Discovering Patterns and Relationships

Making hypotheses

David G.: There’s always 3 less struts than there are sides.

Teacher: Tell them about the theory you wrote in your journal.

David G.: Since there’s 3 less struts for each shape, then I think there would be-
Like, if you have 369 sides you might have 123 struts, because you divide it by
3...[369 ÷ 3 = 123; seems dissatisfied with answer]. I don't know. I keep
changing my theory.

Teacher: I know. Well, let’s talk about this. We’ve noticed that we’re always 3
less struts then number of sides for polygons with 4 to 8 sides. So, David’s theory
was, if I had a figure of 369 sides, how many struts would I use? He suggested
maybe to divide by 3. He’s not sure if that’s right or not. What do you think?

David G.: I think maybe divide by 2.

Teacher: So if you had a 100-sided figure-

David G.: You’d have 50 struts.

Teacher: Does someone have another idea?

Involving students. Idea being considered not the student

Cole: I think you’d probably have 97 (number of struts for a 100-sided figure).

Teacher: Why?

Cole: Because there’s always 3 less struts than the number of sides.

Teacher: OK. Let’s go back to David for a minute. What was your thinking when
you said divide by 2?

David G.: With 6 sides you have 3 struts, so 6 divided by 2 is 3. And 4 sides
divided by 1 strut is...no. Certain numbers...certain even numbers can be divided
to equal the struts. Like 4 ÷ 4 = 1, 6 ÷ 2 = 3, um...

Teacher: So you were looking for some kind of pattern.

Lauren: Maybe it has something to do with certain even numbers.

David G.: Whatever you can divide the number into, I think. If you put 5 into 100,
that’s 20 times. And there’s 2 struts in each 5, so there ought to be a total of 40
struts.
Teacher: He’s revised his theory. Now he thinks it’s 40 struts. What do you people think of that idea, or does someone have another idea about the number of struts for a 100-sided figure?

Revising theory.

Richie: I think it’s 97, because it’s minus 3 on the other shapes.

Cole: He said it’s half, right [6 sides divided in half = 3 struts]?

Teacher: Yes.

Cole: But look at 4. That’s not half [4 has only 1 strut, not 2]. Does that mean if it’s 10, it should be 5 struts?

Teacher: According to his theory, yes.

Cole: But I think it’s just 3 less.

Teacher: Someone say some more about this whole business…

Brandi: I think it’s 3 less, because on the 8 it’s 3 less, and 7 it’s 3 less.

{NOTE: what we learn about how our students learn things helps us reshape how we see things}

Debating the number of struts

Teacher: Let’s go back to David again, since he’s the person who stirred up this conversation.

David G.: I think maybe what you do is subtract 3 off of each number. Like, 5,637 you might have 2,304 struts. (He subtracts 5,637 – 3,333 = 2,304; he is attracted to the “less 3 theory” and applies it to a larger number in this way.)

Teacher: So you agree with subtracting 3, but you think you ought to subtract 3 from every number. This is a new theory. Who would like to talk about this theory, or another one? This is a great conversation.

Leslie: I still think it’s take away 3, so it would be 5,634.

Teacher: Why wouldn’t you take away 3 from all the numbers?

Leslie: (long pause) I don’t know.
**Teacher:** David, why did you subtract 3 from every number? What was your rationale for that?

**David G.:** Well, see, when you get a high number, such as 5,637, it would be kind of strange to just subtract 3, instead of 3,333.

**Crystal:** When you had 4 sides and 1 strut, you only took away 3. But when you have 5, 637, you’re taking away a thousand, and some other stuff, so you’re taking away too much.

**Derek:** If you take away 3 from every number, then if you do that for 100, it wouldn’t be 97, it would be some other number…

**Teacher:** Yes, David, with your theory, how would we take away 3 from every number if we had 100 sides?

**David G.:** You should only take away 33 (not 333). So it would be 67 struts.

**Cole:** David, you keep changing your hypothesis about everything. It sounds like you’re really not sure about which one it is.

**David G.:** Every time somebody else says something it gives [me] some other idea that one [theory] might be wrong, but this other one might be right…

**Brandon:** I don’t understand the whole…all right, this is what I heard. When you have a large amount of sides, some people say it’s 3 less. I don’t understand that because why can’t there be the same amount of struts as the sides? I don’t understand.

(We look at his figures and note 4 sides = 1 strut, 5 sides = 2 struts, etc.)

**Teacher:** So, you’re asking if it’s ever possible to have the same number of struts as sides. Maybe someone can answer that.

**Brandi:** I want to know how we’re going to know which one is right?

**Teacher:** That’s probably what I’d ask you?

**Jennifer:** Make it [i.e., a 100-sided polygon].

**Teacher:** Yes, one way is to make a 100-sided figure. Maybe there is a simpler way…

**David G.:** For that problem of 100 sides, there should be 70 struts in a 100 because if there’s 5 struts in 8 sides, then there would be 6 struts for 9 sides, and
then 7 struts for 10 sides. So if you just multiply 10 by 10 you get 100, and if you multiply 7 by 10 you get 70.

**Derek:** There could be a couple of different ways. I mean, maybe one answer is not the right one.

**Lauren:** I think it’s 97 and I think I’ve got it proven. If we were right about going up one each time, and I went all the way up to 100, and I got 97 [displays large chart of her numbers].

**Teacher:** Lauren continued our chart as a way to prove that a 100-sided shape would have 97 struts.

**Teacher (Robin):** I was just looking at Brandi’s 8-sided figure, and was thinking if you start at one corner, you don’t go to the corner next to it (in either direction) because that’s a side, so you go to the next one. So you skip an angle here and go to the next one. And so you skipped 2 angles, and the one you started with doesn’t really count. So does that work for everything?

(Robin drew a figure on the board)

**Teacher:** That’s a good idea. Let me summarize what we’ve been saying. How are we going to find out the number of struts needed to make a 100-sided figure rigid? First, we could follow Lauren’s way and make a table. Second, we could try to make it, but that may be fairly difficult. Third, we could try to create a theory, like what Ms. Cox did, based on her observations of the figures and then try her deductions about those observations. Fourth, we could draw it, and try to figure it out that way. Any other ideas how we could test out our problem?

**Cole:** If you just draw it, you can’t hold it or move it. So you really couldn’t test it.

**Teacher:** Yes, you’re right. We couldn’t test it with our hands.

**Melanie:** Maybe for 100, we could do 50, do half, and then add those two up together.

**Chris:** I don’t agree with Melanie, because if you make it into two 50’s, that would come out different than a 100-sided shape.
Children reflect on the conversation

Crystal: Today we had a longggggg discussion about different people’s theories on the sides and struts. I like the theory to just take 3 away because I understand it.

Lauren: I think my theory is 97 struts. I think this because I made a chart from 3-100. #100 read 97. I used the class theory that each time the extra paper [strut] goes up.

Derek: I think Lauren’s idea to make it because that’s what we did on everything. It’s like 3 – 0, 4 – 1, 5 – 2, 6 – 3, 7 – 4, 8 – 5 and so on. It would be better to see it right in front of you.

Richie: I think it takes 97 struts to make 100 sides because there are always 3 more sides than there are struts and the others are too complicated to understand.

Brandi: My theory is that it’s 97 because all the other are 3 away. I also think there is 97 struts in 100 because Ms. Cox said that you skip, like this:

(brandi drew a figure)

Kelvin: My theory is that the answer is 97 struts because it will follow the basic pattern.

Hedda: I like the theory to just take 3 away from the original number. Although I don’t really understand any of them [very much] but I did understand that one [kind of].

(Children giving credit to others; teacher reflecting on experience)

Questions:
What is the relationship between # of triangles and # of sides?
What is the relationship between # of struts and # of sides?
Where else are their strong structures?