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Larson Fairbairn

Pacific Lutheran University

Kameelah Jackson

Pacific Lutheran University

Ksenija Simic-Muller

Pacific Lutheran University

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Making Art in Math Class During the Pandemic

Larson Fairbairn

Pacific Lutheran University, Washington, USA

larson.fairbairn@plu.edu

Kameelah Jackson

Pacific Lutheran University, Washington, USA

jacksoka@plu.edu

Ksenija Simic-Muller

Department of Mathematical Sciences, Pacific Lutheran University, Washington, USA

simicmka@plu.edu

Synopsis

For many of us, the pandemic has changed how we teach and how we support students. Here we describe the positive impact that creative assignments in a mathematics content course for preservice K-8 teachers had on students during the early days of the pandemic.

This article highlights creativity as a way to support student mathematical and emotional well-being. The story is told by the instructor and two former students in the course.

Keywords: humanizing, creativity, teacher education, geometry

Much will probably be written about the unprecedented spring semester of 2020, how it caught us off-guard, how we managed it, and all the losses we endured. This manuscript has a different story to tell, one about a successful moment of humanizing mathematics and an unexpected instance of thriving in a class hastily moved online. It is a collaboration between a faculty member and two students enrolled in one of her classes in the spring.

Mathematics at its best is a humanizing endeavor. Humans have always engaged in mathematics to make sense of the world. Unfortunately, current schooling in the United States has taken much of that away, and many practices present in schools at all levels dehumanize students. Gutiérrez lists traits of schools that she and others have identified as dehumanizing, including “being asked to leave one’s identity at the door,” “speed valued over reflection,” and “perpetuating the myth that mathematics is objective and culture free” [5, page 3]. To counter these practices, we are tasked with rehumanizing mathematics. In a rehumanized mathematics classroom, students would bring their entire selves, their communities, and their histories; they would engage in mathematics as a living and creative practice; they would see themselves represented in the curriculum; and they would take ownership of their learning. In a rehumanized mathematics classroom, students would be able to “depart from a purely logical perspective,” “draw upon other parts of themselves,” and therefore “be more in tune with themselves and less likely to succumb to pressures to ignore their senses and ‘just pretend’ in order to do school mathematics” [5, page 6].

When universities made a quick switch to virtual learning due to the pandemic in March 2020, the inequalities that were always there came into sharper focus [1, 9]. While some faculty had already been aware of the challenges that many college students deal with, including mental health issues, housing and food insecurity, and race and class issues, to name a few, many others saw them for the first time. Faculty members were advised to connect with students, provide more flexibility, and prioritize relationships over content [3]; in other words, to humanize our teaching. In the example we will describe here, humanizing happened in an unintended and perhaps surprising way, through giving students space to be creative and make art in a mathematics class.

Mathematics, Creativity, and Art

That mathematics is immensely creative is possibly one of its best kept secrets (or perhaps another evidence of its dehumanization in school settings). Su discusses exploration, play, and beauty in doing mathematics, and frequently appeals to creativity, stating that it is “the sign of human flourishing” [12,

page 131]. All of these, we believe, are components of mathematical creativity, by which we mean the use of creativity to engage with mathematics and solve mathematical problems. A recent issue of the *Journal of Humanistic Mathematics* (Volume 10 Issue 2) was entirely dedicated to this topic, as creativity is an essential part of humanizing mathematics. One article from that issue in particular aligns with our goals here: “Recognizing Mathematics Students as Creative: Mathematical Creativity as Community-Based and Possibility-Expanding” by Meghan Riling [8]. This article will help us frame our own essay, though we should note that Riling discusses mathematical creativity generally, while we more narrowly focus on artistic expression for the purpose of learning mathematics.

Three of Riling’s observations are especially relevant here.

First, while we can agree that mathematics is an inherently creative endeavor, the notion of mathematical creativity has also been used as a gatekeeper, as only certain segments of the population have been assumed to possess mathematical creativity and therefore be good at math [8]. The third author, KSM, works with preservice K-8 teachers, many of whom have negative attitudes toward mathematics that stem from prior negative experiences with the subject [11]. These students are also likely to come from white middle-class backgrounds, but will teach in highly diverse public schools. It is therefore important to provide them with experiences in which they can see themselves as mathematically talented and creative, both to repair their own relationship to mathematics, and to challenge limiting beliefs they possibly hold about their future students’ mathematical potential.

Second, Riling notes that “[a] creative action may take many forms. The actions that have creative potential are those that students decide to take of their own accord, using their own agency” [8, page 18]. While connecting mathematics to creativity can happen in many forms, not all are empowering in the same way. For example, studying mathematics in already existing works of art is worthwhile, but leaves less room for student agency. If our goal is to rehumanize mathematics for all students, then our students need to have a say in what and how they learn. Riling’s observation therefore aligns with the goals for the assignment described here, namely for students to be creative actors rather than witnesses of others’ creativity.

Third, Riling notes that creativity is related to status in the classroom. She writes that the ability to be creative “depends on the status that individual students have in their class or group which are often influenced by perceptions of and assumptions about students’ gender, race, and social class” [8, page 16]. Despite our best efforts to create a cooperative classroom, some students will still likely have higher status than others. Race, class, and gender play a part in these configurations. While online classes have many downfalls, they allow some students to escape the judgment of their peers. In this case, no one but the students themselves are the judges of what it means to be creative and how this creativity is related to mathematics.

To summarize, in this article we consider and offer examples of assignments that encourage creativity to broaden students’ perceptions of mathematics and improve their perceptions of themselves as mathematics learners. We believe that the pandemic context gave us the opportunity to do this in a way that allowed students to use their agency, and in a setting that was potentially limiting but also provided opportunities for improving their perceptions of themselves as mathematics learners.

1. Context

The course described here is the second of two connected mathematics content courses for preservice K-8 teachers at a medium-sized private liberal arts university. The third author, KSM, teaches these courses most semesters. At its best, in person, the course is based on social constructivist pedagogies [15], allowing students to work in groups to deepen their understanding of K-8 mathematics. The course focuses on probability, statistics, geometry, and measurement, while also giving more space for thinking about teaching mathematics in culturally responsive ways. It is based on the premise that mathematics and mathematics teaching are not neutral but culturally and politically situated [4, 6].

Students enrolled in the class are typically not yet in the education program and have not yet begun their practicum. The majority of the students identify as women and most present as white, though the diversity of the class has been changing along with the overall student demographics at the university. Many in the class are also first-generation college students.

During the pandemic, a few continued to work full-time or take care of family members. Some dealt with family and mental health issues.

After the switch to online learning at the end of March, the class met synchronously twice a week via Zoom. There was a breakout room activity during each class, consisting of check-ins and group work. All throughout, KSM worked on maintaining the sense of community among students, though with mixed results. Students adapted admirably, but there was a pervasive sense of loss for the instructor and students alike. It may also be worth noting that KSM had no prior training or experience with online teaching.

Assignments and Assessments

In the pre-pandemic version of the course, there were four monthly assignments, one for each strand of mathematics covered. Each gives students the freedom to choose a topic within the guidelines. For example, the probability assignment consists of doing a probability analysis of a game students have played with families and friends.

With the switch to online learning, homework assignments became more central to the course, and were adapted to the new environment. Homework was assigned weekly and split into smaller components. Each homework assignment included prompts related to teaching and usually required creativity and hands-on work. For example, when learning about symmetry, students looked at quilts from Gee's Bend (see [10] for more information on these quilts, their makers, and their history) and created their own quilt patterns. When learning measurement they were to do a measurement scavenger hunt around their home.

The place where creativity was most evident during the Spring 2020 semester was the geometry assignment. This assignment consisted of creating geometry art (see Appendix A for guidelines). Students were given some options for art they could make (e.g., tessellation, Islamic pattern, perspective drawing, or a drawing consisting only of geometric figures), or they could choose their own. They were to make the piece of art and write a reflection about how they would use it in their classroom. Typically, in pre-pandemic times, a few students, those who self-identified as artistic, would put significant effort into this assignment, while others would end

up submitting passable tessellations, sometimes copied from the Internet. The instructions for the assignment did not change in the spring of 2020 from the previous semesters, but the results did, and it was clear that just about everyone put a significant amount of effort into their creation.

Another place where creativity came into play was the final exam. The assessments during a typical semester are more traditional, including a final exam that consists of problem solving in different strands of mathematics. Inspired by Francis Su's blog post that suggested alternative exam questions that would prioritize values such as curiosity, imagination, or creativity [13], the final exam was turned into a portfolio-type assessment. Students were allowed to turn in their exams in any format they wished, including writing, typing, drawing, making videos, recording songs, or making slide presentations.¹ Students were asked to use activities from class to answer mathematical questions (e.g., "Why do we multiply along branches in tree diagrams?") as well as questions about their own learning (e.g., "Give an example of a problem, activity, or assignment that will be useful to your future teaching."). While not everyone put as much effort into the final exam, probably due to exhaustion from an unprecedented semester, some clearly enjoyed the ability to do their work in a non-standard format.

A Note on the Writing Process

This article is based on the work and reflections of two students, LF and KJ, who will share their experiences in their own words. All too often, education research focuses on what preservice teachers cannot do. While the field is beginning to overcome its deficit views of children [7], it still focuses on preservice teachers' beliefs and practices considered deficient. Our research can become adversarial [2]. Furthermore, education research oftentimes is about observing and analyzing our own students, which comes with its own ethical concerns. In the spirit of collaborative research [2] and inclusivity, this article is written with rather than about students. These students were selected because of the quality of their work and because of the insights their reflections provided.

¹ This approach is aligned with Universal Design for Learning [14], and fosters inclusivity.

In the next two sections, LF and KJ will describe themselves and will provide commentary to their reflections and work. In each case, the instructor, KSM, will provide additional commentary. In both sections, we will indicate whose voice each part of the writing represents.

Case 1: Kameelah

Kameelah's Reflection (by KJ)

I am currently a junior majoring in Elementary Education who would describe myself as an unapologetic passionate extrovert who has social anxiety. My relationship with mathematics can be described similarly to my relationship with mental illness. I am familiar with it, and I feel as if, for the longest time now, I've tried to avoid it because it makes me have a certain feeling of discomfort. With the two topics bringing in a form of stress into my life, it wasn't surprising when I realized that they started to lead to a direct hit on my work ethic and selfhood. These topics were hard for me to cope and work with because they brought me a sense of vulnerability that I was afraid would be misinterpreted as a weakness rather than a strength.

Due to my past experiences of math courses, I've always seen math as a topic that focused on competition rather than cooperation, which was what made it even more intimidating. My memory of elementary and middle school math consists of doing timed races for multiplication facts, pop math quizzes instantly after a lesson, being put on the spot to solve a problem in the classroom in front of everyone ... those days were full of nothing but anxious moments. I feared math because I misunderstood the true meaning of learning it. The structure of how math was taught during my time as a student was very stressful, as if I was constantly being challenged and not growing because I kept comparing my skills with others' based on the pace it took me to solve a problem. I liked learning at my own pace and being introduced to other methods to understand concepts. However, as I found myself having my creativity in solving problems limited, I gained a cognitive distortion of black-and-white thinking: *it had to be solved in one way, while everything else is considered incorrect*. My anxiety began coming up inside and outside of school, and I began accepting this ideology where I was considered not as intelligent because I didn't learn as quickly or could not always answer a problem through a certain way.

I wish it didn't have to take a global pandemic for people to start realizing that they needed to incorporate more creativity in the classroom in order for students to learn better. For the time being, the pandemic has affected my math learning experience because it has allowed me to give the time to not just reflect on myself, but on my studies as well. During my time in quarantine and taking online classes, I found my way to work through my anxiety; my math professor continuously assigned us lessons that incorporated much creativity, and that was enough to relieve stress. I am not saying that creativity in a classroom instantly cures a pandemic or mental illness, but sometimes a cure or coping mechanism can be found through creativity. We did activities in the classroom like coloring, making geometrical art, learning about African American culture that could be tied to our mathematical lessons, etc. Examples like these showed that the class didn't really just feel like a class for mathematics. What made it creative was that the course made us rely on cooperating with ourselves, peers, and professors . . . there was no need to feel competitive because there was nothing to compete for. With creativity, everyone goes through things at their own pace and using their own definition of how far they need to go to actually understand the concept. There is no need to feel left behind because the point of the lesson isn't necessarily meant to compare the work to others; what matters is if we have an understanding based on the way we try to engage in that knowledge and able to comprehend for ourselves in our own way.

KSM's Reflections on Kameelah's Work (by KSM)

As Kameelah writes in her reflection, in both classes she took with me, she expressed discomfort with mathematics and frustration that her peers completed assignments faster than she did. In that respect, the switch to remote learning provided her with some relief and ability to work at her own pace. On the other hand, Kameelah also hinted at some difficulties associated with the pandemic and the uncertainty, stress, and anxiety it created. In a few of her reflections about the geometry art assignment during the semester, Kameelah wrote about the positive effect of this and similar assignments on her well-being.

For the geometry assignment, Kameelah created a drawing that she described as an attempt at poly art representing party hats (something we would not

be using for a while), seen in Figure 1.

Figure 1: Kameelah's geometry assignment.

In the accompanying reflection to the assignment, she wrote:

I will admit as well that a part of this drawing was made for the sake of it being therapeutic for me. I've been feeling a little overwhelmed more than usual since lockdown, so I went a little off rubric and did random shading all around the background of the party hats.

While Kameelah most openly discussed the assignment as therapeutic, other students expressed similar sentiments in their reflections, so her comment can be considered representative.

One of the questions on the final exam asked what students' favorite and least favorite assignments were. Kameelah listed the final exam as her least favorite, adding,

I am just burnt out, like a lot of students. My favorite activity was when I got to make symmetrical/geometrical art. It was when I got to express my creativity but also not feel so stressed

out while doing it. It was therapeutic to color and make shapes with no rush.

Note that she again describes the creative geometry activities as therapeutic. Finally, in the final check-in for the course, when responding to a question about the effectiveness of homework assignments, Kameelah wrote:

They were entertaining, stress relieving, and the due dates were flexible. We could do the work on our own time, and some assignment questions weren't necessarily structured as one-question-one-answer. The Geoboards and Symmetrical assignments for example, was work where I found myself not to feel too pressured in searching for one correct answer.

Many students learn, through the dehumanizing teaching of mathematics, that there is one right answer to each problem. In the symmetry assignment, students were to create different quilt designs with particular types of symmetries. Figure 2 shows a design with rotation and no reflection symmetry, and another with no symmetry. Many solutions were possible and students can be as creative as they wanted.

Figure 2: Kameelah's quilt designs.

In all three of Kameelah's reflections, the difficulty of the semester is evident. What is also evident is the ability of the creative assignments to provide some relief from the difficulty. Kameelah did not see herself as a successful

mathematics learner, despite all my attempts to convince her otherwise. She found mathematics intimidating and found her classmates who were faster at solving problems challenging to work with. As a woman of color she also had to navigate the complex landscape of race in the classroom. While the switch to online learning was difficult for her, she was also able to reclaim some of her agency as a mathematics learner and to transcend status issues through working at her own pace on creative assignments. These outcomes are aligned with Riling's observations about creativity in mathematics [8].

Case 2: Larson

Larson's Reflection (by LF)

In a sentence, I would describe myself as an athletic, academically motivated young man who follows Christ and is invested in my friends and family. I live in a small town in the very northwest corner of our state where I enjoy hiking, cliff jumping, movies, and almost anything related to athletics or adventure. From my perspective, my race identity is not as significant to me as the broad idea that my large Norwegian and Swedish percentages have caused me to be a larger statured, white man. This means that because of my skin color I am privileged. My gender is a more important factor of my identification because of my wonderful blessing of having a twin sister. This fantastic situation has helped me to realize the extreme sexism and inequalities all around us when it comes to the treatment and expectations of men and women. Having been exposed to this imbalance, I think that I am more aware of other social issues than I otherwise would be.

My relationship to mathematics has been a balance of confusion and confidence. From the early stages of education, there were a few things that were very obvious to me. The first thing that stuck out to me in my experience was that math builds upon itself. Throughout elementary school, middle school, high school, and even in college courses, there is always a growing system. You must first learn the fundamentals, get comfortable enough that they are unconscious, like muscle memory similar to a baseball player catching a ball. Then as you advance, these fundamentals are implemented, twisted, and challenged, like a trick play at the end of a football game. If you don't first have the basics down, you will never get into the game.

In Spring 2020, the day after my first ever collegiate track meet, I was told that I was going to go home for a few weeks because of the novel coronavirus. This news quickly spread to the cancelation of all in-person classes for the rest of the semester. During this time, I was forced to adapt to a new style of learning, along with professors many of whom, for the most part, were challenged to modify the way that they had been teaching for many years.

At first, several professors took a lot of time trying to figure out the new format that they would be working with, not knowing that this was going to continue for so much longer. It wasn't what any of us had signed up for, but it was the way it would be for a while.

There were several positive and negative aspects of the online experience last year, including the fact that everyone's rhythm was thrown off.

The positive sides of the situation included several pieces that are often overlooked (especially in the midst of a global pandemic). The first thing that I noticed was that so many people instantly got to spend time with their families. This was a rough adjustment for many, after getting used to the freedoms of college, but the fact that families were forced to be in the same house, eat meals together, and discuss lives—this could just be me showing some of my privilege, but it still feels right to state—seemed like it turned out to be good for many hearts and souls. Another good thing that I saw which was also reflected in several of my classmates and friends was the education style. Because you could use notes and information on many exams, it took away a lot of the stress of trying to cram and memorize everything that you would've needed to remember for the test and apply a larger amount of focus on actually understanding the bigger picture and developing long-term base knowledge of that subject. By figuring out the key parts, and gaining an overarching view of the subject, many peers reported that their learning seemed to become more applicable to the real world.

The negatives were also very relative during this part of the semester, and I think educators will also have to consider them carefully if they are going to prepare the future generations. Many professors had done their job the same way for a long time, and being forced to go online was an overwhelming transition period for them. Through that time though, many professors clung to their same standards of learning and provided the students with the

same tests as they would've if they would've been on campus. This would make sense from an outsider perspective perhaps, but when you consider the resources such as internet access, capability of devices, time and space allotted for school, access to people like tutors and office hours, as well as the inability to clearly get a point across over a technological gap, it becomes clearer that certain things besides the learning platform have to change while we continue to learn online. People simply need more time and resources if they are expected to get that work done at home instead of an environment literally created for the sole purpose of higher education.

My mathematical learning didn't suffer too much throughout the course of last semester, but I would say that I am pretty unique in that way. Since my math classes were more based around how to instruct and present math to elementary students instead of learning a whole new form of mathematics, it seemed like the instruction was able to function more seamlessly in an online environment. I understand that several of my classmates and friends who were taking high-level calculus type classes would report that their understanding and grades were brought down by the fact that they lost tutoring, one-on-one instruction, group collaboration, and several other pieces that they were previously relying on and that seem forced and useless online. However my experience was quite different.

Last semester in my math class, there were a few things that worked well. The fact that the instructor created small break-out rooms is something that helped my understanding of the material immensely. During the semester, the professor realized that if we continued to collaborate with groups of people who we already knew, and enjoyed working with, that we would feel more free to talk and collaborate about perspectives and ideas, whereas when we talked to more randomized groups, the discussion would include simply answers and findings instead of the crucial process that it took to reach those results. The other benefit of this was that we were free to just talk and interact with other people our age, which helped get us into the school-like headspace that we have been raised on. This same professor also incorporated several current and very relevant things into our education such as information on the pandemic, as well as things such as using traditional native quilts to help us learn geometric terms and measurements in ways that were easy to see and would also easily translate to the instruction of younger students.

Our instructor also incorporated creativity into our class assignments. Because of this situation, I felt that the homework was able to feel more personal and thoughtful than lots of the online worksheets that we would fill out for other classes. By including essences of creativity into a class that we all were sure to use for our future employment, this professor helped us feel like there was both a stronger understanding of the material, but also made it more relevant to whatever was happening in our lives during that time.

KSM's Reflections on Larson's Work (by KSM)

Larson attended all the virtual meetings and was always one of the first two students to turn in homework assignments. His grade was secure early on. Nevertheless, he put significant effort into the geometry assignment, creating the piece in Figure 3.

Figure 3: Larson's geometry assignment.

In responding to a prompt on the final exam asking for a particular idea in the class he found creative, Larson wrote the following reflection:

I think that the assignment that I found to be the most creative was probably similar to most of my classmates. The assignment nearing the end of the semester that was centered around some sort of project on geometry gave the utmost liberty and room for creativity. During even the process of planning and scheming up an idea to work on, I found myself enjoying the freedom to be able to relax, listen to some music and work on a project that I selected. My project was mainly centered on perspective built around triangles. It was difficult at times to try to get the colors right to get the reflexional type appearance that I was hoping for but the whole process was enjoyable and makes me want to do art type things more often.

While Larson does not refer to the process as therapeutic, as Kameelah did, his reflection refers to the relaxing properties of the assignment. He also mentions the benefits of being able to select his own project, i.e., to have agency in deciding how to be creative.

Larson was also one of the students who turned the final exam into an exercise in creativity. Figure 4 shows his responses to the prompts asking what the big ideas were in the probability and statistics units, in the form of conceptual maps.

Figure 4: Larson's representation of big ideas in the Probability and Data units.

Both show the ability to synthesize the information in a meaningful way and were likely more interesting to create than writing a paragraph.

Even though Larson seemed to adjust better than most to the switch, it does not mean that it was easy. It is unlikely that anyone was unscathed by the losses of community, routines, and responsibilities campus life offered. Having agency despite all these losses seemed to be another beneficial aspect of these assignments for him.

Closing Remarks: Potential for Mathematical and Other Healing

In previous semesters, there was much to claim students' time and attention. Most were not with their families during all waking hours. The world, while far from perfect, was running the way it always had. A geometry art assignment may have seemed like just another thing to accomplish in their busy academic and social lives. In Spring 2020, however, the creative assignments provided a respite from the real world. Students reported feeling isolated at home and a sense of loss for not being able to be on campus, see their friends, go to sports practice, or have their independence. There was even more uncertainty about the pandemic then than there is now. As Kameelah and Larson, along with other classmates, wrote in their reflections, creating a piece of art with their hands provided an opportunity to do school work, learn mathematics, think about teaching, and relax at the same time.

The assignment provided students with the opportunity to do mathematics in a creative way that departed from a purely logical perspective and to bring themselves into the assignment rather than leave parts of themselves at the door [5]. The latter is especially true for students who are creative and yet do not see themselves as being good at mathematics: in a final reflection, a student wrote that art was always important to her, and said, "when we were assigned to create art for the Geometry lesson, I was pretty excited, and that assignment was one of the few math assignments I have ever done that I actually enjoyed." In response to the question, "What do you wish your teachers had known about you?" this student also wrote, "I wish my teachers would have known that I really enjoy art, and wish they were more flexible about projects and allowing me to express myself in that way." As Riling points out, not everyone has access to mathematical creativity; but for this student, art could have provided an entry point into mathematical creativity and a feeling of belonging in the subject [8].

The pandemic will eventually be over. We will return to the classroom and most aspects of the lives we had before. Perhaps students will not have time to dedicate to coloring and shading a drawing or cutting out a fractal. However, existential, financial, and mental health circumstances for many college students will continue to be precarious. Unless we act intentionally to change the status quo, school mathematics will continue to serve as a gatekeeper that assigns status based on outdated traits and will continue to ask students to leave themselves at the door. Providing spaces in mathematics classes that are creative yet intellectually stimulating and educational, holds great promise for mathematical healing of our students, whether we work with them in person or virtually.

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A. Appendix: Geometry Assignment

A.1. Overview of the assignment

You will create an artwork that uses geometry in a meaningful way. You can choose two- or three-dimensional geometry and can be as creative as you like. Some possible projects are below but you do not have to choose from this list:

- Create a tessellation. Make sure your tessellation is sufficiently complex, and not just <https://paulsolarz.weebly.com/audrey/math-tessellations>; and please don't just copy one from the Internet but create your own design!
- Create an art piece that uses only polygons or only circles (if you choose this option, make sure that it's a sufficiently complex piece: more like <https://paintingvalley.com/drawing-pictures-using-geometric-shapes#drawing-pictures-using-geometric-shapes-35.jpg> than a stick man).
- Create a fractal (here is an example I have done in a 1-3 grade classroom: <https://fractalfoundation.org/resources/fractivities/fractal-cutout/>, and you should also look on the internet for others).
- Create a perspective drawing.
- Create an impossible figure like in Escher's art (<https://lifestyle.howstuffworks.com/crafts/drawing/how-to-draw-impossible-shapes.htm>).
- Create a pop-up card (see <https://makepopupcards.com/how-to-design-your-own-pop-up-cards/>).
- Design or make a quilt that has different types of symmetry in it.
- Create an Islamic pattern (see <https://www.arch2o.com/meticulous-beauty-islamic-patterns-create-check-tutorials/>).

A.2. To turn in

Whichever project you choose, your task is two-fold:

1. Make the artwork. Make sure that your work is neat and creative and that you spend enough time with it. I expect you to spend (significantly) more than 15 minutes on it.
2. Write a one-page reflection about how you could make a classroom activity out of the project that you made. Include the intended grade level and the appropriate Common Core Standards that would go with the lesson (Here is a link to the standards <http://www.corestandards.org/Math/>; note that there may not be an exact standard match, so try to match as closely as possible).

A.3. Grading

Design

Geometry is visibly present in the design (15 points).

The geometric design is complex (10 points).

The design is original and not copied from the Internet (10 points).

The design is aesthetically pleasing (10 points).

The design is neat (5 points).

The design shows significant effort (15 points).

Reflection/Activity

The reflection or activity is at least one page in length (10 points).

The reflection or activity makes clear connection between design and mathematics teaching (10 points).

The reflection or activity describes a meaningful way in which this project can be incorporated into the classroom and teaching geometry (10 points).

The reflection or activity includes standards and grade level (5 points).

Total: 100 points.

Author bios:

Larson Fairbairn attends Pacific Lutheran University and will be entering its School of Education and Kinesiology in Fall 2021. After graduating from high school and taking elementary education courses at the collegiate level, his current view on mathematics is in a transitional period. Previously he focused on expanding his personal knowledge, but presently it has changed to learning to engage with students in meaningful ways. Throughout his time at Pacific Lutheran University and his experience as a captain on the track and field team, he has begun to recognize how critical effective leadership is, particularly the necessity of seeking to offer individualized connection with those around him. As a future educator, he is excited to do his part in changing the world and thinks this is best done through creativity and intentional, personal support.

Kameelah Jackson is an Education major at Pacific Lutheran University who will be getting her degree in Spring 2022. In the mathematical world, she considers herself to have the intersecting identities of a teacher and a student. However, her role in the mathematical world is circulated between the identities of an incoming teacher while also being an ongoing student. A large part of her experience in math as a student mostly came from trying to understand the ‘what’ factor of a mathematical problem. As she started to focus more on her career, however, she began to open up a mindset where mathematics was more about the ‘what’ and ‘why’ factors of problems. To her, the mathematical world is something that welcomes change for methods of problem-solving but also challenges its members to preserve those methods with critical thinking and explanation. Part of her identity is recognizing that in teaching mathematics there is still room for learning, and while learning mathematics, there is still the desired opportunity to share and teach.

Ksenija Simic-Muller initially trained as a mathematician, but retrained as and identifies as a mathematics educator. She teaches in the Mathematics Department at the Pacific Lutheran University, predominantly working with future teachers. She sees her teaching and scholarship as intertwined: in both she focuses on helping create a rehumanized and just mathematics community that empowers learners.