DOINGWHATWORKS

Teaching Quadratic Functions

Twin Groves Middle School, Illinois • November 2008

Topic: National Math Panel: Major Topics of School Algebra

Practice: Topics of Algebra

Highlights

- Approach to teaching quadratic functions
- Quadratic functions written in standard form
- Finding the vertex of a parabola of a quadratic function
- Graphing quadratic functions by hand and with a calculator
- Finding maximum and minimum values using quadratic functions
- Application of quadratic functions to real world problems

About the Site

Twin Groves Middle School
Buffalo Grove, IL

Demographics

83% White

15% Asian

2% Hispanic

1% Black

1% Free or Reduced-Price Lunch

2% English Language Learners

Staff from Twin Groves Middle School have been active participants in the district's processes of vertical alignment of standards, development of power standards, and enhancement of algebra instruction. Features:

- Vertical alignment process to identify overlaps and gaps in curriculum;
- Development of power standards to guide curriculum and assessment, specific standards for advanced and honors math;
- Analysis of power standards to develop well-aligned formative assessments;
- Use of computerized assessment and reporting system;
- Variety of types of formative assessments, including observation during in-class lessons;
- Intervention options for struggling students;
- Emphasis on student understanding of the major topics of algebra and connections among them;
- Improving student proficiency in solving algebra problems, including problem translation, transformation of equations, and explanation of solutions;
- Teaching quadratic functions, including graphing functions by hand and using a graphing calculator; and
- Teaching students about symbols and expressions, including understanding terminology, simplifying expressions, using teacher modeling effectively, and providing opportunities for practice during and after lessons.

Full Transcript

Slide #1

Welcome to Teaching Quadratic Functions.

Slide #2

My name is Wendy Loeb, and I teach eighth grade math, which is Algebra II, Algebra I, and Pre-Algebra, at Twin Groves Middle School in Buffalo Grove, Illinois.

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I begin introducing functions in Pre-Algebra; however, these are very basic linear input/output problems. In Algebra I, we move onto linear functions and introduce absolute value functions and quadratic functions. In

Algebra II, I review linear and absolute value functions. Then, I introduce piecewise functions and go into much more depth on quadratic functions, and then I introduce polynomial, radical, exponential, logarithmic, and rational functions. In Algebra II, I try to show students connections between both linear and nonlinear functions and how they apply to various situations. The main concepts involved through our functions are graphing, solving systems of equations, operations with polynomials, and making real-life connections.

Slide #4

Since quadratic functions have various forms, we practice factoring techniques, completing the square, and the quadratic formula. When solving polynomial functions, I also teach dividing polynomials, solving polynomial equations by both factoring and graphing, and applications such as using Pascal's triangle when expanding a polynomial. So, I try and make a lot of connections between functions and other math skills and topics of Algebra.

Slide #5

My goals for this lesson were for the students to graph quadratic functions in standard form, by hand and with a calculator, and to find the maximum and minimum values of quadratic functions. First, the students were expected to find the vertex of a parabola—of a quadratic function that's written in standard form. And what we do is we use the opposite of b/2a to find the x coordinate, and they substitute that in to find the y coordinate, and then they are going to make a table of values where they are going to find an ordered pair on either side of the vertex so that they could plot the graph. And we do this by hand, and then we do this on the graphing calculator. And we also like to show how to find the vertex on the graphing calculator, so that in case a number is a very, very complicated fraction, they can see how the calculator can check their answer for them.

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And after we find the vertex and we graph the parabola, we try and talk about characteristics of the parabola, what each part of the equation means. What does the a in the quadratic function represent? How can you tell whether it's going to open up or open down? How can you tell if it's going to be a wider parabola or a narrower parabola? We talk about when do we use the parabola, and what does the vertex mean in a real-life situation?

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The first thing that I do is introduce the topic of what, well, first of all, the parts of a standard form of a

quadratic function so that the students knew what the different parts of the equation meant. The standard form would be $f(x)=ax^2+bx+c$, what the purpose of the a is, what the purpose of the b is, so that they can understand how to find the vertex by doing the opposite of b/2a.

Slide #8

Then, what I do is I give them an example of a function in standard form, and we take a look at what the graph of that would look like. So, I would say, "Okay, here is the equation $y=x^2-4x+3$, let's find the vertex of this equation." And we will find the vertex by hand first. After we find the vertex by hand, we will start to make a table, and we'll find two other ordered pairs on either side of the vertex so that we can make a nice symmetrical graph of this parabola. And we will plot those points on graph paper and graph it. We do the problem together. Then, I say, "Okay, now here is an equation for you to try on your own."

Slide #9

I show them how to do this on a graphing calculator. We put in the same equation, and I show them where to find the features on the calculator so that they could calculate the vertex. And then we go to the table on the calculators and say, "Look, this is the same table we created by hand on our paper," so they can see the connection between the two. After that, I am going to apply, "Well, why do we need to even graph a parabola? Why do we need to find a vertex? What's the application of this?" And this is when I try to give them a real-world connection. So, the one that I used in class was the one where a company was trying to sell some unicycles, and I gave an expression that models the number of unicycles it sells per month, and I said that p stands for the price and the r stands for the revenue, and I gave a range of prices that it could sell for.

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We come up with an equation so that we can figure out the vertex of this to come up with what the price would be to maximize our revenue and the maximum revenue. And then, we say, "Well, in order to find the revenue, we need to multiply the price per item by the number of items." And so, we discuss well, what's the price per item? We don't know; that's our p. What's the number of items? That's our expression that we have. And we multiply those together so that we can get a quadratic function.

Slide #11

We find our vertex, and then I ask the class, "Well, okay, what does this number in the vertex represent? That's the price." So, the first number we get represents the price of one unicycle. How can we find out

what the revenue would be? Well, we have to substitute that back into the equation. So, the students substitute that back and they find the revenue. So, what does this represent? The maximum revenue when you have a particular price. Then, I will give them a different problem and say, "Okay, now here is your new problem. See if you can find what price will maximize the revenue in a different situation."

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My students have the most trouble with abstract concepts. For example, even though they understand what an imaginary number is, they have a hard time understanding when they are going to need to use it. Piecewise and logarithmic functions are probably the most difficult functions for my students to grasp. Setting up various word problems are usually difficult for many students in general. One of the ways I help students with this is by modeling problems for them in class that are similar to the ones in their homework. I also try to give them multiple-step problems that break down the procedure step-by-step and ties together many of the function concepts they have learned.

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To learn more about teaching quadratic functions, please explore the additional resources on the Doing What Works website.