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"THAT'S JUST SOMETHING I WAS PLAYING WITH." MATH TALK AND AVOIDANCE IN AN ART MUSEUM

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Abstract

This paper examines the findings of a project that brought art and math together in the context of an art museum for intergenerational families lead by custodial grandparents. The project brought together intergenerational families to explore the connections between math and art at art museum in the Southeastern U.S. The project consisted of six intergenerational sessions that promoted looking closely at the art through the integration of math into art museum experiences. Project activities integrated art and math content in ways that provided for a learning experience of greater complexity than art or math would alone. The project's goals were to push families to think mathematically and to help them improve their attitudes and self-confidence toward math. We conducted a final group activity with the grandparents that combined a self-guided gallery tour, a hands-on creative activity, and a photo elicitation focus group. This paper examines how custodial grandparents' spontaneous talk in the focus group explained how artworks brought together math concepts with art. We also examine the conversational strategies they used to contribute or to avoid math conversations. We found that participants spontaneously used a broad range of mathematical concepts without considering them to be math at the same time that they used strategies for math avoidance when math was explicitly mentioned. Based on these findings, we recommend supporting custodial grandparents' development of broader understandings of what constitutes math.

Keywords: *ArtMath, informal math learning, intergenerational learning, photo elicitation, art museums.*

1. Introduction

The InterGenerational ArtMath at the Museum (IGAMM) project brought together children, their grandparents, art museum education curators, and researchers to explore the connections between math and art through ArtMath experiences at art museum in the Southeastern U.S. IGAMM consisted of six intergenerational sessions (June to December of 2017) that promoted looking closely at the art through the integration of math into art museum experiences. These experiences spanned different formats of educational activities typical of art museums, such as self-directed tours, guided tours, gallery activities, and classroom activities. The project's goals were to push grandparents to think mathematically and to help them improve their attitudes and self-confidence toward math. As Ramani, Rowe, Eason, and Leech (2015) showed, caregivers' engagement in math-related activities and talk at home predicts their children's advanced math skills. Thus, the goal was for grandparents to also engage in the project's ArtMath activities and conversations to increase their comfort with them so that they could in turn engage their grandchildren in similar experiences at home. We take Braund and Reiss' (2019) understanding of the integration of STEM and art at the micro-level as the basis for our work in the IGAMM project. We used "pedagogical practices in science and teaching that can be drawn from the arts" (Braund & Reiss, 2019, p. 225). In ArtMath, understanding of the math content provides for a deeper appreciation of the art and appreciation of the art provides for an opportunity to have a deeper understanding of an artwork's underlying math.

In this paper, we examine how grandparents' spontaneous talk in a photo elicitation focus group showed how they expressed ArtMath concepts through their explanations of how artworks (from the galleries and their own) brought together math concepts with art. We also examine the conversational strategies they used to contribute or to avoid ArtMath conversations in a photo elicitation focus group.

2. Design

This study involved a combination of quantitative and qualitative methods, including surveys, observations, a photo elicitation focus group, and interviews. In this article we focus on the photo

elicitation focus group with grandparents. The researcher conducted a photo elicitation (Harper, 2002) focus group with the participating grandparents at the art museum. This method involved participants in data collection and analysis by providing them with digital cameras to take pictures that answered to a prompt posed by the researcher, which in this case was: "Take a picture of an artwork that brings together shapes/patterns with art." Participating grandparents were also asked to use magnetic tiles, pattern blocks, and/or Lucite dots to respond to the following prompt: "Using magnetic tiles and other materials, create something that expresses similar ideas to an artwork in the galleries. Take a picture of yourself while creating or with your creation once it is completed." Subsequently, participants analyzed photographs of the artwork and of their own creations with the researcher in a focus group. The questions the researcher asked about the pictures involved the description of the images, how the images brought together math with art, and how the images represented their experiences with the program. The focus group was recorded and transcribed verbatim. The project obtained Institutional Review approval.

We used inductive thematic coding (Saldaña, 2015) to create categories from the data. We developed two main categories of codes: (1) content of the participants' talk, and (2) participants' responses to the researcher's prompts for ArtMath content and connections.

3. Findings

The findings in this study suggest an interesting dynamic of abundant spontaneous discussion of mathematical ideas such as proportion and perspective from grandparents participating in the focus group, indicating that they integrated some of the ArtMath content they were exposed to in the project. At the same time, they used strategies for math avoidance when the researcher-initiated questions or comments using the word "math" and certain other math terms (e.g., shape names), indicating that math phobia is still prevalent among participants in spite of their integration of art and math content during the project.

3.1. Math vocabulary

Grandparents used math vocabulary in the focus group to describe the art that they took pictures of and that they created 19 times. They used different math vocabulary to describe different types of images. Participants used shape names, sometimes incorrectly (e.g., rectangle, triangle, circle, *octangle* (sic)), and types of lines (e.g., curves, straight line) to describe paintings, sculptures, and their own artwork. In the example in Figure 1, Tallulah used mathematical terms to describe Lee's creation, such as its symmetry, the shapes used, and position words like underneath and top to describe layers. She also used a familiar image, such as the double-decker bus, to help describe the repetition of layers and the symmetry in the composition. Participants' use of math vocabulary in their descriptions of their images helped provide an understanding of how they were viewing the artworks to listeners. In Tallulah's case, her use of language around symmetry and the position of the manipulatives helped listeners grasp the idea of layers that she was trying to convey.

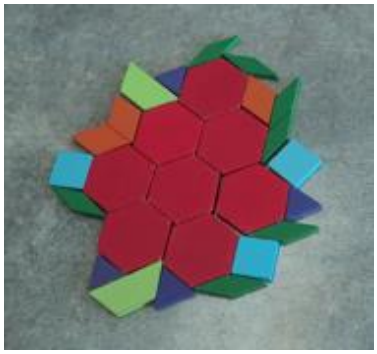
Figure 1. Shapes.

You were making a symmetry kind of thing, you were very conscious of getting it symmetrical, and everything, I thought. Because it's like a double-decker. I mean, not a double-decker, that's not what I meant. But like the lines have something else underneath it, and then you have the magnetic square. And then you have something else on top of that. So you've got like three [layers] (Tallulah talking about Lee's artwork).

3.2. Grappling with math concepts

The second math content theme that appeared in the focus group was grappling with math concepts, which we saw 10 times. In these instances, participants' words indicated that they were trying to understand math concepts that they were using or portraying in their images, such as grasping how figures fit together or using mathematical concepts to understand art. In Figure 2, Pearl tried to understand how shapes could be adjusted to create other shapes.

Figure 2. Ball/Fishing Lure.



I was trying to do a ball, you know, a round ball with that [hexagon pattern block pieces] but I couldn't get the pieces to fit around like I wanted to. So that's kind of like a fishing lure. And it'll catch all kind of color of fish. Because you know fishes is different colors. So that's my piece (Pearl).

Pearl was trying to fit hexagons and then other shapes together to make a circle. However, she found that she couldn't fit hexagons together in this way, and consequently decided to change her original plan of creating a ball to creating a fishing lure. This theme allowed us to see in real time how participants were making sense of experiences that integrated art and math and how they thought about the concepts that initially were not obvious to them.

3.3. Perspective

In nine occasions, participants described the position in which the art was viewed or described the vantage point it represented. Their words described how looking from different angles provided opportunities to see the same thing differently and how something seemed to transform as the viewpoint changed. In Figure 3, Bonnie described the perspective from which she took the photograph as looking up from underneath the display cases where artworks were displayed. By changing the perspective of the photograph from the typical focus on the art, she changed what was visible in the image and what was worth looking at from the artwork to the display cases.

Figure 3. Squares.

Bonnie: I like these, too, because I took the picture up under, and you could still see the shapes. They're three-dimensional. They're on the wall, and they're like squares, and this is up underneath it.
Nuria: [laugh] You're getting really creative.
Bonnie: So, you know, from up underneath, you're still seeing those shapes. Like you can still see that one's a rectangle, and that was more of a square. But they're hanging up there, and they're three-dimensional. This is just from the bottom up.

3.4. Emotionally charged math content

In five instances, participants described (1) their emotional response to an artwork with reference to its spatial arrangement or geometry, or (2) the emotions that they perceived were expressed through the mathematical elements in the artwork. In Figure 4, Lucinda interpreted the mathematical elements of the sculpture, such as shapes and weight, as transmitting emotions of sadness and pain. In her view of this piece, Lucinda interpreted the weight of the shapes and bottles as baggage that the portrayed woman was carrying and that was inflicting pain on her. For Lucinda, the mathematical content of the art contributed to her understanding of the piece.

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Figure 4. Lady.

Lucinda: Well, when I looked at that picture, I see all the different patterns in there. It's like, triangles, there and blocks and rectangles, but they also look like bottles, and all kinds of stuff going on in there. But I also see, when I look at it, I'm seeing like, this lady standing there, and she's got a whole lot of stuff going on. When I look at the bluish green, it seems like she's kind of sad, to me. Yes. And then when you get to the red, it seems like that's a whole lot of pain going on. I mean, I can just see this, she's got a lot of baggage, a lot of stuff. That picture tells a story.
Nuria: Hmm. So all the cans and all the bottles and all that stuff, is that her baggage?
Lucinda: Yes. It's telling a story, yes. Yes. And you notice that it starts from up here at the top, it starts lighter, and then as you notice it, and keep looking at it, and it gets heavier and heavier, so they keep adding more shapes, bottles, more, you know -- more pain is going on.

3.5. Using a math lens

In five instances participants described artwork as containing mathematical objects (e.g., geometric shapes) when it did not literally do so or described the art using math to make sense of the image.

Figure 5. Bobsledders.

That is The Bobsledders. If you look, see the green, and you'll see the man who is pushing the back of the bobsled. And you can see another one here at the front, and he -- you have to imagine them being able to fit there in between. There's a four-man bobsled; there's a two-man bobsled. To me, this is the two-man bobsled. And one pushes the front, one pushes the back, and before they get to the timeline, they have to jump in and get ready to go down. Yes, that's the way I see it (Vernon).

Vernon talked about "you have to imagine them being able to fit." The viewer does not need to do what Vernon said in order to understand the piece. However, Vernon uses a mathematical lens to explain how he views the role of physical space in the piece and help others understand it.

3.6. Absence of math content

There were two focus group participants (Lee and Beulah) who used very few to no math concepts to talk about their photographs. For example, Beulah would talk about the pieces in terms of their beauty, but would not explain what made the pieces beautiful, even when prompted about it, as below:

Figure 6. Plates.

Nuria: Let's look at other art that you took pictures of. Oh, look at all those plates. How about this one?
Beulah: See, those are beautiful, what I can see. I just -- I just cannot see that well.
Nuria: Mm-hmm. What do you like about it? Like, it has -- this has like squares, and this one has random dots.
Beulah: I like all of them. I wish I had those in my house.

The beauty of the pieces made Beulah want to own them, but she did not put into words what made her consider them to be beautiful. Like in the quote above, she talked about her poor sight: “I really can't see the picture of it -- I put my glasses on it and I still can’t see it.”

4. Discussion and conclusions

As our findings show, focus group participants spontaneously discussed a variety of math content, such as proportion, perspective, relationships between 2D and 3D structures, while viewing their photographs. This suggests that participation in the IGAMM program helped them integrate math concepts into their understanding of art. At the same time, some participants chose to disengage when the researcher prompted them with “math” terms.

This article’s findings suggest the need to support caregivers, and particularly grandparents who fulfill caregiving roles, in their understanding of what constitutes important math for the children in their care. Adults, and especially those of older generations, tend to have narrow understandings of what constitutes math based on their school experiences (Pattison et al., 2017) and need to be encouraged to develop broader understandings of it. This would help them be proactive at engaging in mathematical activities and conversations with their grandchildren (Ramani et al., 2015) without feeling the need to avoid mathematical content in their interactions. We recommend further research to corroborate and expand the classification of strategies to avoid math talk by caregiving adults and to find strategies that will promote mathematical conversation without constraining agentic activities that integrate art and math.

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