

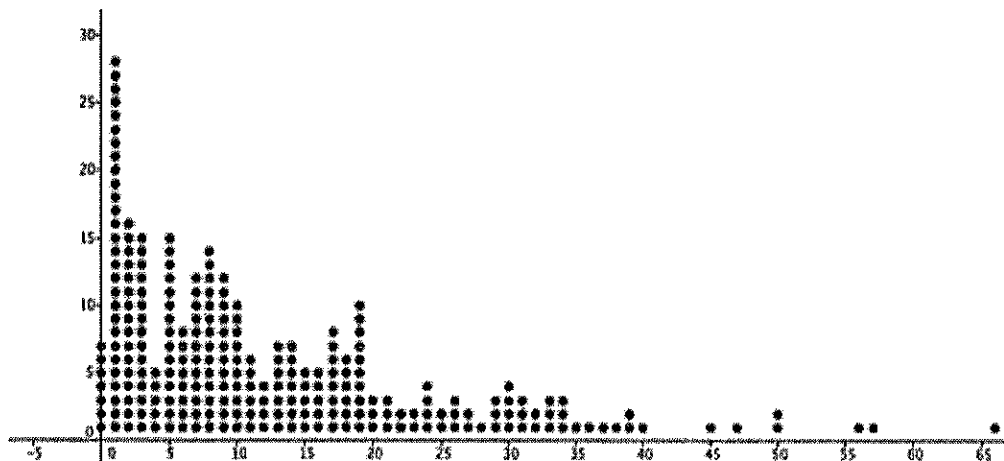
**TEAM-Math and AMSTI Professional Mathematics Learning Communities  
Effective Questioning -- Discourse**

**Vignette for 9-12 (NCTM, 2014)**

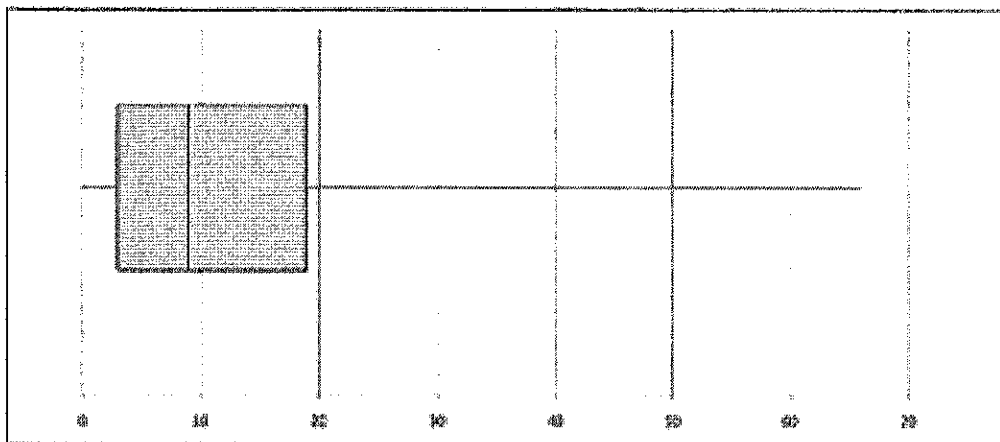
Students in two high school classrooms are investigating how much money it costs to mint coins. As part of the investigation, the students decide that it would be helpful to determine the approximate number of years that a coin stays in circulation. Rather than studying all different types of coins, the students choose to collect data about the ages of pennies. This sets the stage for the students to investigate the question, "How many years does a penny stay in circulation?"

The teachers' mathematics learning goals for the task are for students to collect data, analyze the data, and reach a conclusion, as well as to identify the limitations of this investigation with respect to its sampling method. Specifically, the teachers want the students to recognize that the results do not generalize to a larger population.

Both teachers ask all the students to bring in pennies. The goal for each class is to bring in the equivalent of about one roll for every two or three students. Small groups sort their pennies by the year of minting and determine the age of each coin. The data from the entire class is recorded in a table on the board. The small groups then create dot plots and box plots similar to those shown below, based on the age of the coins.



Age (years)



Coin age (years)

**Fig. 15.**

The teacher subsequently leads a class discussion of their findings:

*T:* What do you notice about the graph? [*waits briefly*] Do you see a pattern in the data?  
[*waits briefly again*] What are the measures of center for the pennies?

*S1:* The mean is about 12.9 years, and the median is about 9 years.

*T:* What does the box plot tell us about the variability of the data?

*S2:* It has a long tail on one side.

*T:* That may be true, but what about the interquartile range—the IQR? What does it tell us?

*S3:* Where most of the pennies occur.

*T:* Is that really what the IQR tells us? What does each part of the box plot stand for?

*S4:* Each part is 25 percent.

*T:* Yes, so what else?

*S5:* The middle is 50 percent of the pennies and is from 3 to 19 years old.

*T:* Good. What can we say about pennies on the basis of this information?

*S6:* That most of them are about 10 years old.

*T:* But since these are pennies, what does that tell us about all coins?

*S7:* That coins will be about 10 years old.

*T:* Well, 10 years is for pennies, but this wouldn't necessarily be the same for, say, quarters. Why not?

Here is an alternative approach the teacher might take:

T: What things do you notice or wonder about the age of pennies?

S1: It doesn't seem like many of them are very old.

T: What about the graph makes you say that?

S1: There's a big mound for newer pennies.

T: Is there anything else that you notice?

S2: I found the interquartile range and saw that most pennies are from 3 to 19 years old.

T: Explain to us what the interquartile range tells us.

S2: It is where most of the pennies occur.

T: What do you mean by "most of the pennies"?

S2: Well, I mean the middle 50 percent. I thought the graph made it hard to tell where things really were. It doesn't look normal, so I couldn't use the middle 68 percent thing we talked about.

T: I'm not sure I understand. Can someone else comment on what she's saying?

S3: She means that since there's a tail, the graph isn't like the normal curves we studied. If it were, we could approximate where the most likely ages are—like 68 percent of the data would be within one standard deviation of the mean.

*[More discussion follows, and the students determine that 75 percent of the pennies are not more than 19 years old.]*

T: Would I be correct if I said that a fifty-cent piece would probably be no more than 19 years old?

S4: Yes, because these coins were a random sample, and that means we can generalize.

S5: But we looked at pennies, so we can't generalize to quarters. People use pennies more.

T: What do you mean by that?

S5: Pennies may wear out. We don't know about other coins from our sample, because quarters would be a different population.