

Mark Russo's Journal

2/01

Beginning Tinkercad has been a bit of a challenge. I think this is mostly because of other things going on in work/life, but also due to my experience learning a brand new tool, and recognizing that if I didn't learn it fairly close to when I would use it, I would forget. I realize that I wouldn't be able to master it ahead of time, so I decided to familiarize myself as best I could in advance of class 2, when we would begin with Tinkercad. To start, I completed the basic introduction activities on the left side of the screen - they were pretty self explanatory, and the program itself is reasonably user-friendly. I then moved on to Eileen's Tinkercad tutorial, which built on many of the concepts in the Tinkercad tutorial, but added the element of humor, as well as an interesting-looking shape. I think I will ask students to attempt both of these tasks - the built-in Tinkercad tutorial, followed by Eileen's tunnel-like shape - as a way to introduce Tinkercad. I think this will be an engaging, manageable introduction to Tinkercad, which can be followed by the creation of a more complicated shape in the "Tinkercad Basic Shapes" menu, such as "Minecraft Party Glasses" or "Chess Pawn." I plan to work on multiple of these in the coming week, in advance of class 3.

2/03

We tinkered for the first time in class today. I found that some teachers were moving ahead quite quickly, while others were taking their time. There are certainly some challenging aspects to Tinkercad - grouping, aligning, setting an additional workplane that is different from the given - and different teachers got stuck in different places. The biggest question, though, had to do with the manipulatives themselves. Some indicated that they didn't even know where to begin thinking about the manipulative. Others suggested some manipulatives, but they weren't really targeting mathematical understanding (eg. bowling pins), or they weren't much different from manipulatives that currently exist. They also asked a couple questions - can we make more than one item, and can you write on these manipulatives - that I didn't know the answer to. The idea of what to create is also quite challenging for me, and I am trying to balance that with learning Tinkercad. When teaching, I rarely teach the skill before the concept or the why, but in this case, we started with the skill. Teachers wanted to talk about the why, and I don't blame them.

2/10

We completed Tinkercad day #2 tonight, where I left thirty minutes for teachers to try one of the lessons (a skeleton, chess pawn, etc.). Things went more smoothly tonight, and we already have some rising experts who are both offering help and being sought after. Next week, we will do one of the projects, before we finally turn our full focus to the manipulative. So far, questions revolve around the project and what type of manipulative, more than Tinkercad. I am going to iron out a more concrete suggestion for the interviews and assignments. I wanted to keep it open to allow for creativity and flexibility, and I will still do so, but I will create an organizational chart for myself, and then offer it to the class if it might be of any help.

2/17

We spent a good deal of time tonight thinking about project ideas, and this was a much more engaging, interesting conversation. To be honest, the software felt a bit restrictive, since I had to impose some limitations (only one object, one color, one size), and in previous weeks, the software held back the discussions from focusing more exclusively on the mathematics. Even tonight, I had to leave time, and then push the teachers' thinking to the mathematics. One idea was a cube that had different fractions circles on each face, but this, to me, was an example of a manipulative that fit the criteria (and Tinkercad), rather than the spirit of the project. Another involved a football template (a flat in base ten blocks) where base ten block pieces were made of 1s, 2s, 3s, and 6s, for a student who loved football and as working on addition. A third involved a subtraction situation, where balls, a trap door, and a funnel could be used for modeling purposes. If I were to do this again, I would not introduce Tinkercad too early, and I would focus on making meaning, then manipulative ideas, then Tinkercad. The problem, though, is that we are quite limited in what Tinkercad can do (at least I think we are - I don't really know yet). The interaction between Tinkercad's capabilities and teachers' ideas is going to be an interesting one to explore. I will try to keep track of which one is the dog, and which one is the tail. I imagine each will be both, at various times. The question is whether that conflict will be helpful, or whether it will diminish the mathematics.

Question: Can the 3D Printer print a specific color (or different colors)? I assumed no, but just wanted to confirm.

2/24

We spent a significant amount of time talking about both aspects of the project - the interviews, and the manipulative. Some teachers already completed their first interview (or two), and their experiences took a lot of the pressure of the rest of the class. Further, Eileen's "Getting to Know You" interview protocol was very helpful, particularly for the handful of teachers that seemed very nervous. We spent time in small groups discussing our project ideas, and then some time as a large group. Different suggestions were shared, and then some teachers shared their confusion/frustration, and we were able to generate some ideas as a group. Teachers stated their student's age and what they were working on, and the group was able to make some suggestions, either based on their own ideas, some of their failed ideas, or some of the manipulatives they know students use in those grades. We also had a teacher who had already completed his project, so he was able to show it to the class, and show them the website (thingiverse.com), which shares examples of 3D printed objects. I have found that there is a measurable level of stress from some teachers, but also some real discussions among teachers about what to do and how to do it. I like the idea of a problem situation/challenge, and teachers seem to be gearing up for it. My fear, still, is that the technology will take precedence, and the mathematical value the back seat, but I will work to try and help teachers balance the two.

3/02

We had a really productive class tonight. Teachers were designing, asking each other mathematical questions, and I had more opportunities to really talk about whether the manipulative would deepen students' mathematical understanding. Some are further along than others, and some are more mathematically meaningful than others. I think we are ready to move towards the "is this feasible" place, at least for some. Can I send some initial proposals along to get feedback? I would love to be able to offer this feedback myself, but I am not familiar enough with the process. Could I have some help?

Student #1

Here's the pizza link

<https://www.tinkercad.com/things/9inKM7wYCnk-pizza-prek-manipulative/edit?sharecode=WWD0mIR2g-LiDMeVk5nNfuc4ExZG8I3fPhI0SvRIA=>

-Will the pizza print if it is 3.55 inches

> Yes. But if you want it larger, you can edit the grid and adjust the size. Or you can just mention the size you want when you send it to print. Currently, the diameter is almost 8 inches. That's a pretty good size.

> Also consider dividing the pizza into slices that are NOT equal parts. Maybe half the pizza is divided into thirds? That will allow for other kinds of engagement that existing fraction circles don't already allow. For instance, you could have conversations about the importance of equal partitions. You could also ask, What fraction does each piece represent? (it's no longer obvious that they're eighths); How many eighths in all? How many sixths in all? What is the sum of two pieces of different sizes?

-how can I raise the pepperoni so that it also prints

> Not sure what you mean. They're raised just a bit as it is. Note that everything here needs to be grouped into a single object. Otherwise, the printer treats these pieces separately; they're not stuck together. Also note that everything prints in a single color. That color is whatever filament is in the printer. If you want a specific color, include that request when you send it to print. If you want, you could remove the pepperoni and print a bunch of pieces separately. Then glue them to the slices. We could print those in red.

-will it print in slices?

>Yes.

If that doesn't work here is the link to the 3-D die

<https://www.tinkercad.com/things/aFi7xK0ckUl-3-d-die/edit?sharecode=0OVwk71nGq9EN98DjM9mQ9VJmSlPwgB61LsfA3WUOA0=>

-will this print correctly?

-will it come out all the same color or different shades?

>First, all of the pieces need to be grouped into a single object. Otherwise, the printer treats these pieces separately; they're not stuck together.

> It will all print in a single color. Currently, the "three" is on the bottom. I suggest the four or the six so that it's balanced. Note that some of the object is in the air above the workplane. The printer can't print in mid-air, so it prints supports in order to accomplish that. These supports are filament that will easily break away. I'm wondering what the advantage of having the dots protrude from the die. (Hey Mark, Eileen here, are the protruding dots for special learners?) If that's not essential to the design, I would make them set into the cube instead. It will print more cleanly. If it IS essential, the supports will make the print work.

> What affordances does this die have that existing ones don't? How about making dice with only evens? Or only odds? Or fractions? Or one with fractions and one with decimals?

Students #2

Here are our 3 3D designs:

<https://www.tinkercad.com/things/7pVO5ltcJe0-less-than-gator/edit?sharecode=aZFAGUM5dXzdJW0gtjAK51JglSqPuHWxWRL1Sq8apXU=>

https://www.tinkercad.com/things/3VRC5qMchV4-greater-than-gator/edit?sharecode=FL6ZCu_8Uw00xxGGHt1ZL2zXwRS5bMbF94firIYeH_k=

_____>The printer only prints in a single color. That color is whatever filament is in the printer. If you want a specific color, include that request when you send it to print. Consider making a hole where the eye is since you can't print it in its own color.

Also, everything here needs to be grouped into a single object. Otherwise, the printer treats these pieces separately; they're not stuck together.

Finally, some of the teeth are raised in the air. The printer can't print in mid-air, so it prints supports in order to accomplish that. These supports are filament that will easily break away. It seems like you could lower those teeth into the workplane without compromising your design. If that's true, I suggest you do that.

https://www.tinkercad.com/things/1PfpCN3tmC-amazing-turing-bombul/edit?sharecode=UcYwpPXaGTy_B2WbxkoxR4SHK4saI_-JrPGEoK1kuqY=

_____> Consider attaching them with a thin rail, so it's clear that they're meant to be used together.

> What does your design allow for that written symbols don't? How does it allow them to think differently about the mathematics? Why have separate tools for less than and greater than, when one is simply a rotation of the other? (Hi Mark, if the designer centers the "eye" it will be more easily rotatable) What's being compared? Physical collections or things written on paper? How can these be used to determine which quantity is greater? How about making just one of these and put it on a spinner? Then you could set it between two quantities, and the student would spin it in the "right" direction. It currently has no center of gravity where you could make a hole for a peg to go through, so you'd have to modify the design a bit. If the equals sign had teeth on it and each branch were separate, you could ask the student to use just that piece for comparison: they would do so by rotating each branch to produce a less than sign (rotate top branch counterclockwise and bottom branch clockwise), an equals sign, or a greater than sign (rotate top branch clockwise and bottom branch counterclockwise).

Summary Feedback for Mark:

Hey Mark, Steven indicated that he wrote the feedback so it could be read by the students so please feel free to share with them.

When you're talking to them in class or during design sessions: Think about asking them to consider how their tools are going to be used by children? What kinds of problems or investigations can be pursued with them? Are teachers anticipating different kinds of reasoning because of the use of the tools? I am sure you know there are no right or wrong answers here. . .but in case the children do something innovative with their tools during the interviews, they can be on alert and think about how to support and further the children's thinking (using the tool!).

So again, we wanted to ask: How many manipulatives total do you think the class will be producing? I encouraged groups who had similar ideas to get together early on in the interest of minimizing the print load.

If it were up to me (Steven), I'd reject the alligators and push them toward a tool for learning like I tried to describe above. Rejecting ideas wasn't rare, and in doing so, I emphasized the purpose of the project. For example, I did this with a tool that simulates flipping and multiplying

There seem to be 3 main constraints to emphasize:

1. Parts must be grouped together if they're part of a single object.
2. Things can't print in midair without supports. Supports can break away, but it's best to try and avoid using them. They're a bit messy and they increase the risk of a failed print.
3. Objects print in a single color. That color is not determined in Tinkercad. It's determined by whatever color filament is fed into the printer.

Eileen and Steven here: How are you feeling about the project? Is there anything else we can do? Just an FYI: I was a neophyte on printing when I taught 577 and as Steven informed me of the very constraints he lists above, I brought these to my students as constraints imposed by the technology. . . and my students were understanding and able to adjust designs (if needed) or just roll with things as they were. And we are here for the blaming (if needed!).