

Preservice Elementary Teachers: Creative Thinking, Pedagogy and MathArt Projects

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Abstract

Preservice elementary teachers, themselves taking a Mathematical Investigations class, completed a project whereby they created an artistic representation of a mathematics concept of their choice. An eclectic collection of produced works demonstrated various interpretations of the assignment. In this paper a very brief theoretical background for this work is provided as well as a sample of preservice elementary teachers' works with the accompanying reflections.

Introduction

As we already know, today's teacher education requires transformative models that cross disciplinary boundaries to create a holistic approach to education. Such transformation entails preservice elementary teachers as well as their instructors to rethink their prior knowledge and transform their approaches to teaching particular disciplines. Mezirow [5, p. 167] captures this transformation in the following way:

The process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand, and feel about our world; changing these structures of habitual expectation to make possible a more inclusive, discriminating, and integrating perspective; and finally, making choices or otherwise acting upon these new understandings.

In this paper, we illustrate how a group of preservice elementary teachers is beginning to rethink their ways of conceptualizing mathematical ideas by developing visual, creative representations of familiar mathematical concepts. Their MathArt project is a part of a longitudinal study focused on developing math-related pedagogical content knowledge [7].



Figure 1: Julie Wingate: MathArt Project Transformations

Nurturing Habits of Mind. Mathematical Investigations is a class that elementary preservice teachers take after taking some general mathematics courses and before taking methods classes with field experiences. So, in addition to “dissecting” selected number of mathematical concepts and processes, and in order to nurture necessary transformative learning processes, the class is focused on analyzing and nurturing habits of mind described in the following paragraphs.

Robert and Michele Root-Bernstein [6, p.11] have studied the value of interdisciplinary learning which led them to demonstrate that creative people often use cognitive skills that go beyond disciplinary boundaries. They write,

... at the level of the creative process, scientists, artists, mathematicians, composers, writers, and sculptors use...what we call “tools for thinking,” including emotional feelings, visual images, bodily sensations, reproducible patterns, and analogies. And all imaginative thinkers learn to translate ideas generated by these subjective thinking tools into public languages to express their insights, which can then give rise to new ideas in others’ minds.

Briefly, they suggest the following goals out of which we can think about cognitive skills and habits of mind that need to be nurtured in any mathematics classroom:

1. Emphasize universal processes of discovery in addition to the disciplinary knowledge;
2. Teach intuitive and imaginative skills necessary to creative processes;
3. Engage in multidisciplinary activities that place the arts on an equal footing with the sciences;
4. Integrate the curriculum by using a common descriptive language for innovation;
5. Emphasize interdisciplinary lessons of disciplinary learning;
6. Use the experiences of people who have successfully bridged disciplines as exemplars; and
7. Present ideas in every discipline in many forms, to reach the widest range of learners.

Furthermore, Robert and Michele Root-Bernstein identified a set of cognitive skills that capture how creative people think effectively across a range of disciplinary domains and contexts. These habits of mind are: observing, imaging, abstracting, recognizing patterns, forming patterns, analogizing, embodied thinking, empathizing, dimensional thinking, modeling, playing, transforming and synthesizing.

Creativity in the Mathematics Classroom

Mathematics is most often viewed as the attainment of algorithms ([1], [4], [7]) contrary to instigating one’s ability to think beyond established habits of mind and to apply mathematical knowledge in different contexts. Creativity is usually associated with arts and that might lead preservice teachers to “neglect it in mathematics, particularly when they also struggle to understand how it may work in the classroom... A worst-case scenario would involve newly qualified teachers entering the classroom unable to recognise creativity, ultimately discouraging those creative pupils from pursuing mathematics or, at least, from being mathematically creative” [2, p.19].

MathArt Project Synopsis Given to Preservice elementary teachers. For an inspiration and your creative imagination, you might want to start by looking at mathart storybooks and other mathart websites, such as <http://bridgesmathart.org/bridges-galleries/art-exhibits/> to see what mathematicians and artists are creating. Imagine that you are making a book with your class mates and you need to make an innovative, creative and unique two-page contribution based on the following requirements:

- Page 1. High quality image of your most creative math-focused artwork—painting/drawing, 3D construction...;
- Page 2. Description of your artwork (technique, artistic value), definition of the relevant mathematical concept captured and what inspired you (reflection)?

Sample Artifacts. In the spring 2014, 35 preservice elementary teachers participated in this study in an effort to create creative/artistic representation of mathematical objects. Most of these preservice elementary teachers experienced only a very traditional mathematics education.

Julie (Figure 1) writes: “I created three drawings incorporating the mathematical concept of transformation. I took a picture of a cat’s face, and then sketched half of it onto another piece of paper. My artwork uses six of the seven different elements of design. ... I was inspired to do this because transformations can sometimes be intimidating terms for 3rd and 4th graders when first learning them. It gives the chance for the preservice elementary teachers to physically do each transformation while enjoying a creative art project.”



Figure 2: *Sierra Hickey: Overlooked (side view and top view)*

Sierra (Figure 2) writes: “My artwork is an abstract picture that I call *Overlooked*. The piece contains both geometric and free form shapes, as well as both two and three-dimensional shapes. I also used black and white throughout the art piece to make the small amounts of color really stand out. I used mostly permanent marker on my piece, but later added cubism with cut up pieces of origami paper for color and design...” She continues to describe mathematical objects and concludes with, “A checkered flag inspired me to make this piece. When I saw this flag I started thinking about shapes and lines, and how to make them stand out when they are normally unseen. Shapes are everywhere; on flags, coins, a mouse pad, and especially the tile in my bathroom. Lines are also everywhere. There are lines in a heart monitor, on animals, on sweaters, and on the road. So I made my artwork containing shapes and lines and color that made me feel excited. I wanted my art to speak to me and make me feel happy, so I chose shapes and designs I like and made it about me as well as about shape and lines.”

Toyanna (Figure 3) writes: “The technique I used to draw “Lucky Number 7” was solely based upon my background knowledge of line segments, different types of triangles, circles, and numbers... Charles Demuth’s “The Figure 5 in Gold” painting inspired me to create my piece of art, “Lucky Number 7”...

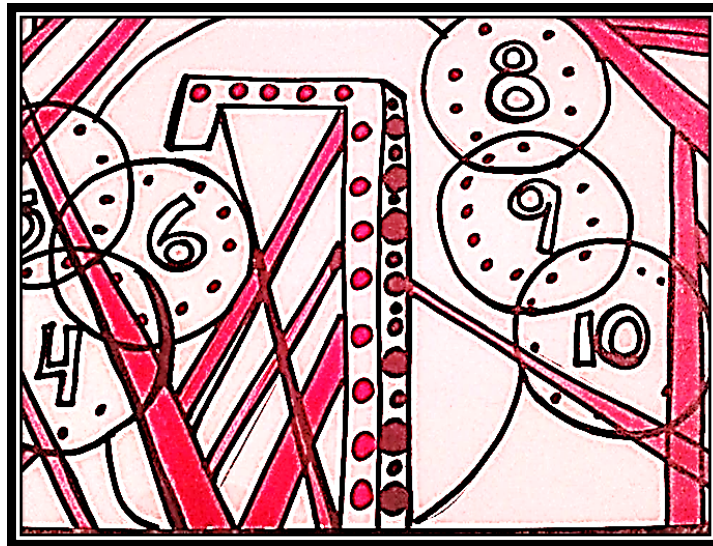


Figure 3: Toyanna Pop: Lucky number 7

Conclusions. Assessments revealed that preservice elementary teachers appreciated this opportunity to experience arts-based pedagogy in a mathematics classroom. All of them reported how they could use these ideas in their classrooms and some mentioned that they felt “inspired and engaged” to think about mathematical concepts through the arts-based representations. Some were more cautious, emphasizing that not all mathematical concepts lend themselves naturally to artistic representations. As expected, works were eclectic and choices of mathematical concepts quite varied. The majority of preservice elementary teachers focused on the concepts from geometry; some works were more focused on elementary classroom concepts and some works were designed in a digital format. The next step in the MathArt project was to use these works in teaching a child of appropriate age underlying mathematical concepts while using related pedagogical content knowledge. Analysis of the collected data and associated findings will be reported elsewhere.

References

- [1] Beghetto, R. A. (2007). Does creativity have a place in classroom discussions? Teachers’ response preferences. *Thinking Skills and Creativity*, 2(1), 1–9.
- [2] Bolden, D.S. and Harries, A.V. and Newton, D.P. (2010) 'Pre-service primary teachers' conceptions of creativity in mathematics, *Educational studies in mathematics*. 73 (2). pp. 143–157.
- [3] Gadsden, V. (2008). The arts and education: Knowledge generation, pedagogy, and the discourse of learning. *Review of Research in Education*, 32, 29–61.
- [4] Kennedy, M. (2005). *Inside teaching: How classroom life undermines reform*. Cambridge: Harvard University Press.
- [5] Mezirow, J. (1991). *Transformative Dimensions of Adult Learning*. San Francisco, CA: Jossey-Bass.
- [6] Root-Bernstein, R.S, & Bernstein, M. (1999). *Sparks of genius: The thirteen thinking tools of the world's most creative people*, Houghton Mifflin: New York.
- [7] Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4.