do those problems?

They engage very quickly with the reversibility ones, so by selecting the right problem, like the one I think I gave where you select the dividend and the divisor so that you get a number larger than 1 divided by a number less than 1/2, between 0 and 1/2, gives them an opportunity then to look at the relationship between the dividend, the divisor, and the quotient, and come up with a great generalization.

So I think Lynn posted that. It really is a great technique, Lynn, to be able to do that. Because you can accommodate getting students the access to the problem easily, and then you can use their own responses to create that generalization. And we actually write our generalizations in a Google Doc since we're in a Chromebook situation. The students— we have a class-shared page of generalizations that students and I have created. We keep those generalizations as an archive, and then we revisit it.

And I really like being able to do that because sometimes when you just talk about it in class or you write it on the document camera or something like that, you don't archive it and you can't go back and revisit it. Because, sometimes when we go back to revisit it, we'll make changes in the way in which we thought about that generalization, and make it more specific or make it broader so that it accommodates bigger classes of problems and number types. So thank you for that comment.

DAVID YANOSKI:

Okay, Barb, it looks like the last question is just sort of a more-information-type question. "Does any video exist of teachers implementing these strategies?"

BARBARA DOUGHERTY:

There are some that exist in that. There are some that are available from the University of Hawaii because these are techniques that we've been using quite often. There are some— NCTM has been putting together a library of videos. And I'm not sure if they're ready to release those or not, but you'll be able to see some of those techniques in some of the NCTM videos.

There's also some available from— and it just completely left me. It will come to me. And, David, are you going to share my email address? Like, when I remember where that other place was I'm happy to give them a reference for that. If they email me I'm very happy to do that.

DAVID YANOSKI:

If we have your permission, we can send an email to all registrants with your email address.

BARBARA DOUGHERTY:

You can certainly do that.

DAVID YANOSKI:

Okay. Then we will do that. We do have one last question, Barb. "Do you have an example of the three types of questions in a word problem, and maybe a strategy to tackle?"

BARBARA DOUGHERTY:

Of the three types of questions, a word problem and a strategy. Was that the question?

DAVID YANOSKI:

Yeah. You know, applying these three types of questions to a specific problem.

BARBARA DOUGHERTY:

Yeah. So actually the examples that I shared are exactly the kinds of questions we ask the kids in the classroom. And we oftentimes will structure these problems or those question types so that we can introduce a new topic by asking, for example, a flexibility question or reversibility question that pulls in some prior understanding to moving it forward.

So you don't often see these as a, quote, unquote, "word problem" type, but they'll be given to students exactly as they were in this presentation.

DAVID YANOSKI:

All right. Well, great. Thank you very much, Barb. And thank you everybody for participating and sticking with us until we finally were able to present this.

Just a couple very quick things. REL Central will be producing a video recording of this webinar. That will be available in approximately three to four weeks. It takes us a couple of weeks to get the captioning and all the different pieces that we have to put together. And then that will be available on the IES YouTube site. For those of you who don't want to try to find it there, we will email all registrants for the webinar when this video is available so that you know that it is there.

Again, thank you very much Barb, and thank you very much all participants, and we appreciate your time today.

BARBARA DOUGHERTY:

Thank you all.

DAVID YANOSKI:

Thanks.

BARBARA DOUGHERTY:

Thank you all so much for bearing with me today. And I really appreciate your questions and comments, and I'll look forward to hearing from some of you. Have a great rest of the Tuesday.

DAVID YANOSKI:

All right. Thanks everybody, and I'm going to sign off now. Bye.