Math Cleverly Disguised As/With String: Overlapping Math Instantiations in Weaving

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Abstract: One way to address disparities in math education is to leverage multiple understandings of mathematics (epistemological pluralism: Turkle & Papert, 1990) to design educational contexts. Weaving is deeply mathematical, yet weavers perceptions of this are not fully known. Interviews with weavers seek: How do experienced weavers characterize the relationships between weaving and mathematics? Findings suggest weavers use math in overlapping instantiations involving arithmetic, shape, and pattern.

Keywords: mathematics, weaving, epistemological pluralism

Introduction

Mathematics remains a gatekeeper in schools, and some learners may disidentify with mathematical engagement despite the presence of math embedded in the world. However, many individuals and groups participate in mathematical activities voluntarily and in their free time, through deeply cultural practices and in ways that are both related to and unrecognizable from classroom math (e.g., Nasir, 2002). Weaving, a craft pursued by many, can be understood as highly mathematical (e.g., Saxe & Gearhart, 1990; Barta & Eglash, 2009). However, it is not known how weavers understand the math in their weaving. We ask: How do experienced weavers characterize the relationships between weaving and mathematics? Exploring this question through a lens of epistemological pluralism (Turkle & Papert, 1990) can help educators consider what mathematics is and can be in diverse contexts when produced by diverse doers of math. This may also help us expand school-based framings of mathematics in ways that affirm learners' intellectual work, dignity (Espinoza & Vossoughi, 2014), and epistemologies.

Methods

Twenty-two participants were recruited for this study through participation in online crafting communities, snowball sampling, and through prior indication of interest in participating in research. I reached out to crafters in these communities, and interested weavers with at least five years of craft experience were selected. Interviews were video/audio recorded and took place via secure video conferencing. Participants lived across the United States and Canada, 21 identified as women and 1 as nonbinary. Two participants identified as Black, two as Asian, and 18 as white, and one as other. Their ages ranged from 23 - 76 (average 52.9). All had some college or more, and 19 pursued or enjoyed math in school. Each interview lasted about an hour. In addition to questions such as "What, if anything, do you find to be mathematical about weaving?", participants were asked to provide 3-10 images of items they wove to spur conversation. I used techniques from grounded coding (Glaser & Strauss, 1967), coding directly onto the video using the software AtlasTI. As themes emerged, I engaged in focus group check-ins with experts in mathematics education to check that the themes made sense and were seen by others.

Findings

The data reveal that weavers describe and use math in their weaving in three simultaneous and overlapping instantiations: 1) arithmetic & calculations; 2) image & shape transformations; 3) multiple embedded patternings. Excerpts from the interviews demonstrate the richness of these instantiations. Additionally, the poster will include multiple images of artifacts that also showcase these instantiations in practice. The poster will also describe some connections to Common Core Math Standards (2010), although such standardized metrics of mathematics do not provide a full enough picture of what it means to do math. This work seeks broader understandings beyond standards and common school framings.

Arithmetic and calculations

This category was mentioned by 21 of the 22 participants and includes operations generally understood as addition, subtraction, multiplication, or division. Weavers described using math in this way as they set up their looms based on the desired length and width of the finished product, taking into account a certain percent of expected shrinkage that occurs in the finishing process, often involving known equations. A weaver explains: *"Every beginning weaving class has a piece of paper, a chart, a worksheet that says ok you know here's how wide you want it to be, here's how many ends per inch, here's how long you want it to be here's how many picks per*

inch and then you can do all the multiplying to find out how many yards of each color am I going to require" These concepts, such as operations, appear in formal math education and often exist in relative isolation, perhaps building on each other but still considered one at a time.

Image and shape transformations

By contrast, this second category involves considering and transforming multiple measurements in concert, such as unidimensional length and width as well as two-dimensional area. This was described by 20 of the 22 weavers. A weaver planning to adapt a design must consider how to change the size and shape of the artifact and the type of materials used and how this change will impact the images and motifs within the artifact. As a weaver explains: *"I did think about how it would square up… and because it's not gonna be wool, the wool will felt a little to itself and it stands when you wash it, but cotton doesn't… have that same kind of characteristic and so I knew that the floats couldn't be as long"* These concepts and practices must be used simultaneously and in relationship, setting this category apart from the first.

Multiple embedded patternings

Described by 20 of the 22 weavers, this third mathematical instantiation deals with the inherent mathematical nature of weaving. Built on a gridded structure, weaving is made up of nearly endless combinations of binary choices as each individual string is "up" or "down" at any given point. On floor looms, these strings are connected in various ways to shafts that assist the raising and lowering. Thus, weavers must consider patterns of order, sequence, and timing in their work. One weaver explains: *"We talk about… these permutations of numbers but that's only useful because we all immediately know what order those numbers go in… I'll come up with just four random things… to reinforce for people… that the numbers are not important, it's the shape of things and the pattern of things and the sequence"* This moves beyond many school-based conceptions of math toward invention, experimentation, and play with mathematical structures and principles.

Implications

These three emerging instantiations remind us that math is a complex set of ideas and practices that can be taken up in multiple ways. Weavers understand different layers of mathematics simultaneously, suggesting a nuanced understanding of many ways math exists. This also points to an understanding of math that is playful and adaptive rather than rigid. Opening up this definition in educational spaces could work toward educational equity – more learners could pursue multiple ways of knowing and doing math toward more potential imagined futures.

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