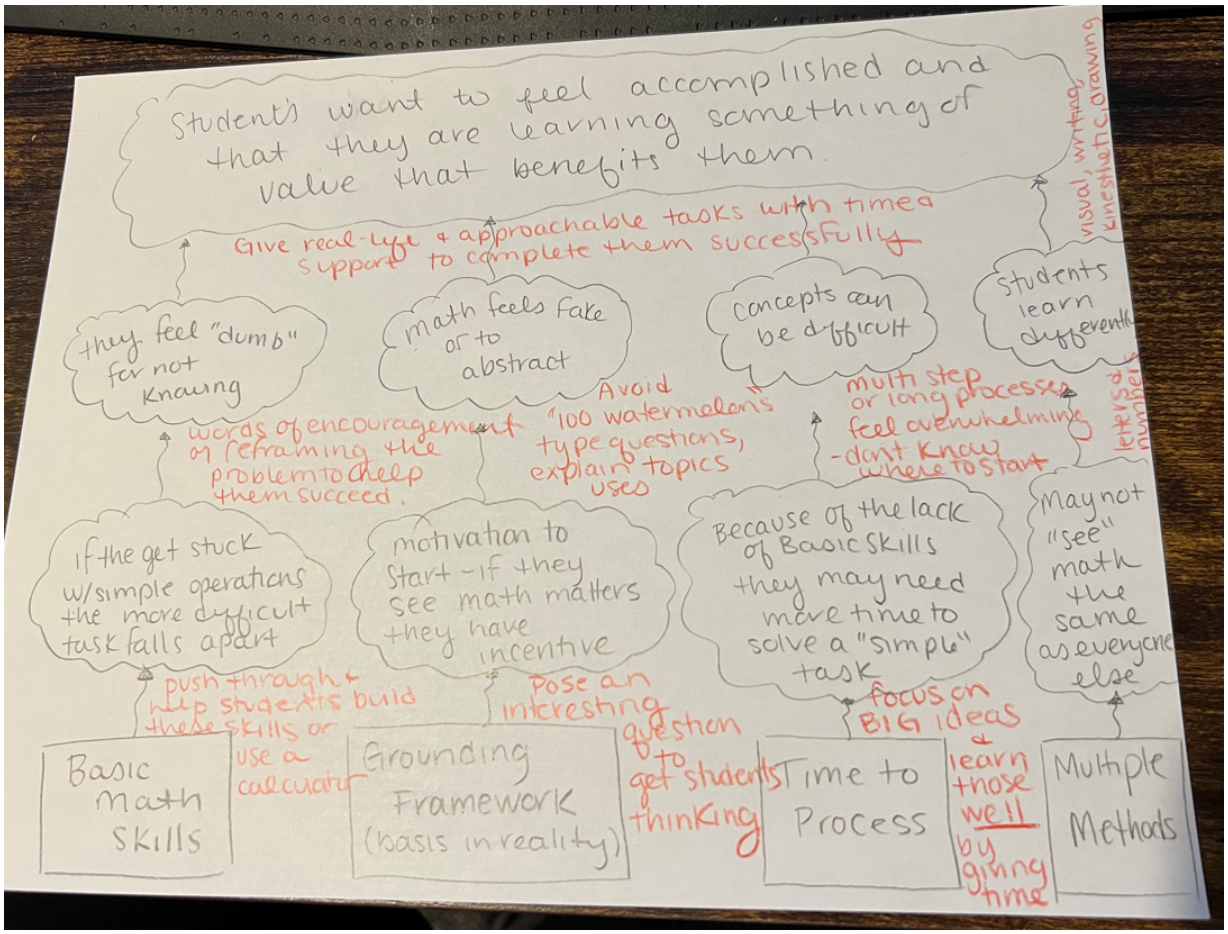
PoP - Final Report

A continuing and major problem facing mathematics education is students feeling disconnected from the subject area and anxiety towards even attempting to engage with the subject matter. I decided to focus on this for my problem of practice. To approach this problem and ultimately try to come up with a solution, I followed the Stanford design modes - empathize, define, ideate, prototype, and then test. Each step along the way I discovered a bit more about my students and their struggles and myself as a teacher and how I could help them feel more successful learning mathematics.

The first step I took was a practice in empathy. I feel that I already am a very empathetic person, however observing my students this year I needed to offer them even more grace coming back from a very difficult, 100% virtual, year of learning. However, to push myself even further to empathize with students who have high anxieties towards mathematics, I did a bit of research on the topic and tried to put myself in their shoes. The typical anxious math student may freeze up when called on, may not even attempt problems (at home or in class), or try to leave the classroom altogether as an act of avoidance for fear of feeling incapable (Picha, 2018). As a teacher I also try to remember myself at that age, learning a new topic that might be difficult or new and how I might appreciate time to wrap my head around the new idea. Or I think of my own difficulties with writing and how I overcome by just getting words out and how that could also translate to mathematics. I tell my students that it is good and ok to be wrong in a math class, that is one of the best ways to learn math - make a mistake and then see and correct it, so take a chance! Start the problem, see where it takes you and if you get stuck, go back and look at what you already have and see if you can adjust.

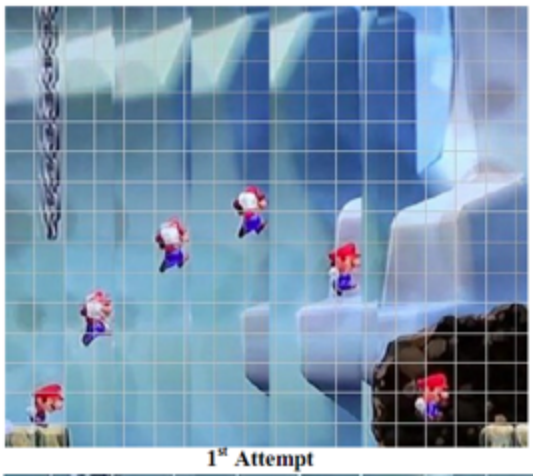
After observing my students, putting myself in their shoes, and doing a bit of research on anxiety in the math classroom I found that I need to reframe, or really get to the bottom of what I was trying to accomplish. By asking the question ‘why’ over and over again in regards to my problem I found that the root cause of students to feel anxious about doing and learning mathematics is that generally learners want to feel successful and accomplished and that they are learning something of value to them. Then by asking how I can accomplish this you begin to think of more actionable items that you can start potentially creating to help with the problem. Below

is my 'why-how' ladder as I continued to ask why something was and then try to answer how I could do something about it.

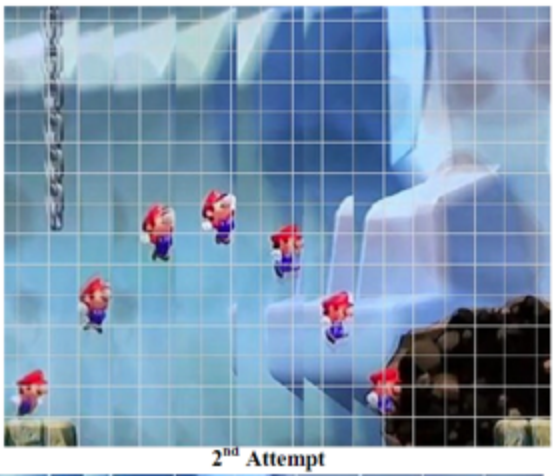


After thinking more deeply about the root cause of my problem and how I might start to approach the next steps on paper seem easy - just sit with your ideas and let them grow, change, and develop over time. This can be somewhat of a challenge however, and it was for me. Sometimes in our busy lives we don't always have time to give time for ideas to grow and change. I find that in small ways I do this - as I shower in the morning before the school day starts I think about each of my classes and what we have learned, where we are now, and where we will be headed to ensure that I am creating a cohesive year of learning for my students to reflect back on and have confidence in going forward. Sometimes while doing this I think of new or different ways to approach a topic or lesson coming up or in the future so the moment I get into school I start creating. This is where I initially thought about a lesson I had done a few years ago based on a 3-act-math about Super Mario and if he would make a jump. Mario's jump is in the shape of a parabola, and we were just about to start learning about parabola's in my Algebra 2 class so I wondered if this would be a good way to hook my students.

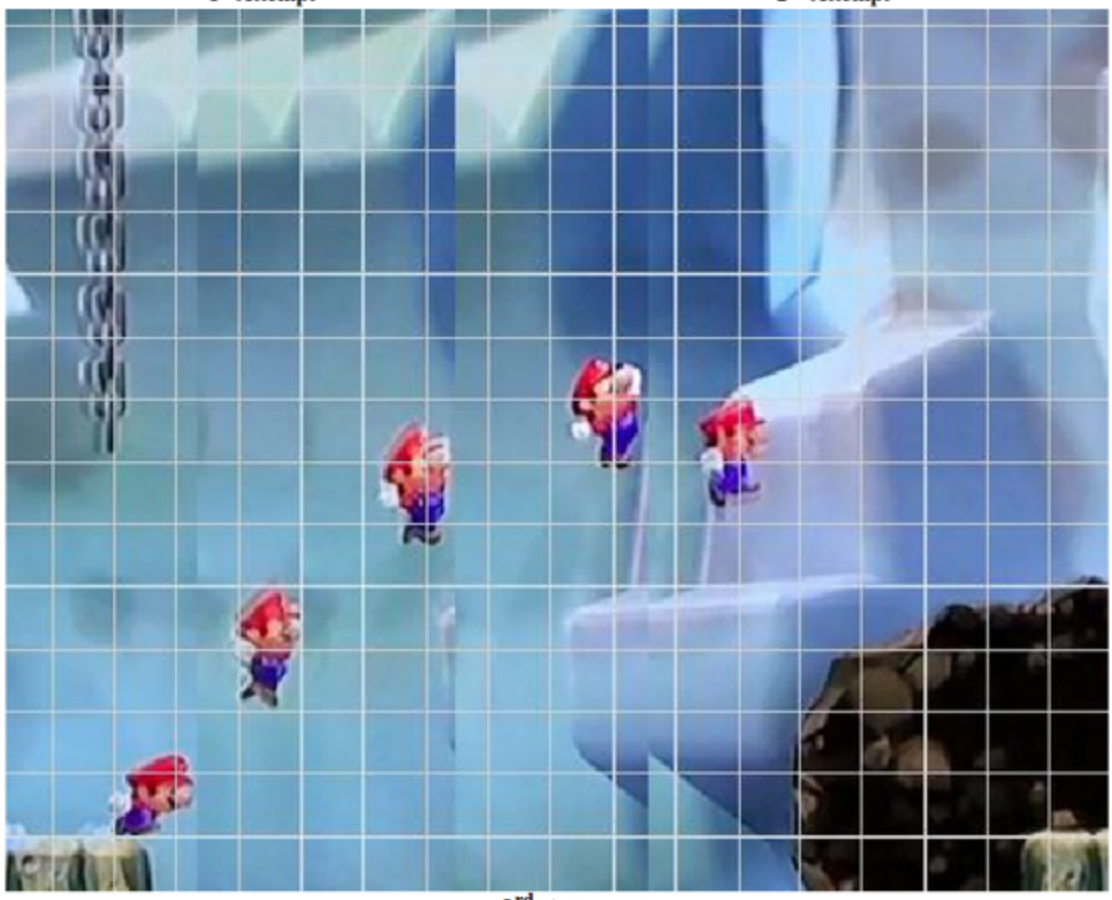
The graphs below include screenshots taken from the video. Observe the patterns in the graphs and predict whether or not Mario will successfully make the jump on the third attempt.



1st Attempt



2nd Attempt

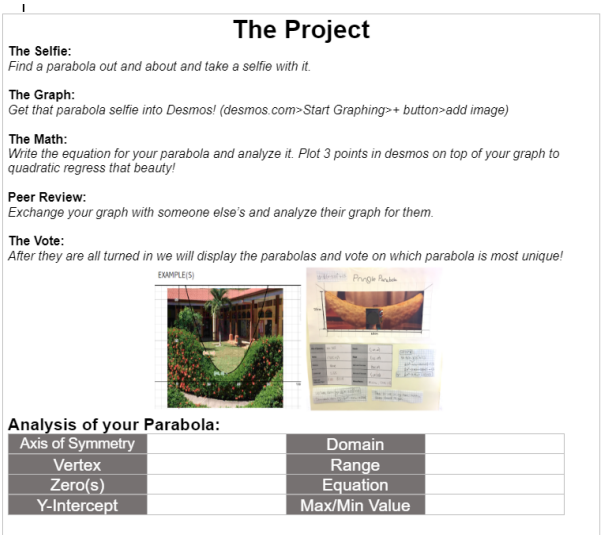


3rd Attempt

Another thing that works really well during the ideate process for me, is taking a walk and sometimes talking out that idea with another person. Again, committing time to a walk is somewhat difficult and on top of that finding a person to collaborate with can also be a challenge. Luckily I have found an online

community through Jo Boaler's website, Youcubed.org, that truly inspires me and activities that I try to bring to my classroom. So even if you cannot collaborate in person, perhaps finding a community online to connect with will work for you. Overall, it's important to ruminate on an idea and give it time to evolve over time so that when you begin prototyping you can feel confident about what you tend to create.

Next I began my favorite part of the design process - prototyping! I have to admit, I probably should spend more time with the ideate process before jumping into prototyping but I love the cycle of prototyping and testing to see how something will work out. I could have just used the Mario example of a parabola, but while some of my students would connect with Mario, others may not so as I developed my idea I decided to just have my students find a parabola somewhere out and about. They should take a selfie with it and then we would upload it into desmos and put a parabola on top of it, analyze the features and vote on who had the most unique parabola. Below is a preview of the assignment and a few of my student's parabolas.



The Project

The Selfie:
Find a parabola out and about and take a selfie with it.

The Graph:
Get that parabola selfie into Desmos! (desmos.com>Start Graphing>+ button>add image)

The Math:
Write the equation for your parabola and analyze it. Plot 3 points in desmos on top of your graph to quadratic regress that beauty!

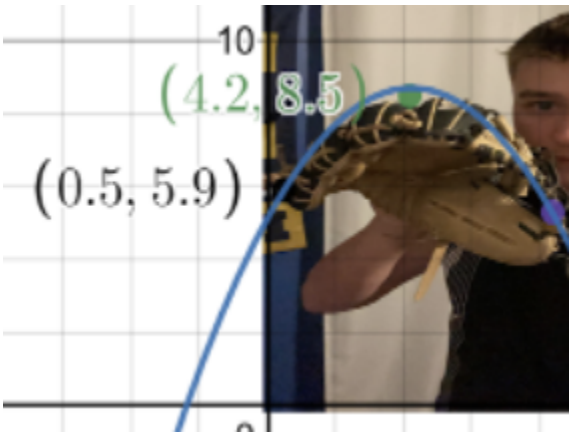
Peer Review:
Exchange your graph with someone else's and analyze their graph for them.

The Vote:
After they are all turned in we will display the parabolas and vote on which parabola is most unique!

EXAMPLE(S)

Analysis of your Parabola:

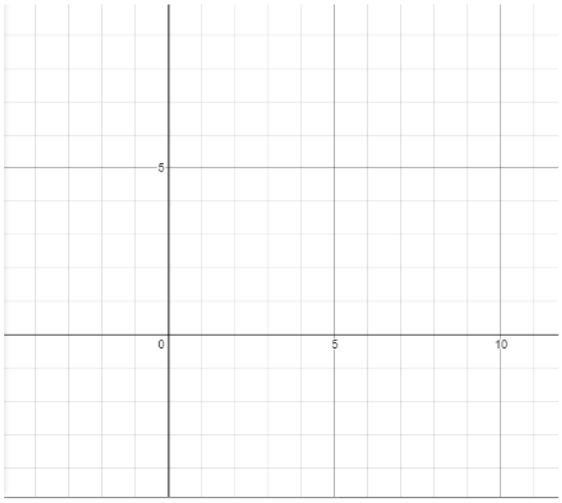
Axis of Symmetry		Domain	
Vertex		Range	
Zero(s)		Equation	
Y-Intercept		Max/Min Value	



While my students did really well with this assignment overall, I used it as an assessment at the end of the unit and had them do most of the work outside of class so I didn't get a great idea if students who were struggling in math actually enjoyed or felt successful about this activity. So for my next group of students I decided to change the assignment a bit more. During the Super Mario activity, and another activity I had seen on desmos.com - Will it hit the hoop?, the parabolic path was shown by a video. You could watch the motion of an object and as is the case for a 3-act-math lesson you do not get to see the ending. So, while you see part of the parabola your brain has to finish the rest of it and I liked this added layer to help students that struggle. We all know what shooting a basketball looks like, so we likely can envision the parabola so having struggling students feel successful in predicting the path was the ultimate goal. Below is a revised version of my parabola selfie project where instead I had students take a 3 or more screenshots of a video of something being thrown or dropped so that they could plot points and then get a parabola on top of their object being thrown.

Parabolas Lab

Task 1: Sketch the path the football takes when <student1> tossed it to <student2>



Task 2: Add at least 3 Key Points to your graph above, and write them out in the table below.

X	Y

Task 3: Use the desmos quadratic regression calculator to come up with a smooth curve that goes through all of your points. Write the equation below, and graph it in a different color on your graph above.

Equation:

Your Turn!

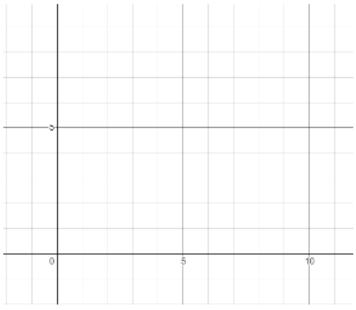
1) Record a slow motion video of a parabolic path.
2) Take at least 3 still images of the object following the path at 3 different points.
3) Upload these images into desmos one at a time (click the + button>image>find your image, rotate or drag and drop it so the corner of the picture is at the origin)
4) Add at least 3 points to your graph and write them out in the table below:

X	Y

5) Use the desmos quadratic regression calculator to come up with your quadratic equation. Write your equation:

Equation:

Graph:



They created the video, graph, and eventually the equation. My students had a lot of fun creating their videos and everyone was able to plot and graph the parabola. However I still know there is room for improvement here - adding in a part to

analyze key points of their graph, or watching and analyzing other students' paths, or come back to the idea again at the end of the chapter to make an even better video and graph are great ways to improve upon this lesson.

Even after the prototyping and testing process and seeing my struggling students enjoy and find value in math there is still so much more that can be done and needs to be done to help students struggling in mathematics. Words of empathy and kindness go a long way to just let those students know that their anxiety and struggles are seen and respected. If you can give your students more time to sit with a new topic and see it from different perspectives and show them how each of those things connect they have more opportunities to be successful. By engaging your students with mathematical tasks that they see value in doing because it has some sort of connection to reality can help them finally see the value in learning mathematical concepts. Going through the entire design process I really have a new appreciation for how much teachers do this daily in their classrooms when considering each new lesson they bring to their students.

Resource:

Picha, G. (2018, May 17). *Recognizing and Alleviating Math Anxiety*. Edutopia.

https://www.edutopia.org/article/recognizing-and-alleviating-math-anxiety