IN THE CLASSROOM

The Redesigned SAT Calls for a Conceptual Approach

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I TEND TO OVERESTIMATE the math abilities of my students. But rarely am I this wrong. I posed this SAT-like question:

$$f(x) = (x + 6)(x - 4)$$

*Which of the following is an equivalent form of the function f where the vertex appears as a constants or coefficients?**

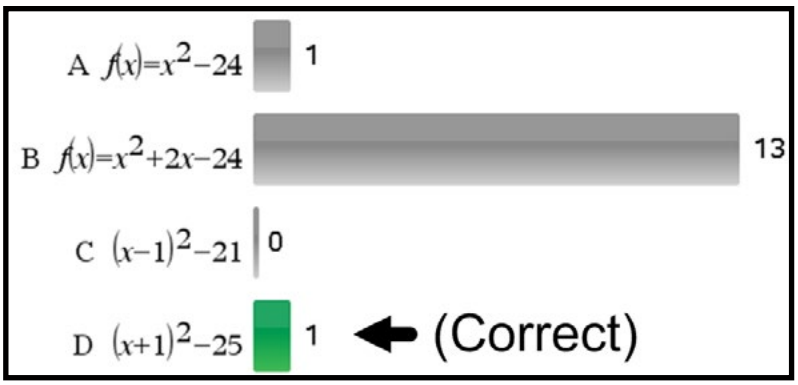
A) $f(x) = x^2 - 24$

B) $f(x) = x^2 + 2x - 24$

C) $f(x) = (x + 1)^2 - 21$

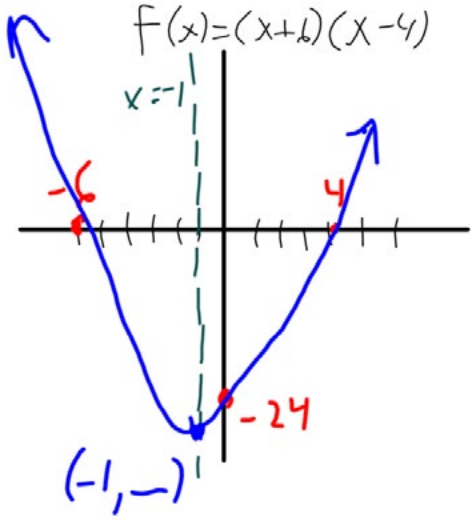
D) $f(x) = (x + 1)^2 - 25$

We had just finished a chapter on transformations of quadratics. I don't want to brag, but, my students were very good at transformations. Being good at procedures does not set up students for success on the SAT. Here is what happened:



Only one student (in all of my Honors Algebra II classes) got it correct? How could this be? Why did they get it wrong? I had so many questions. But right then, I knew that I needed to change the way I taught and assessed my students. I was not doing a good job of preparing my students for questions that were more conceptual than procedural.

I asked the student who got the question right how she solved it. It wasn't the way I expected. She didn't complete the square, instead, she sketched a graph.



She found the intercepts of the parabola and reasoned that the middle of the parabola (axis of symmetry) would be the average of the x-intercepts (-1) . She didn't take the time to find the minimum value of the function, but she knew from the sketch that it had to be smaller than -24 . What an elegant way to to solve this problem!

I am still a work in progress. But here is a summary of things I am learning.

Encourage students to think graphically.

As Jo Boaler says, all students understand math in a deeper way when they can see the graph. The textbook I use (like most textbooks) starts with factoring before it gets to solving a quadratic graphically. This may sound sacrilegious, but I have switched the order. From day one of factoring, I want students to make connections with the graph. The tougher

the problem, the more it helps to sketch the graph. From my experience tutoring students, it is often the last thing they would think of doing.

Attend to precision with mathematics vocabulary.

Think about all of the math vocabulary in that opening question: equivalent, minimum value, constant, and coefficient. If students don't understand the language of math, they are going to struggle on many of the wordy SAT questions. Of course, it starts with the teacher, but I am more and more convinced that students don't really understand the math language until they are able to verbally explain a concept to other students. We have to get our students conversing about math to each other! Card sorts are my favorite way to do this. Pair students up and have them ask and answer questions to each other.

Solve problems elegantly.

Mathematics can be too compartmentalized, too prescribed. In Algebra II, I teach my students how to solve quadratics many different ways (factoring, quadratic formula, completing the square, graphing, etc). So, on a test, I'll ask them to solve a quadratic using a certain method. I'm not saying that is a bad way to do things, it assures that they know how to do each procedure. But, what kind of question could I add to my test that would force students to determine which method would be best? Maybe something like this: What method would you use to solve this quadratic? Explain why you chose the method you did. $x^2 + 12x = 64$. I want students to use the structure of a problem to help them decide on the method they would use to solve it.

Bottom line.

If your assessments contain only procedural questions, how can students be expected to perform well on a conceptual test? From my experience, that is not a good plan. I challenge you to be intentional about including conceptual questions on every assessment that students take.

*https://collegereadiness.collegeboard.org/pdf/sat-practice-test-4.pdf

Jeff McCalla teaches AP Statistics and Algebra II at St. Mary's Episcopal School in Memphis, Tennessee. In 2009, Jeff won the Presidential Award for Excellence in Science and Mathematics Teaching. Jeff is an instructor for T³™ (Teachers Teaching with Technology) and has written two books for Wiley Publishing, TI-Nspire for Dummies and TI-84 for Dummies.