Project INSPIRE Grade 2-5 Course 2 Lesson 6 (32:05)

SPEAKER 1: Welcome to "Grades 2 to 5: Nemeth Code Symbols for Fractions and Spatial Problems, Instructional Tools, Materials, and Technology." This is "Lesson 6: Developing Students' Abacus Skills." Slide 2 has the objectives. You're going to be able to identify the different types of abaci that are available from APH, recognize prerequisite skills the student needs prior to abacus instruction, name the parts of the grammar Cranmer abacus, and describe the different methods for using the abacus.

Slide 3 puts you right to work with "Activity 6A." Please, pause and write down the names of each of the four abaci shown on the screen. No cheating on the APH website. When you're ready, come on back. Alright, slide 4 is our answers: the beginner abacus, the expanded beginner abacus, the Cranmer abacus, and the large abacus.

Slide 5 makes you work again. I want you to answer the four questions in "Activity 6B." Once you've answered them, please come on back. Slide 6 is the answers to "Activity 6B." So, did you know that those cute little white spherical things are called the beads? The bumpy black bar on the Cranmer abacus is the separation bar that separates the top bead from the beads below. What you do when you push one of those cute little white beads towards the separation bar is called "setting," or writing a number, as I like to think of it. And what you do when you push a bead down, or pull it away, is called "clearing," or as I like to think about it, we're taking away something. So we set and we clear our beads when we're using the abacus.

Slide 7 talks about the two kinds of beginner abaci. We have the beginner abacus original, and then we expand it. So the beginner abacus has two columns of nine beads each, so I can set numbers up to 99. I can work on my place values in the ones and the tens column. Expander beginning abacus, I added a third column, so now I can set numbers up to 999, can work on hundreds, tens, and ones columns, and I can also use it to set money like, $3.75. Some of our students may have trouble with orientation, as far as those nine beads, so you might want to put a piece of graphics art tape on the fifth bead to help them with orientation.

Slide 8, let's talk about some skills used with the beginner abacus. One of the first things is, our students need to know the terms "set," and "clear," and "bead." They need to understand one-to-one correspondence. They must also be able to rote count, but at the same time, they need to understand cardinality, that idea of connecting counting to the number of objects. So if I have three balls, how do I write the number three? How do I set the number three? And then, we want to think about having them understand place value in the ones, the tens, the hundreds column, and then being able to set and clear those numbers that involve more than one column.

Slide 9, I want to take a moment to show you video to introduce you to direct addition and regrouping, or indirect addition, and then also to direct subtraction and regrouping, or indirect subtraction. So let's watch the video.

SPEAKER 2: Our first problem is going to involve direct addition, and we're going to use 38 + 41. So, on the two-column beginner's abacus, I'm going to set 38. So I'm going to move 3 beads up in the left column and 8 beads up in the rightmost column. To add 41, I'm going to move 4 more beads up in the leftmost column and 1 bead up in the rightmost column. And then I'm going to check to see how many beads are there now. So, there is actually 7 in the tens column and 9 in the ones column, for an answer of 79.

Our next problem, we're going to do regrouping, or indirect addition. We'll use 57 + 28. So I'm going to set 5 beads up in the leftmost column and 7 beads up in the rightmost column. To add 28, I can add 2 more beads in the tens column. So that's the 2 tens in 28. But next, I have to add 8 ones, but I only have 2 ones to add, so what I'm going to do is move 1 more bead up in the ten column, so I've really added 10, but I needed to add 8 so I'm going to move 2 away because I added 2 too many in the ones column. And then, I'm going to look at the answer that I have left, which is going to give me 8 in the tens column, 5 in the ones column, for an answer of 85.

I'll clear the abacus. My next example will be direct subtraction. I'm going to use 95 - 23. So I'm going to set all 9 beads up in the tens column on the left, 5 beads up in the ones column on the right, and then I'm going to subtract 23. So I'm going to take away or move down 2 beads in the left column to represent the 2 tens, and then in the ones column, I'm going to move 3 beads down to represent the 3 ones. Then I'm going to look to see what I have left, and I actually have 1, 2 3, 4, 5, 6, 7 beads in the left column, 2 in the right column, for an answer of 72.

Our last problem-- I'm going to clear again. Our last problem is going to be regrouping for subtraction. So I'm going to do 62 - 15. So I'm going to go ahead in this tens column and set my 6 tens in the left column and 2 ones in the right column, so that represents my 62. Now, I need to subtract 15, that's 1 ten and 5 ones. So I'm going to go ahead and move one bead away, because I'm subtracting it, in the tens column, which leaves me with 5 beads in that column. But now, I need to take away 5 ones, the 5 ones that are in 15. The problem is I only have 2 ones to take away, so instead, I'm going to take away a ten, but I was supposed to take away 5, so that's 5 too many. So I'm going to return 5 in the ones column, so I'm going to move 5 more beads up, 1, 2, 3, 4, 5 in the ones column. Then, I'm going to read what I have. I have 4 tens, and I have 7 ones, for an answer of 47.

SPEAKER 1: Let's take a look at slide 10 and talk about the common core state standards in specifically our kindergarten to second grade students. The common core state standards have domains, as you know, and three of them that pertain to abacus would be counting and cardinality, operations and algebraic thinking, and numbers and operations in base ten. So if you're looking to connect your IEP goals to your common core state standards, these are the three areas you're going to want to look in.

Now, in some states, you also need to use your standards for mathematical practice. And I've listed six of them here for you, which again, tie to what we've been talking about with teaching our students abacus skills. So being able to make sense of problems and preserve in solving them, so that's an important thing for our students to do. Absolutely, reasoning abstractly and quantitatively, so that's where our being able to understand the relationship between numbers and the beads come in. Construct viable arguments and critique the reasoning of others, and this is

important because our students can't just be little rote folks, they need to really understand what they're doing and how they're doing it. Being able to create models, so the abacus really lends itself to that.

Probably the one that really ties in the most to the abacus is item number five here, which is to use appropriate tools strategically. Our students really have an advantage in being able to strategically use the tool of the abacus to demonstrate their understanding of math concepts. And that idea of precision, being able to get that accurate answer.

Slide 11, let's make it fun. How can you engage your student with the abacus? Well, let's say they're learning about the seasons, that there's four of them. They can name each season and set a bead for each one. This works well for days of the weeks, months in a year. We also could have a student set a bead for every sound they hear. It works great to tie in with O&M and sound vocalizations. So let's go sit outside, set the timer for two minutes, how many sounds do you hear? You name each sound. They can set a bead for each family member they can name or student who sits at their table at school, set a bead for each goal or basket or runner out that they've made during a sporting event, for example. One of my favorites, they can figure out how many days it is to their birthday, set that number of beads, and then every day clear one, and when there's no more beads left, it's time for chocolate cake.

Slide 12, let's get into the Cranmer abacus. This was invented by Tim Cranmer. Its design is actually based on a Japanese Soroban. We have the regular and the large sizes you know. It's been modified, this abacus. And it's with tactile markings, which I'm going to show you in just a moment, and our beads do not easily roll, they're actually spherical. The Cranmer abacus really allows a student to do math computation with speed and accuracy, at the same time, they're focusing on concept development, and it's portable, and it's inexpensive. I can throw it in my backpack.

Slide 13 is a drawing of the Cranmer abacus. I want you to have this drawing because it's good to share with teaching assistants, general classroom teachers, and family members. But I'd actually to show you video and talk to you about the parts of the Cranmer abacus.

VIDEO: Let's take a look at the Cranmer abacus, developed by Tim Cranmer. This is a rectangular-shaped tool. It has a black frame around it. There's also a black bar about a third of the way down that we call the "separation bar." And it has little dots on it, and I'll talk about those in just a moment. Above the separation bar, you find one bead. Below the separation bar, you find four beads. There are 13 columns, or rods, going from right to left. And we think about this from right to left because we think about place value.

I pointed out at the beginning, that separation bar has little dots on it. Those same dots match up at the bottom, underneath all the beads. Starting from right to left, I feel the first dot, and that lets me know I'm in the ones column. I go to the left, and I feel the second dot. I'm in the tens column. I go to the left, I feel the third dot. Start to go over to the fourth column to the left, and I'm going to feel a line. Think of that as your comma. I'm separating between the hundreds and the thousands.

Now, let's talk about moving these beads. They're actually not circles, they're actually little spheres. And so, I push, I'm over in the very far right column, my units column, and I'm below the separation bar. If I push one bead up to that separation bar, we call that "setting." And so now I've set 1, or I've written the number 1. I'm going to push up another bead in that column, and I'm going to now have written the number 2, or set 2. One more bead goes up and it's set 3, I've written 3. And I'm going to set another bead, and now I have the number 4. Oh dear, I'm out of beads. How will I write 5? Very simple, gang. I'm going to clear, I'm going to take away those four beads, and now I'm going to set the 5 bead because beads above the separation bar have a value of 5. So now, I've pushed down the bead above the bar in the units column, and I've written, or set, the number 5. I'm going to go ahead and clear that 5.

Now, if I go, going from right to left, to the column next to my units column, that's my tens column. This time, I'm going to set 30. So I'm going to push 3 ten beads to the separation bar. And I've written 30. Now, I'm going to go ahead and clear 30.

Okay, in your mind, I want you to think about how would you set 61? Think for a second, 61. We always tell our tactile users to start in the tens column. So if I want to set 60, I need that 50. So I'm going to set 50, you know, push that down to the separation bar, and now set 10. And now I have 60. I'm going to go to my units column, and I'm going to set 1. Now I have set 61. Always want your students to clear, so I'm going to go ahead and clear 61. So I'm pushing the beads back where they came from.

SPEAKER 1: Slide 14, "Considerations for Abacus Instruction." When do you actually start? Well, one of the first things you need to think about is your student's age, and where are they in their instruction? What's going on in the, the math curriculum, and are they at a point where they're ready for that level of instruction that then would tie to things they need to do on the abacus, like writing numbers? Well, we can set those with the abacus. You want to teach your students a part of the abacus, and they need to be able to name those parts. So you need a student who conceptually understands that, and of course, the idea of setting and clearing.

You want to make sure you teach your students proper fingering techniques. So we're going to set beads below the bar with our thumb, above the bar with our index finger, and then we clear beads with our index finger. Clearing is really important. The student must clear all the beads before they set the next problem. You really want to instill that right from the get go.

Our students need to have experience, both with the abacus and the braillewriter, so they can show the steps to give evidence they understand the concepts. Now, we all know that those general ed math teachers, and rightfully so, are going to have times when they want the student to be able to show the work. We need to make sure our students can do the problems on the braillewriter as well on the abacus so they can show evidence.

I just also want to point out, as students get into more advanced math, let's say polynomials in, in middle school level, they're not going to have to do those on the abacus, so they're going to need to know how to do them on their braillewriter. And here's an issue for us as adults. We all learn how to use the abacus, whether through a university program or through a colleague or even a

student, so we know a method, but there are more than one method out there. And you're going to see that in just a moment. We're actually going to look at three methods.

Don't get caught up in the method and try and make all your students fit the method. Different students have different learning styles, and they need a method that works for their learning style. So you need to get familiar with all the methods, and you need to be flexible so that your student gets what they need.

Slide 15 talks about promoting student success with the abacus. First, you want the student to place the abacus on a hard surface, such as a table. For many students, the abacus may slide around, so you might want to use Dycem or rubber shelf liner. The abacus should be about six inches from the student. The single row of beads, the ones with a value of 5, should be as far away from the student. The beads where there's four below the separation line should be closest to the students.

Now, if you're supporting a student in abacus instruction, you want to sit next to that student, and you want to have your own abacus too so that you're working alongside each other. And it's important that you sit next to the student so that you don't get tongue tied trying to flip things around with reversals because, you know, the ones aren't going to look like they're the ones to you if you're sitting across from the student.

Slide 16 is the counting method, so we're going to get into our three methods. Two books that are helpful to you, Abacus Basic Competency: A Counting Method by Susan Millaway and The Counting Method for the Cranmer Abacus by Deborah Sewell and John Rose. So you want to have one of these, or if not both of these books, in your library. Counting is comparable to the method used with young sighted children, so in that sense, it works well for our students because it kind of goes along with what's happening in the classroom because it relies on exchanges, which are very similar to the idea of regrouping. And our students can build their speed with the counting method.

Now, what I'm going to do for the counting method and then for our next two methods is I'm going to have a demonstration for you of the same math problem, 64 + 28, and first you're going to see it on the expanded beginner abacus and then on the Cranmer abacus. Let's watch that video.

SPEAKER 2: For the counting method, we will continue adding one bead at a time by moving it up, and we'll count one more each time we move up a bead. Once we get to the ones column, we will get to a point where we have 9 in that column and still need to add, so we'll have to do an exchange from 9 to 10, and then we'll have to keep adding in the ones column until we have added 8.

Let's look at this particular problem, 64 + 28. So I'm going to put 10, 20, 30, 40, 50, 60 in the tens column and 4-- 1, 2, 3, 4-- in the ones column. So I've got 64 set. Now to add 28, I'm going to add two tens, and then I'm going to add 8 ones. So each time I move a bead up, I'm going to make sure that I add 1, and when I get up to 9, I'm going to exchange that for a 10. So in the ones column, 1 up, 2 up, 3 up, 4 up, 5 up, exchange, 6, 7 up, 8 up. Now, notice I have an answer of 92.

Let's look at the same problem on the Cranmer abacus. On this abacus, there is a bead with a value of 5 above the separation bar. For the counting method, we will continue adding one bead at a time as we move it towards the separation bar. Once we get to that ones column again, we will have to do a couple of exchanges. When I get to 4 and have to add 1, then that's going to become 5, so I'm going to move that 5 bead down as I clear below it, and that's how I'm going to go from 4 to 5. When I get to 9, which means all of the beads are towards that separation bar, and have to add 1 more, I now will add 1 in the tens column and clear out the 9, so now that reads as 10, 1 ten and 0 ones. So, I'll have to do two exchanges using the Cranmer abacus.

So let's do the problem. I'm going to start out by setting it again. So, remember, we're doing 64 + 28. So I'm going to start by setting 6 tens, that's a 5 and a 1 in the tens column towards that separation bar, and then 4 ones. So the counting method says, in that tens column I'm going to go ahead and add 2 tens. Easy enough. Now, in the ones column, I need to add 8 ones. I don't have any 1s down below the separation bar, so I'm going to go up to that 5 bead, bring it down, and clear below it. That's my 4, 5 exchange. So I've added 1, now I'm going to continue adding in that one's column. 2 up, 3 up, 4 up, 5 up, and my sixth one that I'm going to add is going to come from that tens column as I clear the ones, and then 7 up, 8 up in that ones column. So now I have 2 in the ones column and 9 in the tens column. That's going to be 92.

SPEAKER 1: Okay, so you got to see the counting method. Let's move on, now, on slide 17 and talk about the logic or partner method. A book for this is the Use of the Cranmer Abacus by Rita Livingston. This method really focuses on the value of the bead, so it's not a rote method, it's a really value-driven method. So what we're talking about are the logic or partners. And so, what we want the student to do is to learn the combinations of numbers and what we call synthesis.

This method is not going to parallel what's in the general education curriculum, so that's going to make it challenging for some students because they're going to be hearing one thing in math class and then another thing from you. What's good about this method is once students lock in to the idea of partners, they're going to start to come up with their own methods for taking little shortcuts.

Now, slide 18 talks about how to prepare your student to use the logic method. They have to know there are complements or partners that make up their numbers through 10. So for example, if I take the number 7, there's lots of different ways I can make 7: 0 + 7, 1 + 6, 2 + 5. So I have to learn to balance or equate what is seven-ness, and I have to be able to do this for all digits up to 10.

Now, what I'd like to do is I'd like to show you the same math problem you saw with the counting method being done with the logic or partner method, using the expanded beginner abacus and the Cranmer abacus. So let's take a look.

SPEAKER 2: Now, we'll look at the same problem using the logic method. So again, I'm going to set 64 on the abacus. This time, I know that I need to add my 2 tens, so we'll go ahead and do that, but now I need to add 8 ones, and I only have 5 ones there. So the logic method says, if I don't have enough in the ones column to add, I'm going to add a ten. But I was supposed to add

8, so to compensate I'm going to move 2 beads away because I added 2 beads too many. And notice, I have the same answer of 92.

So again, I'm going to do 64 + 28. 6 tens and 4 ones, so 64 I have set on the abacus. Again, I'm going to add 28. So I'll add my 2 tens, but now I need to add 8 ones. And the problem is I only have 4 in that column. I would only be able to add 5 more. So what I'm going to do instead is I'm going to add 10. The problem is that's 2 too many because I needed to add 8, so I'm going to take 2 away. Again, that gives me an answer of 92 because I have 5, 6, 7, 8, 9 in the tens column and 2 in the ones column.

SPEAKER 1: So you learned about the logic partner method. Now on slide 19, let's talk about the paper compatible method. So if you have the Handbook for Itinerant and Resource Teachers of Blind and Visually Impaired Students by Doris Willoughby and Sharon Duffy, there's information about this method. This method is less used, but what's nice about it is that it's similar to paper and pencil method, or the algorithm method, that's used in the classroom, typically starting around fourth grade. But our student really needs to have their basic facts down. They also need to be one of these students who can do mental math because you're going to be using mental math a lot with this method. Let's again watch the same two examples, one using the expanded beginner abacus and the other with the Cranmer abacus, of 64 + 28 and see how the problem is done with the paper compatible method.

SPEAKER 2: Lastly, we will use the paper compatible method. So I'm going to start again by setting 64 on the abacus. I'm going to go ahead and add 2 to my 6, which is going to make it 8. Now, I have 4, and I need to add 8 ones to that one's column. So 4 + 8 in my head is 12, so I'm going to clear out the ones column and put the 2 for 12, and then I'm going to add a ten, and notice I get the same answer of 92. So I got that 12, carried that 1, and that gave me the same answer of 92.

So I'm going to go ahead and set the 64. Now, to add the 28, I'm going to add my 2 tens. Now, to add 8 ones, again, I'm going to use my head to do that. So right now, I have 4 ones. I need to add 8 ones. So that's going to give me 12 ones. So I'm going to, that 12 is a ten and 2 ones, so I'm going to add a ten and then change my ones to 2. And I still get an answer of 92.

SPEAKER 1: So you got to see three methods of how to do computation with a Cranmer abacus. I'd like to go into slide 20 and talk about evaluating student skills. Now, our two tools, both from the Texas School for the Blind and Visually Impaired, one is called EVALS and the other one is the Assessment Kit. The Assessment Kit is older, so you may or may not be able to get your hands on it, but both tools have checklists for abacus skills. So if you're trying to work on an IEP and you're really thinking about, what are we going to focus on in the next six months, in the next year, going to one of these checklists and going through it with your student will help you make a determination about where we're going.

Slide 21 gets into multiplication and division. Now, in order for a student to be able to multiply or divide, they must know their multiplication tables, and they must have the ability to set and read numbers. If your student doesn't have these two things down really solidly, multiplication and division on the abacus is not going to work.

For multiplication, students need knowledge of terms used in multiplication. The multiplicand, the product, so we want to make sure that they know their terms, and they also need to know their rules of addition because we use additions within multiplication. For division, they want to know their terms, such as the divisor, or quotient, or dividend, and they must know their rules for subtraction. We don't have time to look at some videos around multiplication and division, so we direct you to Sara Larkin's website.

Slide 22 talks about a tool that gets really handy when we're getting into more advanced math, and that is the couplar. The couplar links to Cranmer abaci together. It's a metal piece, and it's used for students to work with larger numbers or to extend the number of decimal places in which the division can be carried out. So this is a tool that, probably by the time your student is in about fourth or fifth grade, you really want them using to connect their abaci together, shown in the picture.

Slide 23, so if we think about the abacus from beginning to end, we obviously are going to be doing counting, our basic four computations, decimals and monies, fractions, percents, moving then to greater common factor, square roots that don't result in a decimal, adding and subtracting integers, prime factorization, several of these skills are covered in the Abacus Made Easy and Use of the Cranmer Abacus books, so two resources where you can go to for more instruction. An additional resource for prime factorization are two videos that Susan Osterhaus has made that are on the Texas School for the Blind and Visually Impaired website.

Slide 25 talks about an APH position paper, which is "Appendix D: The Use of an Abacus in Test-Taking Situations." And we really appreciate this quote. "Whenever a test taker is allowed to use a pencil and paper for working calculations, an abacus should be considered an equivalent substitution." So as you're advocating for your students for district level testing, state or provincial level testing, high stakes testing like the SATs or ACTs, you really want to advocate that your student has every right to use an abacus the same way that typically sighted peers use paper and pencil. So they get to have scrap paper, your student gets to have a scrap abacus.

And it's really important to help administrators understand this because our students are entitled to have access to a tool that's going to allow them to view computation. The abacus does not work as a calculator, it's the person behind the abacus who does the computation. So I hope we've been able to give you some ideas that you can apply to your own work with students with visual impairments in the elementary grades. Thank you.