Hatchet

A Lesson for Seventh and Eighth Graders

by Ann Lawrence

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Gary Paulsen's Hatchet *(Atheneum, 1987), a popular Newbery winner, tells the story of thirteen-year-old Brian Robeson, who, after a plane crash, finds himself alone in the Canadian wilderness with nothing but his clothing and the hatchet his mother gave him as a present. After a big storm, Brian sees the tip of the plane's wing sticking out of the lake. With his hatchet, he swims out to see whether he can recover any supplies out of the plane. Suddenly, Brian is horrified to realize he dropped his hatchet and it fell to the bottom of the lake. In this activity, Ann Lawrence engages her students in estimating and then finding the actual number of seconds they can hold their breath. They construct a scatter plot to display their estimates versus actual times and then analyze their data. For other lessons by Ann Lawrence, see the book she coauthored with Charlie Hennessy,* Lessons for Algebraic Thinking, Grades 6–8 *(Math Solutions Publications, 2002).*

I began by asking the class who had read *Hatchet*. A large number of students raised their hands, and Nelson briefly summarized the book. At my request, he stopped at the point when Brian drops his hatchet into the lake. I then presented the following problem to the class:

> When Brian dropped his hatchet to the bottom of the lake, he had to hold his breath long enough to dive down nearly 20 feet, locate the hatchet, grab it, and swim back to the surface.
>
> Could you hold your breath long enough to retrieve the hatchet? Which of your classmates are best suited for this task?

To start the investigation, I asked the students to write down an estimate for how many seconds they thought they could hold their breath.

Before starting the actual timing, we held a discussion to establish the procedure we would use. The students stood up, pinched their noses, and closed their mouths tightly. After a "Three, two, one, go!" countdown, I called out the seconds as they passed. When a person couldn't last any longer, he or she sat down and recorded the appropriate number of seconds. We did two trials in case someone felt he or she had a poor first trial.

Results from the class ranged from 22 to 90 seconds. Despite protests by one student who wanted to use the mean time (he had done well in both trials), the class decided that each person should use the larger number of seconds from the two trials as the actual time that person could hold his or her breath. "After all," Donnie reasoned, "the person showed us that he or she can hold his or her breath that long, plus Brian tried several times in the book."

Next, each student wrote his or her data as an ordered pair (actual time in seconds, estimated time in seconds) on the board and constructed his or her own scatter plot to compare all the students' estimates and actual times on graph paper (see Figure 1).

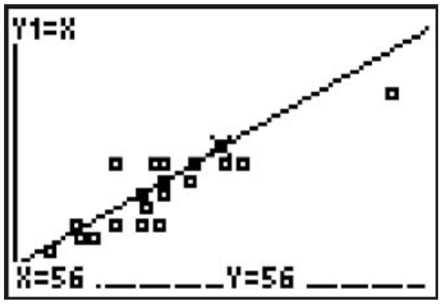

Figure 1. An electronic version of the class scatter plot displays a strong visual image that the students' estimates were consistently below their actual times.

When all students had completed their scatter plots, I initiated a class discussion using the following questions:

- **Overall, were the estimates and actual times close? How does the scatter plot display your answer?**

Students were surprised to find that most of their estimates were less than their actual times. This happens with virtually every class, and these results elicited much conversation (see Figure 2).

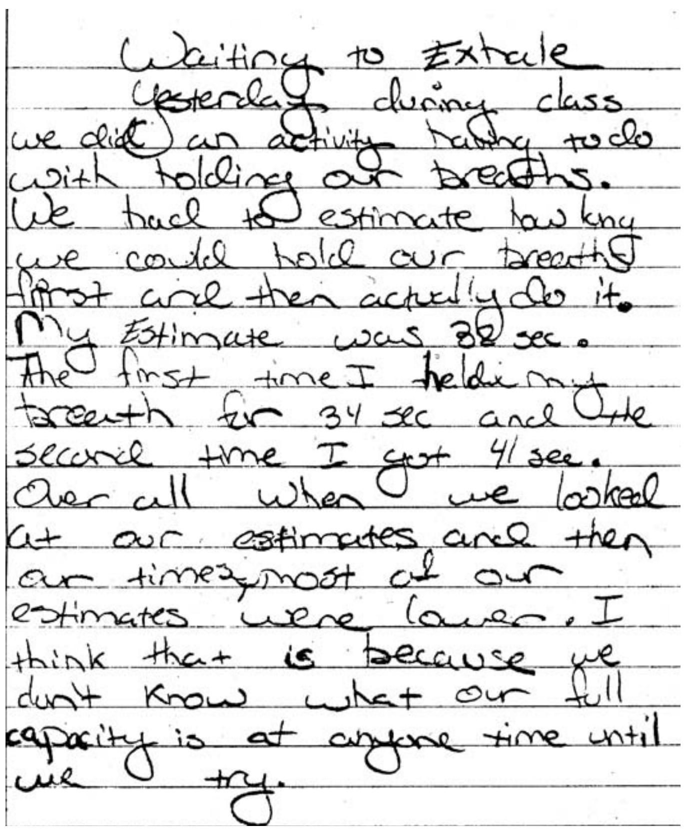
Waiting to Exhale
Yesterday during class we did an activity having to do with holding our breaths. We had to estimate how long we could hold our breaths first and then actually do it. My Estimate was 32 sec. The first time I held in my breath for 34 sec and the second time I got 41 sec. Over all when we looked at our estimates and then our times, most of our estimates were lower. I think that is because we don't know what our full capacity is at anyone time until we try.

Figure 2. Most of the class agreed with Abby's reflection about why their estimates for holding their breath were lower than their actual times.

The students also noticed that very few people had actual times far different from their estimates: this showed up in the graph as a "fat line of points" from the bottom left corner of the graph up and to the right.

- **What does it mean if there are several coordinates in a horizontal line? A vertical line?**

Niya summarized the comments of the class when she said, "Points in a horizontal line are for people who held their breath for the same amount of time—like Gideon, Catherine, and Maya all went forty seconds. Those points are the same height because we used the y-axis for actual times. Points in a vertical line mean the people had the same estimate since they all are above the same point on the x-axis that we used for estimates."

- **What would the scatter plot look like if every single person had guessed exactly how long he or she could hold his breath?**

I would normally have asked the class to use a colored pencil to plot those points on the same graph, but this class had previously done lessons to compare estimates with actual values, so I asked them to describe the graph (a line of points dividing the first quadrant into two halves) and asked for the function rule for the line. Geri offered, "The estimated number of seconds equals the actual number of seconds," and in symbols, "$y = x$."

In this lesson, it is important to relate the graph of $y = x$ to a discussion of *benchmarks.* I reminded the students that they should remember the graph of $y = x$ when they analyzed or predicted the graphs for other linear functions. We then went on to consider the family of functions related to $y = x$ with the following questions:

- In relation to the $y = x$ line, where is the location of the point for a person whose estimate was two seconds more than her actual time? What is the function rule for the set of coordinates for all people with such estimates?
- In relation to the $y = x$ line, where is the location of the point for a person whose estimate was three seconds less than his actual time? What is the function rule for the set of coordinates for all people with such estimates?
- Why might we call these three functions a "family of functions"? How are they alike? How are they different? Give another function rule that would fit in this family and describe its graph.

The students easily answered these questions and then wrote a reflection about the activity. Later, in groups of four, they used the data gathered during this lesson to investigate the following extension:

> Choose a characteristic you think might increase the length of time a person can hold his breath. Divide the class data into two groups, one group with the characteristic and one group without. Find an appropriate way to compare the actual times the two groups held their breath. Do the data support your hypothesis?

Hypotheses about a discriminating characteristic included boys versus girls; students who weighed more than 100 pounds versus students who weighed less; students who frequently swam versus students who didn't; people who ran regularly versus nonrunners; and students who played wind instruments versus those who didn't. Creating two box plots, one for people who had the characteristic and one for those who didn't, fostered good analyses.

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