

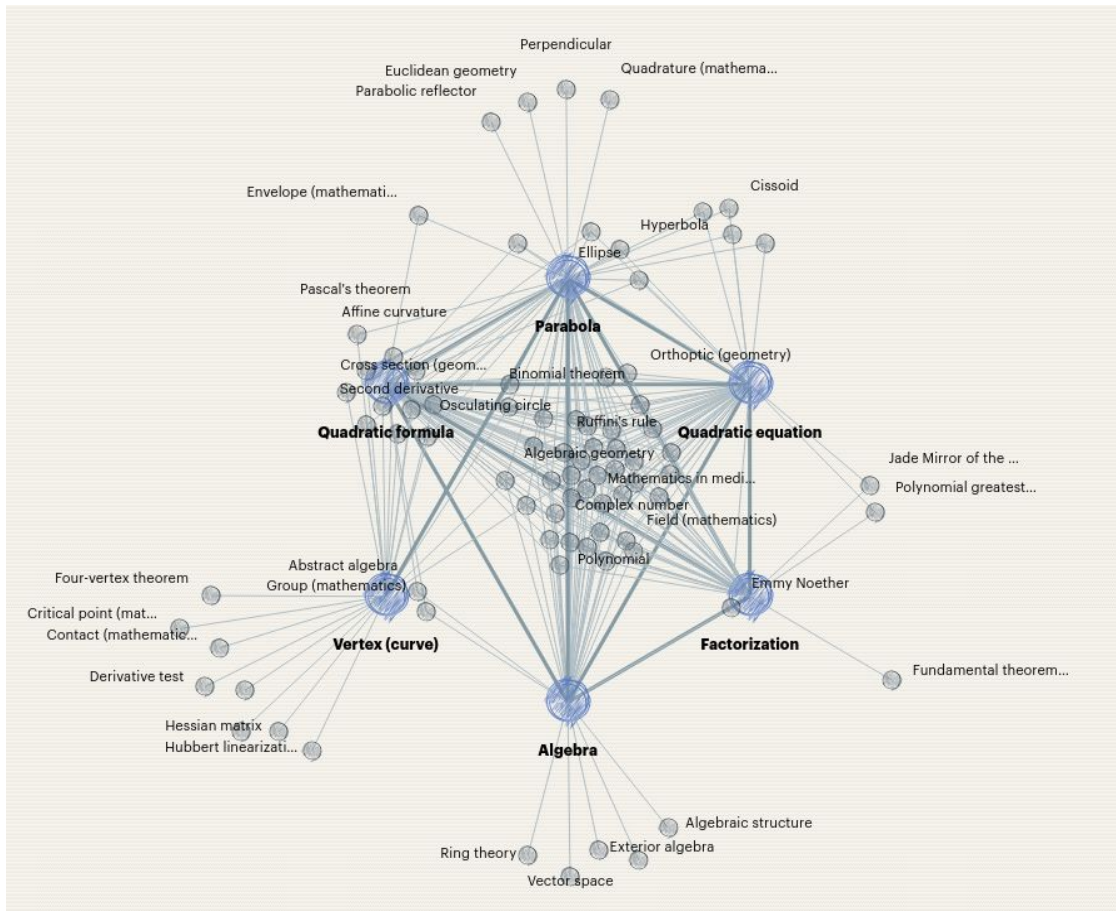
Performance task: Exploring the connections between parabolas and other mathematical terms using Yewno Knowledge Maps

Hezekiah Smithstein, Design Tech High School, Redwood Shores, CA
Designership Institute, Stanford, CA, 94301

Abstract

When students learn about math, many fail to comprehend how different complicated terms relate to each other. Students see the terms quadratic equation or parabola, and think: “How do these terms relate to each other?” With Yewno Discovery, students easily search up terms and create knowledge maps to see how all of the terms relate to each other. You can also find the definitions of the concepts, and look into other minor topics that are related to that initial topic as well. With Yewno Discovery, mathematical terms can be explored in depth and related to each other, so that people understand the interconnectivity of math.

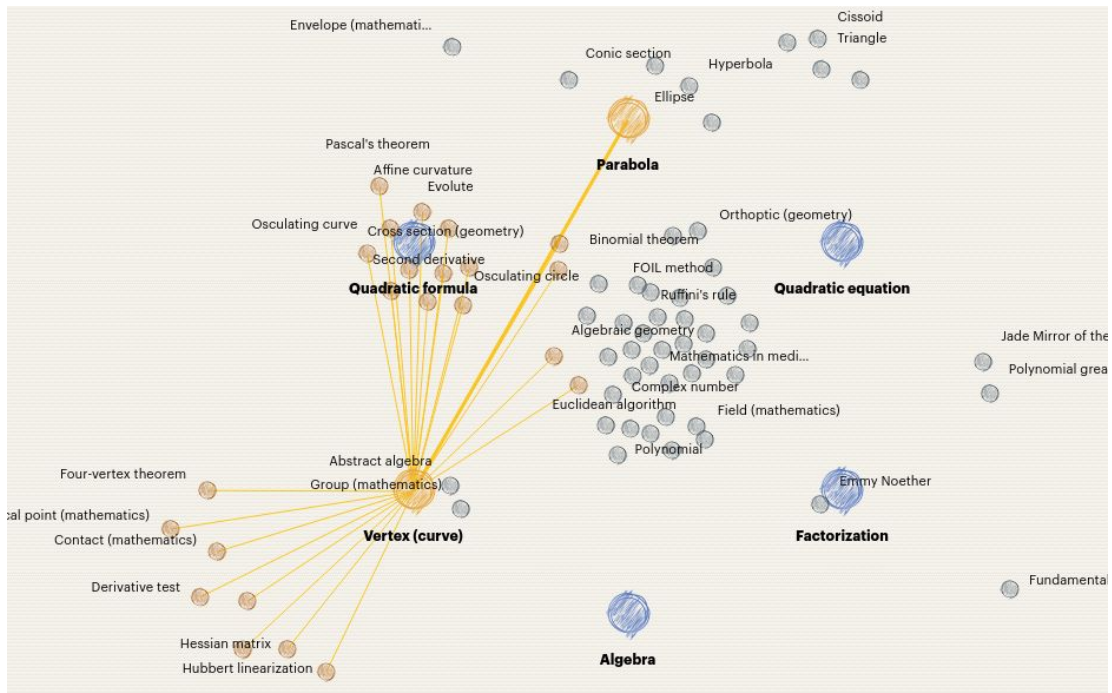
Yewno Knowledge Map



The six terms used in my knowledge map:

1. Parabola
2. Algebra
3. Vertex (curve)
4. Factorization
5. Quadratic formula
6. Quadratic equation

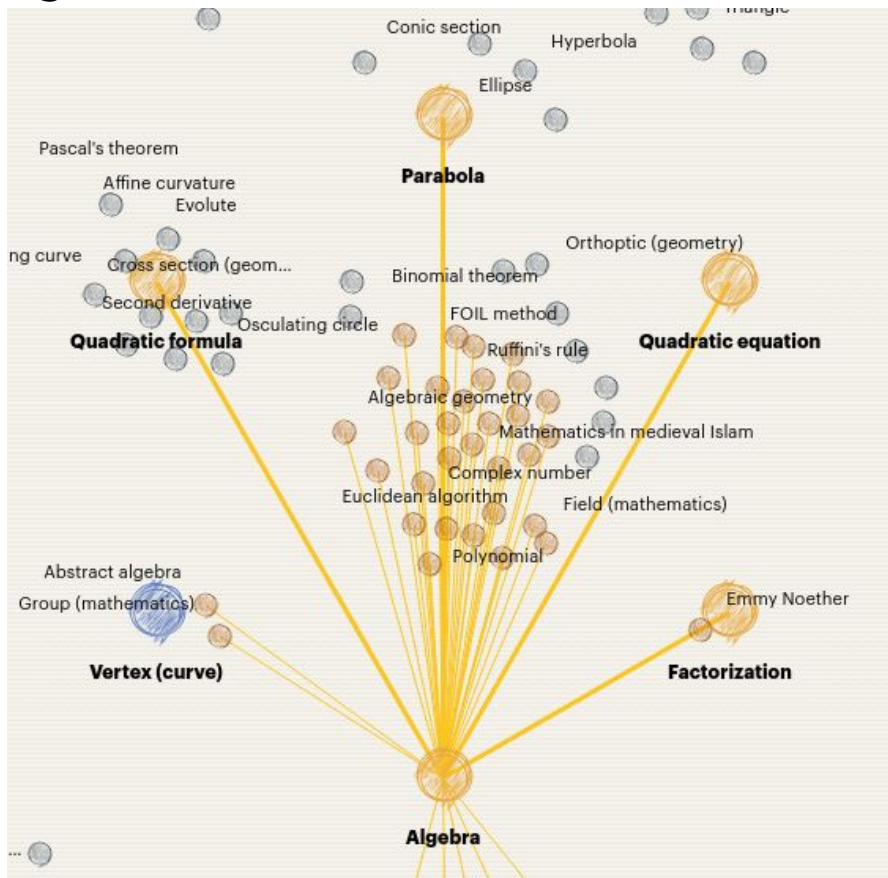
#1. Vertex (Curve) and its connection with other topics



Relationship Between Vertex and Parabola: Vertex and parabola are connected because every parabola has a vertex. The vertex of the curve is an essential part of a parabola and is defined by x^2 . One of the ideas connecting vertex and parabola is tangent. Vertex and parabola are most closely related because the top of a vertex is a parabola, and there is an equation that can be used to show the vertex as $y=a(x-h)+k$.

Relationship Between Tangent, Vertex, and Parabola: A tangent is a straight line (or smooth curve) that touches a given curve at one point. Tangent relates to both vertex and parabola because a line going through the vertex on the outer edge of the parabola could form a tangent.

#2. Algebra and its connection with other topics



Relationship Between Algebra and Factorization:

Algebra connects to factorization because you can factor algebraic equations to turn them into factored form by completing the square and using the box method.

Relationship Between Algebra and Quadratic Formula:

Algebra connects to the quadratic formula and the quadratic equation, which are both key algebraic concepts, by allowing you to see the x-intercepts and other key components of those equations.

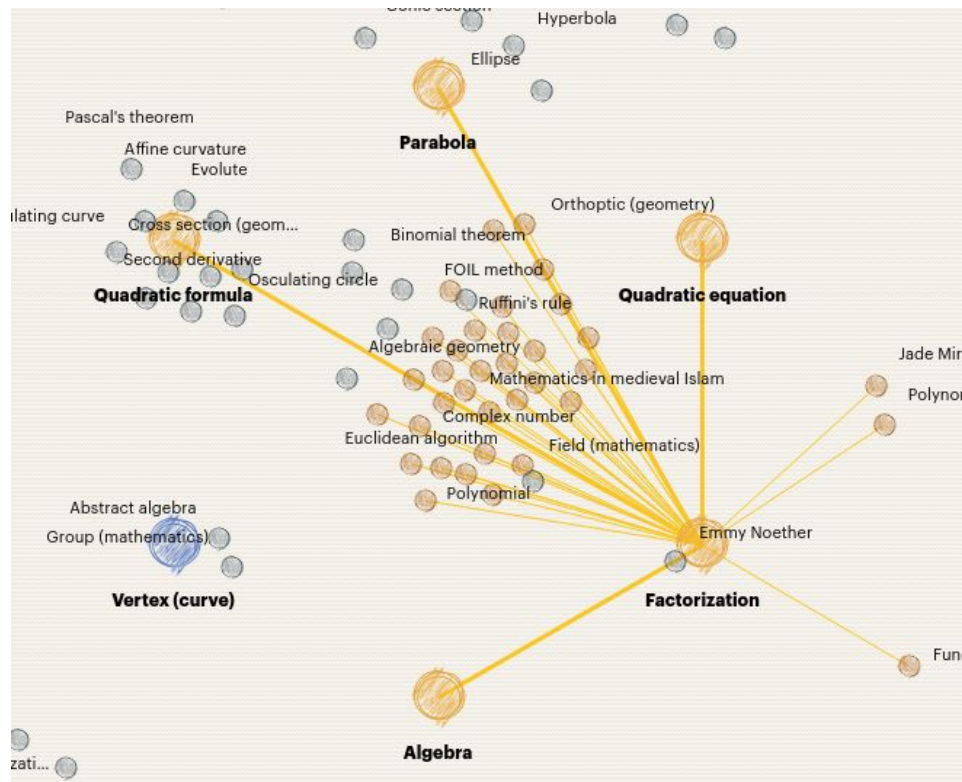
Relationship Between Algebra and Parabola:

The relationship between algebra and parabola is evident in many ways, seeing as the parabola is a component of algebra. Parabolas can be graphed using the algebraic equations of vertex, standard, and factored forms, as previously mentioned, as well as using the quadratic equation.

No Connection Between Algebra and Vertex?

The lack of connection between algebra and vertex thoroughly confused me. The vertex of a curve is definitely an algebraic concept, and yet no line was drawn between the two. If there is a line between algebra and parabola, and a vertex is a part of a parabola, then there should definitely be a line between vertex and parabola as well.

#3. Factorization and its connection with other topics



FOIL Method:

The FOIL method, one of the topics connected with factorization, means First Outside Inside Last. It is used to multiply two different expressions. For example, you start with $(2x + 5)(3x + 2)$ Then you multiply as shown:

First: $2x * 3x$

Outside: $2x * 2$

Inside: $5 * 3x$

Last: $5 * 2$

Your result should be $6x^2 + 4x + 15x + 10$

Then you Simplify: $6x^2 + 19x + 10$

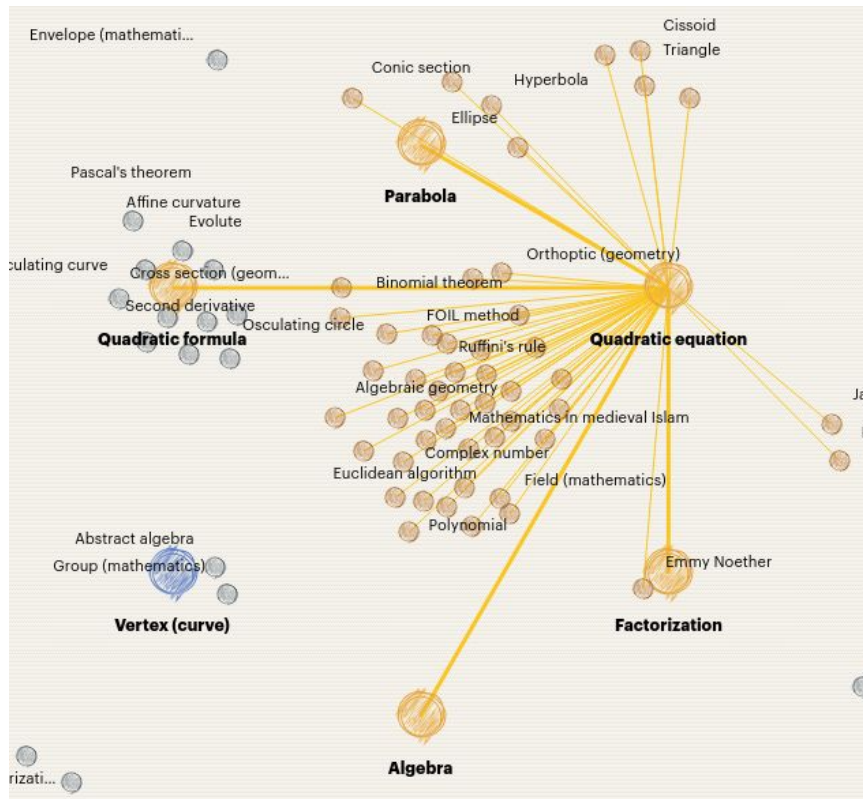
Connection between Factorization and Parabola:

The equation of a parabola can be written in multiple forms. One of these forms is factored form. In order to turn the standard form of a parabola into factored form, you make $y=0$ and then you use that equation to complete the square.

Completing the Square:

To complete the square is a method that can be used to change a quadratic equation into factored form by dividing terms in order to create a perfect square (the same value on all sides of the square). The resulting terms create your equation.

#4. Quadratic Equation and its connection with other topics



Relationship Between Parabola and Quadratic Equation:

The quadratic equation of $ax^2 + bx + c = 0$ is a key part of parabolas because it is the equation that vertex, standard, and factored form come from. These are key to graphing any type of parabolic function.

Relationship Between Quadratic Equation and Polynomials:

A polynomial, in the most simple terms, is an expression of more than two algebraic terms. This expression usually includes variables and coefficients, and often has different powers of the same variables. The quadratic equation, $ax^2 + bx + c = 0$, contains polynomials such as ax^2 and bx , which are fundamental values of the equation.

What is an ellipse?

As you can see, in the top right corner there is a connection shown between quadratic equation and ellipse. So I decided to delve into what an ellipse is to figure out why they are connected. An ellipse is an oval shape that is created by a point moving in a plane so that sum of its distance from two other points is constant. These results form a cone being cut by an oblique plane that does not intersect the base.

#5. Quadratic Formula and its connection with other topics



Relationship Between Quadratic Formula and Quadratic Equation:

If you factor the quadratic equation, it becomes the quadratic formula. These two are related because they are essentially the same equation but in different forms. The quadratic equation can be used to graph parabolas, and the quadratic formula can be used when factoring is unsuccessful.

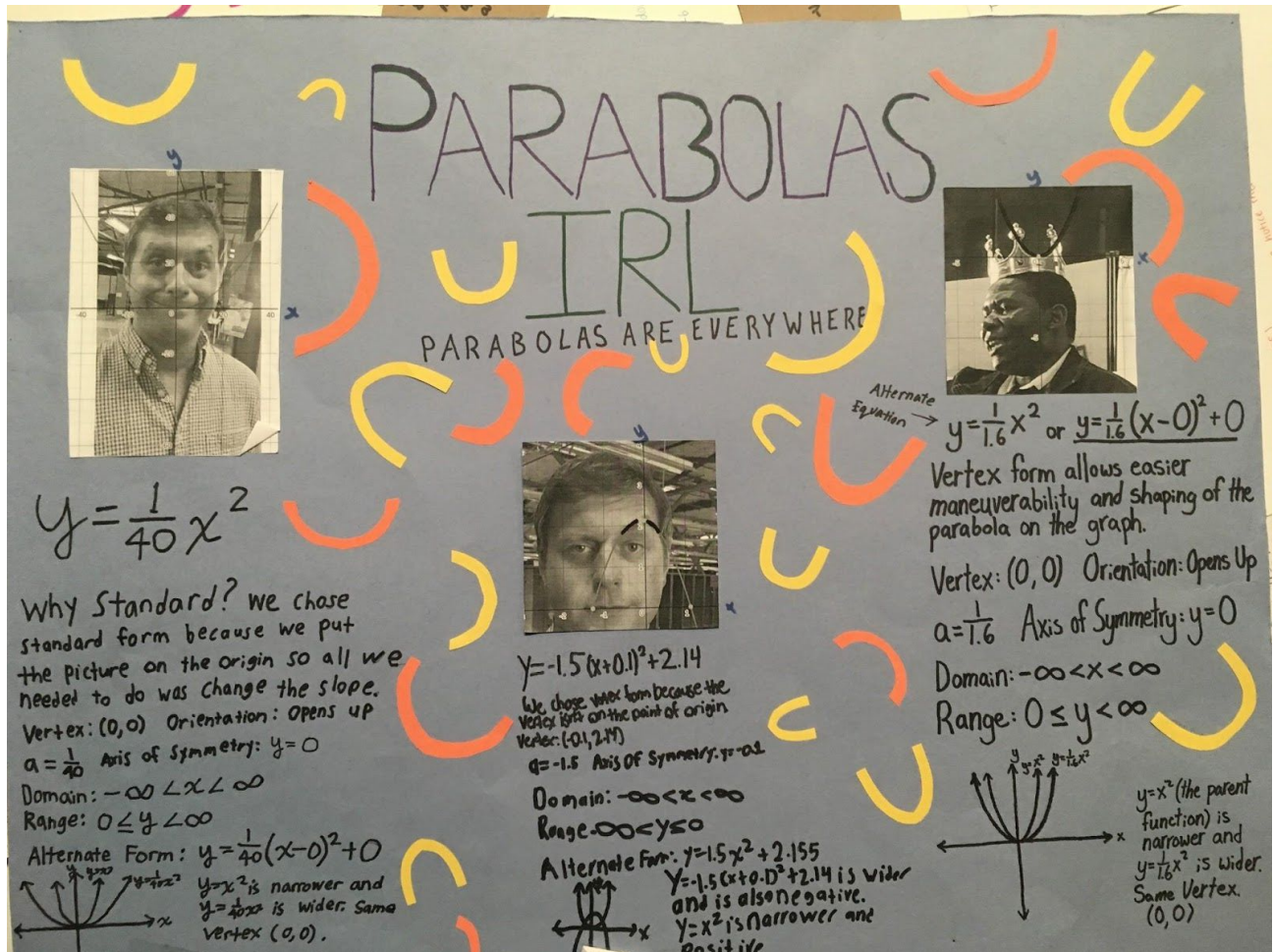
Complex Number:

A complex number is a number that contains the parts $a + bi$, with a and b being real numbers and i being an imaginary number. The imaginary number is in line with the equation $i^2 = -1$. In a complex number a is the real part and b is the imaginary part because it is multiplied with i , an imaginary number.

Lack of connection between Quadratic Formula and Vertex:

I was a bit surprised by the lack of connection between quadratic formula and vertex. Since the quadratic formula is a form of the quadratic equation, and the quadratic equation is used to graph parabolas, and parabolas have vertexes, I expected there to be a connection between the two. However, it may be that that association is not direct and therefore would not result in a connection between the two.

Relating my research back to a previous project on parabolas:



In this Performance Task, I learned more and expanded on the topics covered in our previous poster project. With the poster project, I learned about parabolas in standard, vertex, and factored form. In the exploration, I expanded on this topic by relating vertex, standard, and factored form to other mathematical concepts and diving deeper into other related topics using the Yewno Knowledge Map. With the map, I was able not only to relate my original learning together with other concepts such as the quadratic formula and F.O.I.L method, but I also was able to dive deeper into side topics that are also helpful such as completing the square and complex numbers.

Conclusion/Reflection:

Yewno was a very effective and expansive way to research these mathematical terms. Without Yewno, I would have struggled a lot more to make sense of how everything fits together and related to each other, and would have had a hard time figuring out what concepts I needed to learn about. However, with everything laid out for me in a simple and accessible way, I was able to easily figure

out not only the connections between things but also expand on new topics as I discovered them.