

Background:

This file was tested in an in-person kindergarten classroom where social distancing is being enforced. With these modifications, collaborative efforts like passing string around a circle were unable to be performed. Therefore, the lesson proceeded exclusively via Zoom. The notes below first describe what the instructor did in the thirty-minute class, then they follow with observations that the kindergarten teacher observed.

Lesson Plan:

Each student had an iPad where they could interactively watch a Zoom lesson about this material. The instructor began using the *Class Circle* sheet with student initials filled in. A couple of the students had the same first and last initials, so we took the time to add in middle initials to ensure each student knew where they were located in the circle. One student was not in class, so their initials were swapped out with the last student and the circle was made one smaller. The class that day had 13 students.

After initially creating a class polygon using the *Class Circle* sheet, the instructor moved to the *Polygons* sheet and found the same polygon using the scroll bar. From there the instructor moved up to a much larger polygon ($n = 40$ or so) so that students were able to see how closely the polygon starts to approximate a circle. From there, the instructor moved back to the triangle and went through the first few clickable questions. Instead of providing answers, the instructor asked for thumbs up or thumbs down on an assertion, and most students responded correctly.

From here, the instructor went back to the *Class Circle* sheet and started by using the first 5 students (by setting $O2 = 5$) to hand-draw a star by jumping over every other student. The instructor showed this both manually by holding down the mouse clicker the entire time (which produces a very crude line, much like a kindergartener would draw) and by clicking and then releasing the mouse each time that the instructor got to the second vertex around the circle. The instructor started on the lower left and went to the top, then lower right, then upper left, then upper right, then lower left to finish the star.

Then the instructor returned n to the class size and created an every-other student star. As suggested in the paper, students were asked after the first few jumps whether they thought every student would, in the end, hold a piece of the string. This elicited both answers (yes and no) as expected. As it turns out, the circle had an odd number of students, so the answer was yes. Then the teacher was added as the 14th person in the circle, and the answer changed to no.

From here we created different sharpness stars. The students really enjoyed the ones that had very sharp points. They also independently pointed out that there were shapes within the stars that they could recognize. The instructor scrolled over to the images to the right of the main landing page on the *Class Circle* sheet (to columns AH to AV) where examples are posted. The students thought the different shapes were pretty neat, including the ones at the bottom which are based on more complex counting patterns.

The instructor asked if they would like to make a similar pattern using their own circle? They did, so the instructor asked for fingers to show how many points we should jump over initially. One student showed all 5 fingers so that is what we did, then the instructor asked for a second number different from 5. One student requested 6. The pattern of 5 jumps then 6 then five ... was followed until the pattern ended at the starting place. A pretty cool image resulted, and the instructor mentioned a few of the attributes of the resulting figure.

From here the instructor went to the *Stars* sheet and spent a bit of time showing different sharpness stars by scrolling J up or down for fixed n as well as varying n for fixed J . Scrolling both ways provides interesting patterns that could be discussed if time permitted but by now we were out of time and the students were starting to get restless.

In class, the teacher observations:

I wanted to give you a little bit of feedback from yesterday. That was the first time most of my class was on Zoom and I think that went well once we got the technical things figured out and got them all muted so there was not so much audio feedback.

I think the kids understood the beginning of the lesson where you were talking about the flat and pointy bottom/sides of shapes. They picked up on the fact that it was a pattern of every other one. When you started with the stars, they enjoyed looking at the different shapes and finding different shapes inside the stars (triangles and circles).

Some things that I would have done in addition to the Zoom on the iPads would have been to then build the shapes (a simple one) with string. If we were not working around COVID restrictions, I think I would have included more hands-on activities in addition to the technology of using the iPads. I think that this dual approach (hands-on and electronic) would provide better development and increase their understanding. I would also focus more on using the term "patterns" instead of even and odd and skipping numbers. Patterns are something that the children have a pretty good grasp of.

In a non-COVID year, I think I would start out with a shape review and discuss what we know about the different shapes. Then I would most likely have the children create a circle using a string. I would ask questions like, "how can we make it rounded like a circle?" and "would it be easier or harder if we had more/less people?" Then after we did the hands-on activity I would move to the technology and show the children on the projector as well as their iPads, giving them time to play around with the shape and numbers. We would then discuss our findings and observations. I would probably move on to the stars discussion on the second day. I would start by reviewing what we discussed and practiced the day before and then move into the star activity setting in up in a very similar layout (making a star and discussing what we observed, showing the Excel document on the board as the children used their iPads). Depending on how they do as a whole group, we might break into smaller groups for discussion of what we learned and discovered. After the star lesson, I would allow the children to try to draw the star and color it or maybe print out a star we created and have them color that. This would help build

their understanding and help them visualize better what was happening on the iPad and in the Excel document.

I am impressed with how well they kept focus throughout the lesson but typically 30 minutes is much too long for a lesson that does not include gross motor or fine motor activities and is not developmentally appropriate for this age group. They did, however, figure out the technology fairly quickly, for it being their first time using it. They also seemed to really enjoy using the iPads in this way.