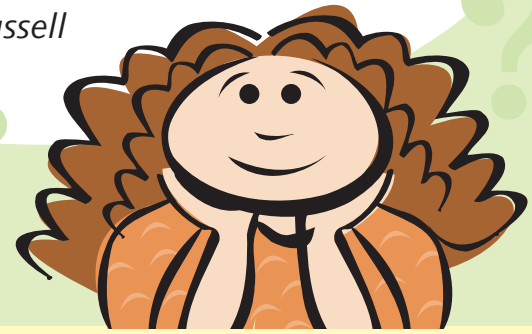
What's in a Question?

By Susan Jo Russell



The National Council of Teachers of Mathematics' 68th Yearbook, Thinking and Reasoning with Data and Chance, includes the chapter *What Does It Mean That "5 Has a Lot"? From the World to Data and Back* by Susan Jo Russell. The excerpt below discusses how students learn about developing and refining a question for data collection. The rest of the article addresses how students make sense of their data once they are collected: how do they relate graphs, numbers, and statistics back to their original question? The Yearbook and CD with a related video episode, can be purchased at www.nctm.org.

What do you think of when you think about data in the elementary grades? You might think about tables and graphs, or about statistical terms such as range, outlier, and median. You might picture students conducting surveys, keeping track of plant growth, or considering questions such as, "How do the bedtimes of third graders compare to the bedtimes of students in other grades?"

All these elements are present in students' work with data. Collecting, describing, representing, and summarizing data are key activities. To understand what data are and how to use them, students must themselves be engaged in developing questions about their world and creating data to shed light on those questions. The phrase *creating data* may be an unfamiliar one. However, this phrase points to an underlying understanding that students are developing in the elementary years: *Data are not the same as events in the real world, but they can help us understand phenomena in the real world...*

Even in the elementary grades, students can start thinking about what it is they want to know and how to ask a question or develop an experiment or take measurements that will best lead to that information. Data collection is not an exact science. There is not one correct question or experiment that we can know in advance will necessarily get better results. By devising a data collection method, trying it out, and revising it, statisticians as well as elementary school students develop better methods—methods that are more likely to result in useful information. Many students in elementary school collect data through surveys of their classmates. In this context, students can learn a great deal about formulating questions. For example, in a second-grade class, students had several experiences working on data questions suggested by the teacher (Russell, Schifter, and Bastable 2002, 30-34). After these experiences, their teacher asked them to come up with their own questions. She wrote:

I anticipated that the initial brainstorming and discussion of interesting questions to investigate would be brief. I expected that the students would be eager to begin and would later discover the issues and ambiguity around their questions as they conducted their survey. In this case, I truly underestimated how far the class had come in their thinking about data. From the very start of our brainstorming session, the students were full of questions and quickly focused on the clarity of each survey question. Many seemed to have the end in mind and were concerned with different interpretations people could give to the same question. [P. 31]

One student suggested the question, *How many houses are on your street?* Here is part of the conversation that ensued:

Susannah: Zachary [the student who had suggested the question] and I live on the same street and it's really short. But what if you live on a really long street? How could you count all the houses?

Zachary: Well, I guess it could be your block. How many houses are on your block?

Helena: What about houses being built? I have a house being built on my block.

Will: And how about condominiums and apartments? Not everyone lives in a house. Thomas and I live in the same building, and we have like a gazillion apartments in the building. It takes up the whole block!

These second graders are focused on defining their questions in a way that will be clear to those they survey and will provide information they can interpret accurately. Later in the conversation, students consider the connection between their data collection methods and their results:

Susannah: Everyone has to understand your question. If they don't understand your question, everyone will be answering just any old way.

Thomas: I wouldn't trust your data very much then!

Teacher: Why not?

Thomas: Well, people wouldn't be thinking very hard about their answers.

Keith: If I came along and I asked the same question, then I might get different answers than Susannah because people might not really understand what we were asking. If we ask the same question and we ask the same people at the same time, then our answers should be the same.

Already these students are developing a notion of "good data"—data that are collected in such a way that they reasonably represent the events they are investigating.

For children in the elementary grades, the idea of specifying a meaningful question can be challenging. However, there is a danger that a focus on creating a clear question can overshadow the focus on collecting meaningful data that are of interest. For example, in this same classroom,

Natasha and Keith tried to define a survey question about the number of states students had visited. As they tried out their question, they discovered that they did not have a clear idea of what they wanted to find out—or rather that the two of them had very different ideas about their purpose. Natasha tried to explain her ideas to Keith about what should count as a "visit" to a state. As the teacher explained (Russell, Schifter, and Bastable 2002, p. 33),

Natasha . . . felt that a visit only counted if you were going to that state for a specific purpose, not simply passing through to reach another destination. Thus, airports could not count. If you stayed with a friend out of state, it counted only if you really, really wanted to see them and you stayed with them for more than a day: The list went on, and the stipulations became more detailed and confusing. Keith was bewildered by her many qualifying factors and stated that he wanted to make it much simpler. Natasha finally declared, 'I know exactly what I mean. I just can't say it in a simple way!'

Natasha has some sense of the kind of information she wants. In her mind a "visit" is something substantial—enough time spent, perhaps, to actually get to know a place, to have some image of what it is like—not just changing planes in an airport but spending time in the place itself. Hers is a sophisticated notion, and her second grader's ability to express her ideas precisely may not be up to the depth of her idea. But Natasha is on to something here. She is wrestling with an important issue in the design of data investigations—the formulation of a data investigation design that will have a good chance of resulting in the information she is after.

Consider another scenario. In a grade 5 classroom, students are also working on this issue as they develop questions for a survey (Russell, Schifter, and Bastable 2002, pp. 27-30). As they formulate their questions in small groups, the teacher helps them clarify what they want to find out. One group is interested in how many times students in their class have moved. They first formulate their question as, *How many times did you move in the last 10 years?* Here is part of the conversation that follows:

Luke: Some of the kids in fifth grade are not 10 yet.

Michelle: You're right! Let's ask how many times did you move in your life.

Silvia: I like this question better.

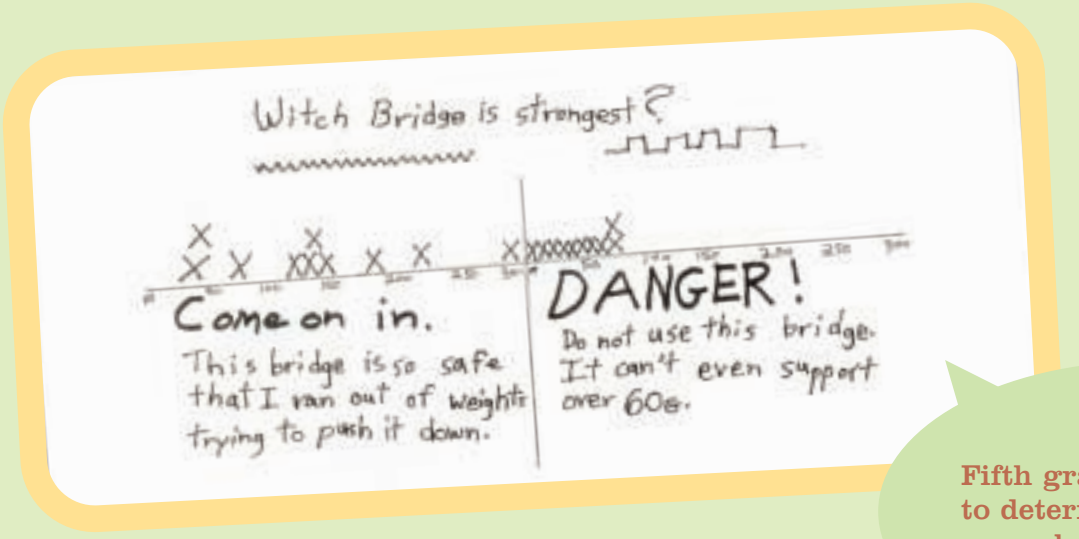
Teacher: What do you mean by "moving"?

Luke: Going from one place to another.

Silvia: From state to state.

Teacher: What about from one side of town to another—is that ''moving"? . . .

Michelle: Yeah! Even from the same neighborhood, like Ron did this year. . . . My brother just went to college, I am in his room now with his TV. Wait! Is this "moving"?



Fifth graders collect data to determine which of two paper bridges is stronger.

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After some discussion, the group decided to ask, *How many times have you moved from house to house with all your belongings?* Later, the teacher asked the students to write in their math journals about what they had learned about developing questions for their surveys. Luke wrote, in part: "Because if the question wasn't clear, then the person might not have a clue what you are talking about or the person might say a different answer to the question than the answer you want." Luke's phrase, "the answer you want," is a reference back to the purpose of the study—the need to collect data that are relevant to what you want to know.

Natasha's and Luke's experiences show that the work that students do in developing their questions is not just about being "clear." A survey question might be limited so that it is clear and unambiguous, yet not result in data of much interest. As Natasha and Keith ran out of time or, perhaps, energy, they settled on a simpler question: *How many states have you ever set foot in?* However, Natasha was dissatisfied: the question would not result in the information she wanted. They were carrying out the assigned task but not creating the data that were of interest to Natasha; in Konold and Higgins's (2003) terms, the question had been "trivialized" and, therefore, the enterprise of data investigation itself had lost meaning for Natasha.

Teachers can help students with this balance between the clarity and manageability of a data collection method and the need for gathering data that are useful and relevant. They can do the following:

- Make sure students try out their data collection methods and refine them according to what they find out.
- Ask questions to help them clarify their questions.
- Help students to keep in mind their original questions and interests and to consider whether their data collection questions and methods are resulting in data that yield information about those original questions.

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