Jacqueline Stewart and Elizabeth Phillips,
Connected Mathematics Project.

Transcript for March 8 – 9, 2007

"Writing Equivalent Expressions:
Say it with Symbols, Making Sense of Symbols, 1.1"

The class is seen working on Investigation 1.1,
"Equivalent Expressions"

The video was shot in real time and edited from 1.5 days,
Approximately 1.5 hours, to 27 minutes.

Say It With Symbols, Investigation 1
Class: 8th Grade
Date: March 8 – 9, 2007

Chapter 1: Intro to Problem 1.1
Approximate time 00 – 2:17 (Times from start of video)

Slide:
Title slide

Slide:
Launch
Real Time: 4 minutes

Line 1, 00:19 T: In the first problem we're gonna focus on equivalent expressions and in Frogs, Fleas and Painted Cubes we spent a lot of time on equivalent expressions or equations. actually most of us were calling em then.umm for example If this was the expression that I have could you write one that was equivalent to that?

Class: Yes

T: Ellie

Line 10, 00:49 Ellie: umm Do you want it in like expanded form?

T: Sure

Ellie: umm X squared + 2x + 3x + 6

T: Are those equivalent?

Class: Yes

T: Yea those would be two equivalent expressions. So in problem 1.1 that's the idea I want you to have in your head. That there might be more than 1 way to write about a situation. and they can be equivalent and they are gonna tell us something different. If
Line 20, 1:16 this was the expression and it was looking at the rectangles in the last unit what would this tell me about the rectangles?

S (unidentified): The length and width

T: The length and width of the rectangles.

T: and what would this tell me?

S(unidentified): area

T: Area..?

S(unidentified): of each piece.

T: Of each individual piece inside it yup. So they
Line 30, 1:36 tell me slightly different things even though they are equivalent in telling me the area of the whole thing. So when you're looking at the problem today I want you to kind of keep that as a kind of background in your mind. That there's more than 1 way to write about a situation and it'll just tell me something slightly different. Today's problem it involved the Custom Pool Company What I want you to think about is at the Custom Pool Co. If somebody calls and they say the size of my hot tub or the size of my pool is

Line 40, 2:12 blah blah blah blah square how can the Custom Pool Co. quickly calculate how many border tiles that person would need?

Slide:
Showing Problem 1.1

Chapter 2: Logan's Group Has a Disagreement About Part B.
Approximate time 2:18 – 3:44 (Times from start of video)

Slide:
Explore
Real Time: 18 minutes

Line 1, 2:29 Logan: We're thinking its x times 4 plus 4.

T: How come?

Logan: Because you're gonna times whatever number they say for that by 4 and then you have to add 4 for the corners.

T: Does that work?

David: Yea

T: Then in the second one it says, "Can you write a different equivalent expression? Is there another way
Line 10, 2:53 you could think about these border tiles?

John: umm You could uhh Say like S times 2 times 2 like if you had s times 2 in parentheses and then times two and then plus 4.

Logan: Ohh I see what you're saying so like parentheses x times 2 Yea its the same. Wait no its not.

David: Yea it is.

Logan: No its not. The first two are the same. The rest of them aren't

David: Wasn't that 16, it was 40 and 16.

Line 20, 3:38 Logan: That's so... That one doesn't work

David: Maybe without the parentheses.

T: I'll let you guys work on that one

Chapter 3: Audrey's Group Has a Different Solution
Approximate times 3:38 – 4:29 (Times from start of video)

Line 1, 3:45 Audrey: Because s is the length of the square umm and so it'd be times 4 to get all these and then plus 4 because the corners cause you won't the corners if you just do s times 4.

T: ohh ok then you're adding the four corners

Audrey: Right, so then you could just shorten it and go s plus 1 in parentheses and then times 4
[(s + 1)4]
because then you could go that's s plu-- that's s plus 1 right there then there s plus 1 right there
Line 10, 4:16 then there's s plus 1 right there and there's s plus 1 right there.

T: ohhh your s plus 1 is a side with a corner.

Audrey: so you get em all ... yea

T: I see and then you have 4 of them.

S: Yea

T: I'm getting it.

T: Interesting.

Chapter 4: One Student Helps another to Correct a Solution
Approximate time 4:29 – 5:59 (Times from start of video)

Line 1, 4:30 Megan: Then you'd have to double that to get all the sides and then add the four corners.

T: Is that what you guys have?

Megan: Yup

T: So let me see if I got you right. You're saying s times s so you're saying 3 times 3 and then times 2 plus 4. so there would be 22 on that one?

Megan: No

Line 10, 4:59 T: Why were you doing 3 times 3 can you say that again? Cause I didn't follow it.

Megan: That'd work for the 2 though.

[slide showing student work]
T: But there's something to do you're saying with these side lengths.

Megan: Right.

T: And that you have... whatever you have here you also have there.

Megan: Right

T: So you're saying there's something

T: with those that might help you.

Line 20, 5:17 Megan: mhmm

T: Do you have any ideas Chelsea?

Chelsea: I think it would be like 3 plus 3 and then times that by two because you're doing the 3 on the side. *[(3 + 3)2 + 4]*

Megan: So it would be s plus s times 2 plus 4.

Chelsea: Yea... Yea.

T: Oh so you're adding those two.

Chelsea: Uh- Huh

T: And then why are you multiplying it by two?

Line 30, 5:40 Chelsea: Because then you have the two other sides.

T: So that would get all four of your sides.

Chelsea: Yea.

T: And then why the plus 4?

Chelsea: Cause you have the four corners.

T: Ohhh...

Megan: That would work.

T: Does it work on this one too?

Megan: mhm...

T: So you got one?

Chapter 5: A Student Is Struggling to Find a Solution
Approximate time 5:59 – 7:50 (Times from start of video)

Line 1, 6:00 T: Does this one work?

Elle: I'm thinking probably not.

T: Let's try it. If it's two, you're saying two squared plus four times two plus one times two, and what's N. Is that the S also?

Elle: Like, I want to know S, it's like, it's the number of border tiles - T: Oh, so it's going to equal N.
Elle: Yeah.
[Table showing what Ellie is trying: $N = s^2 + 4s + s$]

Line 10, 6:25 T: I gotcha now. So does that one work? So two squared is four - nineteen. So did that work?

Elle: No.
T: No.
So they're not working.

T: So I would agree that there are four sides, but I don't think it's included all of the border tiles.

Elle: Unh uh, 'cause then there's still four left.

T: So how could I take what you were saying, the side plus four, and include those corners?

Line 20, 6:57 Elle: Ummmm, maybe to, oh, no -

T: Since we know these didn't work, but you started with the fact that you had four sides. Now what do we need?

Elle: Uh, the, the corners.

T: So how can I write that into the equation?

Elle: Um, maybe you can like, um, put it as a second power.

T: Try that. John, do you have any ideas?

Jon: No. I don't. I'm lost.

Line 30, 7:28 T: Well, Elle is saying there are four sides of border tile -
Elle: So it'd be four S -

T: And there are four corners -

Elle: Four S -
T: So how could that be?

Elle: Four S to the second power.

T: Would that work?

Elle: Maybe.

Line 40, 7:44 T: Well, the side squared - if this one was two – the side squared would be four times four is sixteen,but we needed twelve.

Chapter 6: A Group Has Two Equivalent Expressions
Approximate time 7:51 – 8:50 (Times from start of video)

Line 1, 7:51

T: I haven't talked to you guys. What have you guys found? Tell me about the equations you've found.

Paul: We didn't - we wrote P equals and then like, uh, parenthesis L plus one parenthesis plus four.
[Student notebook showing 2 equations N = (L + 1)4 and N = (L•4(+ 4]
T: What's the L plus one?

Paul: The length of the...
Kayla: The length by adding one, 'cause you gotta have the length of the original pool plus one and you times that by four.

Line 10, 8:13

T: So the length -

Kayla: The length of the pool -
T: Of the pool - oh, and then a corner -

Kayla and Paul: Yup.
Kayla: And then times it by four.

T: And there'd be four groups of that. Okay.

Kayla: And the second one is - you've got the original length of the pool, and then you add four.

T: Say that again.

Kayla: You've got the original length of the pool -

Line 20, 8:32

T: Oh, you've got four of those -
Kayla: And you times it, times it by four,

Kayla: and then you add four pieces.
T: And then the four pieces on the corners.

T:Ooooh. And you've proven that they are equivalent?

Kayla: Um hmmm.

T: How did you prove they were equivalent?

Paul: Used the calculator -

Kayla: Um, put'em into the calculator and when we
Line 30, 8:46 pulled up the table then they're the exact same numbers.

T: Same numbers. Very cool.

Paul: Yup.

Chapter 7: Megan's Group Has Two equivalent Expressions
Approximate Times 8:51 – 10:08 (Times from start of video)

Line 1, 8:52

T: Megan, what'd you guys come up with?

Megan: Um, we came up with S, er, S times four plus four would be the same thing, because -
[s•4 + 4]
T: How do you know that works?

Megan: If you do - for the S plus S times two -

S(unidentified): Wait. What was it? S -

Megan: S plus X plus two, er, times two plus one,'cause if you do three plus three, that's six. And then if you do six times two it'd be twelve, and

Line 10, 9:25

S(unidentified): You put in for –

Megan: You'd get the four corners. Yeah.
[(s + s)•2 + 4]

Megan: And then if you do the, um, four sides, you do the four sides -

T: Okay.
Megan: Plus the four corners, that's sixteen and that's the whole wall.
[(s + s)•2 + 4
s•4 + 4]

T: Oh, that's what this one is? The four sides and the four corners?

Line 20, 9:38

Megan: Yeah.
T: Oooh.

Megan: And here you're just taking that - you don't have to do the actual stuff by doing that. It's just three four times, that's twelve, and then you add the four corners, which is sixteen.

T: So if you were putting it on here, how were you going to prove to me that they were equivalent?

S(unidentified): By the table.

T: And how could the tables tell you?

Line 30, 9:58

S (unidentified): The exact same thing.

T: And have you checked that or you're just starting to?

S(unidentified: No.
Megan: Yeah. It's right here.

T: Oh, you have it. And you have it too, Daryl?

Megan: It's the exact same.

Chapter 8: Summary Starts, Ellie Proposes a Solution
Approximate times 10:09 – 13:14 (Times from start of video)

Slide:
Summary
Real time: 20 minutes

Line 1, 10:19 T: And why does that work?

Elle: Um, because you take, like, whatever your side length is, and then you times it by four, because that's how many sides there are, because that's a square, you know, and then you just, you have like the four corners left because they're included in the sides and so you gotta add the four.

T: What do other people think about that? Audrey?

Audrey: I can explain that.

Line 10, 10:43 T: Okay.

Audrey: Okay. Um, the X times four represents, uh, getting the number of tiles around just the side, and then the plus four gets the corners because when you do S, X times four you only get these, and then you'll have four left so you have to count those four corners. Then you do X times four to get these but then you have the four corners left because it doesn't come with the X times four, so then you gotta plus a four onto it to get these, then you've
Line 20, 11:30 got them all.

S (unidentified): Plus a four onto whatever the length times four is.

Audrey: Yeah.

T: Heather?

Heather: Um, I get what you're saying, but I don't understand how she got her equation.

S (unidentified): Oh, yes.

Heather: Um, it should be just X times four plus four because if you do the four X that's changing it.
Line 30, 11:48 Four doesn't match up?

S(unidentified): Oh, that's what you mean.

T: So -
Audrey: Yeah. It'd just be four. Yea it...
Audrey: There shouldn't be an X there, 'cause otherwise that'd mean -

Josh: Everytime you're times you timesing -
S (unidentified): Yeah.
Josh: It's quadratic.

T: Josh, if we had another X there it'd be
Line 40, 12:06 quadratic and you don't think this is quadratic.

Josh: No, it's not.

Audrey: No, it's linear, because everytime it goes up you're just adding four, because if this was a three by three, then you'd just add another, you'd add, you'd be adding four.

T: Why are you adding four every time?

Audrey: Because there's four corners.

Heather: There's four sides and each one gets another one.

Line 50, 12:26 Audrey: Yeah. There's four sides and you always add one. So if there was four before, on each side, and you add one, then there'd be five on each side, and so it would just be four more.

S: It'd be going up by four.
Audrey: Yeah.

T: So when Josh said it wasn't quadratic, you said, you were saying that because you knew, you thought it was linear.

Josh: No. I'm saying 'cause before she had the four
Line 60, 12:44 uh, X times four X -

T: And you didn't think it should be quadratic?

Josh. No, I didn't.

Paul: Good thinking.

Josh: Thank you.

Audrey: It wouldn't, it wouldn't make sense for it to be quadratic -

T: Because?

Audrey: Because it's not gonna go up to say, tenths,
ten, uh, squares on each side and then just go down
Line 70, 13:07 to nine and then eight -

T: So it's not going to go up to something and come down, you're saying -
Audrey: Yeah.

T: So quadratic doesn't make sense.

Chapter 9: Heather Proposes a Different Solution
Approximate times 13:15 – 14:49 (Times from start of video)

Line 1, 13:16 T: Does somebody have another expression that's equivalent to that and can prove it to us? Heather.

Heather: Um, thank you. You would do that because if you had your square, then you had your border around it - it's really bad - yeah, I know, it's cool.

T: I'm so glad I left the one on the overhead and no one likes to use it.

Heather: These, these are your X's here, your sides.
Line 10, 13:52 And you can't just do X times X 'cause then you'll get the area of your pool. And so you have to do X times two 'cause you have to do the opposite side which is the same length, and then you do the other X times two, and then you have to add them together so you can get the whole outside of the lengths, and then you have to add four because there's four corners.

Logan: What we did differently was we said it was, it's two X times two plus four.
[2x•2 + 4]
Line 20, 14:18 S(unidentified): That'll, that works, 'cause it's like the same exact thing as that one.

S1(unidentified): You just added those two together
Logan: How does that work?

S (unidentified): You're just splitting the times four in half.

T: Where?

Alyssa: For that one over there.

T: You're splitting the times four in half? Where?

Heather: No. What we - what they did there is they
Line 30, 14:37 took the four sides at once and multiplied them. We just took the two sets of sides

Class: Ooooh. [Unintelligible]
T: Ooooh.

Audrey: Would that, wouldn't, would that work when it's a rectangle? That'd work when it was a rectangle?

T: But you don't think it'll work as a square?

S: No. It works as a square too.
T: Oh.

Chapter 10: Ellie Proposes Another Solution
Approximate Times 14:49 - 16:34 (Times from start of video)

[Ellie goes to the board]
T: Two X times two plus two. What were you thinking when you wrote that? Can you help us to understand it?

Elle: Yeah... plus two... probably not right.

T: Well –

Ellie: No I don't mean plus 4

T: Help us out. Tell us what you were thinking and we'll decide if we agree with you.

Class: I don't agree. No, I don't agree.

T: Well, Elle, tell us what you were thinking and maybe we can fix it.

Elle: Well, I was thinking, um, uh, um, if you took just like two of the sides, and then you like - I don't know.

T: You know what I'm confused about? I'm looking up here, and I see a bunch of you guys using your calculators. How are you using your calculator to decide if you agree or disagree with Elle?

S: We're using the Y= and then, um, started graphing it and looked at the table.

T: So if you graph it or table it, how does that help you to know if Elle's is correct?

Class comments: [Unintelligible]

T: So, because we're convinced Elle's first one works, and we're convinced now that Heather's works, you're checking against those in your calculator?

Class: Yes, yeah.
T: That's what your saying? Okay, now I understand.

[Logan goes to the board]

T: Now explain to me why you think that works.

Logan: 'Cause then you're adding - you still - you still add in these four and then you add it.

T: So the plus four is the corners, but I don't understand what the two X times two is.

Logan: The two X is showing like that and that, the two, the two sides, and then you're just multiplying, getting that by two so you get that one and that one -
T: Two sets of that.

Logan: And then you just add the four.

Chapter 11: Megan Proposes Another Solution
Approximate Times 16:34 – 17:42 (Times from start of video)

Line 1, 16:44 T: Tell us why this one works.

Megan: 'Cause if you have the S plus S you're taking the three here and you're adding three here, and you're timesing it by two and then you're adding the four corners.

Class: Yup. Yeah. Good job.

Alyssa: I said it's the same thing as mine.

T: How is it the same thing as yours?

Alyssa: Because we, we put, um, length times width
Line 10, 17:32 on, and then divided by two plus four.

T: Well, instead of saying side plus side you called them length plus width.
Alyssa: Yeah.

T: Are those all of them?

Chapter 12: Kaylie Proposes Another Solution
Approximate Times 17:41 – 18:40 (Times from start of video)

Line 1, 17:41 Kayla: Um, you've got, um, do this one - um, you've got the side length is X,
[*computer graphic]*
and then, um, you want to add one, so that gets you the corner, [and then you times that by the four to get all four corners.
[*computer graphic]*

T: Hailey's question.

Hailey: Well, when, okay, wouldn't it - if you did that side length if you did this length here and then you added the corner, wouldn't you run out of corners
Line 10, 18:13 to add?

Class comments: No. [Unintelligible] You've got corners on four sides.

S: 'Cause you don't, There's 4 and 4 Hailey, they match up perfectly.

T: You can draw right on the overhead if you need to, Kayla and Hailey.

Kayla: Okay. So you've got this first, first set here, and you want to get all that plus the corner. That takes that. Then you've got this plus that
Line 20, 18:36 corner, that plus that corner, that plus that corner.

Hailey: Oooh..

Chapter 13: Ellie Wonders if Two Equations Are the Same
Approximate Times 18:40 – 19:23 (Times from start of video)

Line 1, 18:42 Ellie: Would it change the equation if you just kind of like if you took my first one for example like if you did x plus 4 times 4 like would that change it at all.

T: Try it

S(unidentified): It doesn't work.

T: So you tried X plus four times four?

Elle: Yeah.

T: Why wouldn't that work?

Line 10, 19:02 Elle: I don't know. Well, I graphed like, the regular one and it ended up like normal on that, and then the other way kind of ...

T: So the graphs were not the same.

Heather: That's why it's not working.

T: You're timesing the plus four also the way Elle said it?

T: So you have to do the multiplication before you do the addition.

Heather: Yeah.

Chapter 14: Audrey Proposes y = 2(x + 2) + 2x
Approximate Times 19:24 – 20:02 (Times from start of video)

Line 1, 19:26 Audrey: That one is crazy.
T: I think you're right, Elle.

T: That one's crazy? Tell us about it
Audrey: Yeah.

Audrey: Okay. Um, well first, the X plus two, um, would get me this and these two corners, so it would be like that, and then you'd times it by two, so then you'd get this one also, and then you'd do X times two which would get you these two, and then you get
Line 10, 19:58 it.

S(unidentified): add the four corners.

Audrey: No, you wouldn't need to get a corner.

S(unidentified): 'Cause she already got'em in the ...

Audrey: Yeah.

Chapter 15: John Thinks There Are An Infinite Number
Approximate Times 20:03 - 21:26 (Times from start of video)

Line 1, 20:04 T: Do you think there are more?

Class: No. Yeah, probably.

T: John thinks he might have another one.

John: There is an infinite amount that you can do.

T: There's what?

John: There's an infinite amount because –

T: Why?

John: You can do basically four times any number and get the answer and then you can do that answer times
Line 10, 20:26 X and then divide it by what you timesed your four by and then add a four.

T: Could you show what you were saying up here because I got lost when you said divide.

S: Huh? We're dividing?

John: Well, I won't really be able to draw it as a square but -

John: So, you could basically do like sixteen X divided by four plus four, because four times four equals sixteen.

Line 20, 20:57 Class: Whoa. Okay. That's pretty sweet.

John: You could even do like thirty-two X divided by eight plus four, because four times eight equals thirty-two.

S: And then you could just keep going.

John: Yeah.
S: Divide by -

T: Try it. Does that work?

Class: Yeah, yup.

T: How, how can I test it to see, 'cause John said
Line 30, 21:19 it'd be hard to draw a picture of that, so how can I test it to see if his idea's okay. Let's try graphing and tabling those.

Chapter 16: The Summary Continues the Next Day
Approximate times 21:26- 25:00 (Times from start of video)

Slide
The next day the teacher feels there are more issues that have not reached closure from the day before.

Line 1, 21:38 T: So, so the top equation is MX plus B. Are the rest linear equations?

S(unidentified): Yup

S(unidentified): And they're all equivalent because - and they are equivalent 'cause like, they're - they just are show flipped them down.

T: So if I recognize the situation is linear, I don't necessarily have to use MX plus B, you're saying. I can use all of those other representations
Line 10, 21:20 and they'll still show that it's linear. How are you convinced that those are all equivalent? What would you look - if we had another equation that we hadn't see yet, how would you know whether it was going to be equivalent to all of those?

S(unidentified): Put it in the Y equals and then check it.

T: So you could on your table and graph and what do you look for?

S(unidentified): The - to see that same number come

Line 20, 22:33 up.

S(unidentified): The Y. See if the Y's are all the same.

T: Oh, the two tables - if they're all the same.

S: Then on the graph you see if like the lines are - if they're equal.

T: If the lines are the same. Any other way you would know whether these are equivalent? What if you didn't have your calculator?

Josh: If you just look at the equation you could
Line 30, 22:56 see, uh, if, just see if, um, the equation needs to have four X plus four.

T: How can you tell that just from the equation, if it has four X and four more?

Josh: Uh, like, two X times two, that'd be four X and you have to plus four.

T: This one. So you're saying you could prove it's equivalent because you could turn this into four X plus four,'cause two X times two gives you this part?

Josh: Yeah.

Line 40, 23:22 T: Could this one be turned into four X plus four?

Class: Yeah.

T: That one's nasty looking. How do you get four X plus four out of that?

Class comments: [Unintelligible]

T: I think somebody's gotta show this one to me, 'cause I'm not seeing that.

John: You can take this, X plus two, so when you times that by two you get two X plus 4, if you
Line 50, 23:51 multiply all this stuff by two, by two, and then with this you have two X and you [01:23:55;02] can join these together to get four X plus four.

T: Aaaah. Is that what you were saying, Hailey, something like that?

Hailey: Yeah. I just, you know, like, change like to.. the numbers... to...

T: So maybe there is a way to make all of these four X plus four. Why don't you look at the rest of them with your group and see if you can make the rest of
Line 60, 24:16 them four X plus four.

Elle: We don't have to do it to the divided ones, do we?

T: Could you?

Elle: No. I don't -

T: If you did sixteen -

Elle: Sixteen divided by four is four, so it'd be four X plus - oh, I get it.

T: She's got it.

T: How about the next one? And you said really these
Line 70, 24:41 were the same thing, 'cause it's a square. Will this one become four X plus four?

Brittany: All you're doing is adding these two together and you get four.

S(unidentified): Love your X.

Jon: Oh, yeah.

Brittany: And here's your four, so you're adding four.

Jon: She Just proved me wrong.

T: Oh, because you're adding these, and not
Line 80, 25:00 multiplying them.

Chapter 17: The Teacher's Reflection
Approximate Times 25:00 - end (Times from the start of the video)

[No transcript available.]