DOINGWHATWORKS

Presentation

FULL DETAILS AND TRANSCRIPT

Finding Patterns Within Functions

U.S. Department of Education, Washington, D.C.

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Topic: National Math Panel: Major Topics of School Algebra

Practice: Topics of Algebra

Highlights

- Student difficulty with understanding what causes graphs to change form, why a function shifts, predicting what a graph looks like based on function
- Importance of helping students explore, compare, discuss various function tables
- Lesson with having students describe characteristics of a basic function and visualize its graph
- Adding a variation to the basic function (adding a constant) and asking students to visualize graph
- Using the variation of absolute value
- Discussing the challenge of presenting fractions in the function

About the Interviewee

Julie Shively is a former Air Force pilot and is currently a fourth and fifth grade gifted math teacher from Lawrenceville, Georgia. After nine years in the Air Force, she graduated from Virginia Commonwealth University with a master's degree in early childhood education. In order to better differentiate her

instruction and improve her teaching practices, she earned her gifted instructor certification, National Board Certification, and specialist degree in middle grades math and science from Brenau University.

With her extensive background in math and science and her desire to bring math to the forefront in elementary school, Julie initiated various math and science programs and activities for students and their parents. In an effort to ensure that the teachers knew how to teach math to fourth- and fifth-graders, she helped create a summer math institute to teach best instructional methods to summer school teachers. During the school year, she offered after-school classes to teachers who volunteered to learn in-depth the algebraic concepts they were teaching their students. To reach new teachers with proven math instruction, she volunteered to run a mentor program and oversee more than 30 mentors and protégés.

Full Transcript

Slide #1

Welcome to Finding Patterns Within Functions.

Slide #2

My name is Julie Shively, and I am National Board Certified in Middle School, and I teach gifted math in Lawrenceville, Georgia.

Slide #3

I have observed in my classes that many students enter understanding basic equations. They can find the answers, and they can graph a given function, but they don't really understand what causes the graphs to change form. They cannot describe why a function will shift along the horizontal or vertical axis, and they cannot predict what a graph can look like given just a function. I spend a lot of class time in the beginning of the year with the students exploring, comparing, and discussing different function tables. And because understanding how to manipulate functions is the beginning to predicting outputs in the functions, such as in rates or acceleration, pressure and volume.

Slide #4

For example, I give students a basic function such as $f(x)=|x|$, and the first thing I do is I ask the students to tell me what that means, tell me what is the function, give me some behaviors of the function. And because they know what absolute value is, they can tell me that the function will be positive. They will say that it looks like a V and it's going up so the opening is up. Pushing them a little bit farther, they can tell me that

the minimum is zero, so they know that *y* will never be less than zero, it will never be in the negative. So, when I ask them if they can visualize that and graph it, yes they can because of what they have been able to describe. So, that's the basic function.

Slide #5

Then I give them a variation $|x|+2$. "What does that +2 do to the graph? Visualize what's going to happen." If they are not able to explain it at that point, that's when I ask them to create a table with the *x* and the *y*, and then they will graph it. And then they can see that what happens is the graph moves up to a positive 2. So what happens is that the constant moves the vertical up. Knowing that, I ask them, "Okay well, what about if I have a negative 2?" Given that pattern, they should be able to say, "Well, the graph moves then down to a negative 2," and they can create a table, and sure enough that's what happens to the graph.

Slide #6

Another variation is have everything inside of the absolute value: $k(x)=|x+2|$. Well, we know it can't go vertical, some of them may be able to guess, "Okay, it goes horizontal." "Well, let's check it and see." So, they create the graph, and then sure enough, it goes to the negative 2. That's when some of them become confused because, well, we have got a positive 2 in here, so why does it go to a negative 2? Why is the minimum at negative 2? As they are discussing it, then they realize that, well, it's at negative 2,0. So the *y* has to be zero. So, whatever is inside of the absolute value has to become zero, so they know then that is the opposite of the constant. So then we will try several different variations so they can confirm that, yes, that's what happens. So now they can see how the graph can move on the vertical axis and how it can move on the horizontal axis based on the equation.

Slide #7

When there are fractions in the function, they have a lot of problems, especially when *x* is in the denominator. So we look at the basic function of $f(x)=1/x$. They know if a zero is in the denominator, then that means that the y is undefined or the function is undefined. Then I ask them, "Okay, well, what happens when *x* increases?" Well, then that means that the function decreases towards zero, and then the opposite is true. At this point, I do ask them to create tables. They do realize that the graphs will go towards zero, and they are reflections, they are mirror images. So, that's the basic function is $1/x$. Well let's put in a variation. Let's go $1/x+4$. Well, if they go back to the other functions that we have done, if we have got a plus 4, if we are adding in a constant, then that's going to move the graph vertically. So, if it's a plus 4, it's going to go up to 4.

Slide #8

I have them practice with a lot of different functions starting with the basic and then going with variations, and they can realize then that when you change the coefficient, when you change the sign, when you change the constant, that's going to change the graph, but you always have to start with the basic function.

Slide #9

To learn more about Finding Patterns Within Functions, please explore the additional resources on the Doing What Works website.