

(Re)Humanizing Mathematics for Historically Minoritized Learners:
Narratives of Community College Students in Noncredit Bearing Developmental Math

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While many community college (CC) students come to higher education with specific career or life goals, these aspirations may be forced to change if students are not able to get past the gatekeeper of developmental mathematics. Racially minoritized students are disproportionately tracked into developmental mathematics classes upon entering CC, and often become trapped in a financial and emotional cycle of take-fail-repeat, with student debt linked back to developmental coursework totaling over \$1.3 billion per year across the U.S. (Jimenez, Sargrad, Morales, & Thompson, 2016). This report presents a subset of data from a larger narrative inquiry project that focuses on humanizing stories from an intimate group of CC students, uncovering how they came to know themselves as learners and doers of mathematics. Findings provide insight into how mathematics learning experiences can function to dehumanize, while also paving the way to creating more humanizing undergraduate mathematics learning spaces.

Keywords: mathematics identity, narrative inquiry, developmental / remedial mathematics, community college

Supporting mathematics educators to engage with and act on issues of social and racial justice requires an understanding of the lived experiences of their students, particularly as these experiences relate to mathematics learning and doing. One key aspect we can turn to as a first step to developing these understandings are the storied and lived experiences of historically minoritized mathematics learners as they choose to tell them. This report features data from a larger project that explores the mathematics narratives of an intimate group of community college students who have taken non-credit bearing developmental mathematics coursework, as they describe their experiences learning mathematics, their ideas about what mathematics is, and their self-perceptions as influenced by these experiences and ideas. By centering the self-narrative, we can focus our attention on the following research question: How do current practices in undergraduate mathematics learning spaces function to humanize or dehumanize our students as learners and doers of math?

The larger project from which this study comes focuses on community college (CC) students in noncredit bearing developmental mathematics (NCBD) coursework for a few key reasons. Firstly, these students' specific career or life goals may be forced to change if students are not able to get past the gatekeeper of developmental mathematics coursework. Secondly, racially minoritized students are disproportionately tracked into NCBD mathematics classes upon entering college, and often become trapped in a financial and emotional cycle of take-fail-repeat, with student debt linked back to developmental coursework totaling over \$1.3 billion per year across the 50 states and D.C. (Jimenez, Sargrad, Morales, & Thompson, 2016). And thirdly, despite this, mathematics as a field of study has been positioned as more important than ever before for a diverse pool of learners, all while inequitable access to quality mathematics-learning experiences prevails.

This positioning of mathematics as a high stakes subject within schooling systems begins in elementary school and continues throughout grades K-12 and into undergraduate education. School mathematics requirements have evolved historically out of a movement to privilege

mathematics as a field of study because of its ties to national, capitalistic goals. As such, mathematics has gained a reputation as being necessary for the formation of citizens who are able to contribute to the economic success of our country in innovations requiring knowledge of science, technology, engineering, and mathematics (STEM) (Gutstein, 2003; Schoenfeld, 2004; Secada, 1989; Vashchyshyn & Chernoff, 2018; Washington, et al., 2012).

Theoretical Framework and Methodology

Because students' descriptions of their mathematical learning experiences are central to understanding how they understand their mathematical selves, I call upon the theoretical frame of narrative mathematics identity (Langer-Osuna & Esmonde, 2017; Larnell, 2016), taking a humanizing approach to the exploration of CC students who are currently enrolled in NCBD mathematics coursework. Using narrative inquiry as a tool to learn about students' identities as mathematics learners and doers, I explore narratives of an intimate group of five community college students (including four BIPOC students and one white, disabled student), uncovering how they came to know themselves as learners and doers of mathematics. While the broader study contains stories from these five diverse individuals, this report focuses on excerpts from a single participant, Marty, in order to provide a deeper view of one participant's story within the scope of this paper, as opposed to just grazing the surface of all five participants' experiences.

The self-narrative provides insight into how experiences and actions related to school mathematics starting in elementary school and evolving over the life course through the undergraduate years may shape what students see as possible for themselves. This humanizes the stories about how not just undergraduate developmental mathematics, but school mathematics more broadly as it exists today, can serve as a filter, removing certain students from educational opportunities.

With the idea of humanizing research at the heart of this project, participants were recruited through voluntary response sampling via in-class announcement, as well as a YouTube video posted to the course websites in NCBD mathematics courses within a large community college system in a small Midwestern City. Recruitment took place in 2021-22, at a time when most mathematics courses at this particular community college were being offered virtually, but with live instruction, due to the COVID-19 pandemic. I also had IRB permission to recruit via social media, so I posted recruitment flyers on Facebook and sent emails to my personal networks with permission to reshare. Through this, I recruited six participants, but five followed through and completed the full study. Participants took part in both a survey and two interviews, which were semi-structured in nature, leaving space for various lines of questioning and a more natural conversational flow, rather than just sticking to a script.

Interviews were offered either in person or virtually, not only in light of the COVID-19 pandemic, but also for participant accessibility and preference. Students were given a small token of appreciation for their participation.

After interviews were sound recorded, transcribed, and de-identified, member checks were performed to support participants in telling their stories, and to be sure the story that is re-told reflected what they would like to put forth.

To analyze participants' stories, I call upon Danny Martin's Central Themes of Mathematics Identity (2000), as well as honoring the themes that arise from within the narratives of my participants. Martin's themes include:

- (a) references to the instrumental value of mathematics, (b) references to motivation to attain mathematical knowledge, (c) references to opportunities to learn mathematics, (d) references to strategies to learn or participate in formal and informal mathematics

contexts, (e) references to constraints or barriers on participation within mathematics-learning contexts, and (f) references to one's own capacity to perform in mathematics-learning contexts. (2000)

Transcriptions were coded according to these themes, as well as a few themes that arose from the ground up and appear in data from the larger study (not within the scope of this paper). Participants were sent copies of the analyses of their stories and were given opportunities to provide any feedback they'd like to offer on thematic analysis of their narratives. Pseudonyms have been used to de-identify and protect participant identity, with participants being given the option to choose their own pseudonyms.

Select Interview Data and Analysis: Marty's Story

Apparent throughout my conversations with participants were examples of how students have been trained to identify mathematics quite narrowly, limited only to practice involving numbers, formulas, equations, and the like, whereas creative problem solving, guessing and checking, or other less "formal" methods would go unrecognized as mathematics. Take for instance the following quote from my interview with "Marty" (pseudonym), my focal participant within this report.

Marty: I told a professor years ago that I'm afraid, or I want to learn how to build properly, but I want to learn how to build in a way that I don't have to use mathematics regularly, because I'm not good at it, and he straight up told me that he never does math, and he totally understands, because he hates it. (Interview 2)

Marty identifies as a Latina furniture maker and woodworker who, at the time of the interview, was in her early 30s. At the time of our interview, she had been accepted into art school and was in her first year after transferring. Her narrative focuses on her mathematics identity through activities and feelings she has around mathematics learning and doing over the life course. Marty knew from a young age that she wanted to be an artist and identified furniture making, woodworking, and teaching these trades as her desired goals, all which she believed were possible for herself through art and in spite of mathematics.

Marty was born to Cuban immigrants and grew up in South Florida with one brother. As she shared, she always envied him for being "stupidly good" (Interview 1) at math, as she describes him; a reflection of her own perceived capacity of her ability to perform in mathematics-learning contexts (Theme F). Marty says she struggled with school mathematics growing up, but she was tracked into the "normal classes" (Interview 1). This reflects Marty's own perception about her capacity in mathematics (Theme F). It also reflects how she understands the opportunities she had to attain mathematical knowledge through coursework (Theme C). Marty's self-perceptions of her lower ability in mathematics reflect her mathematics identity. As she worked her way through grades K-12, she started approaching high school graduation knowing that she wanted to go into the arts, and knowing that she wanted to teach one day, which meant college, and specifically art school, was the route she would need to take.

Marty: I decided that I wanted to go to community college because I still didn't know where I wanted to go to art college, and so while making that decision um, it was also like, let me do this. Get all of the credits that are necessary, but unnecessary really, out of the way, and um, and I'll just be able to focus on making my work later. (Interview 1)

I asked her what she meant by "necessary, but unnecessary," and Marty describes how required general education coursework, such as mathematics, science, or language arts, are often centered around art when you take them in art school. Rather than an arts-based interdisciplinary education being an incentive for Marty to attend art school straight out of high school, she says

this was instead a deterrent, along with the high financial burden of paying for general education coursework at an art school.

Marty: ...they're [general education courses] really expensive to take at the university, so I decided to do it at the community college. And when you take those classes at an art school, they shape the class around art. Like, the science class would be, um, like, on color, you know. And I remember seeing some of the homework, and I was like, that's kind of dumb. Like, I enjoyed my, like, my science classes where I took, and it was an unbiased like, art science. It's like science science. And mathematics is math. And English is English, and it's not based around art. (Interview 1)

Marty's differentiation of science, mathematics, or English classes that are contextualized around the arts as being "kind of dumb" got me thinking: does she prefer to learn science, mathematics, or English as decontextualized? And what would that look like or mean for her, and why does she see "purer" versions of these content areas as more valuable? This line of thinking gave me some insight into how Marty has been trained to perceive mathematics and science as higher level when it is context-free or abstract.

Marty demonstrates in the above quote that she was motivated to obtain not only mathematical knowledge (Theme B), but also knowledge in a variety of general academic content areas. Marty also wanted the opportunity to learn mathematics (Theme C) at the community college, rather than doing a more content-specific mathematics course centered around the arts within a 4-year art university.

Marty goes on to describe her avoidance of math while problem solving in her work.

Marty: I don't really use it [mathematics] anymore. As a woodworker, that's kind of a funny thing to say. Um, I just...when I do mathematics now, on the very rare occasion, it's really hard. (laughs) Um, yeah, cuz it's art math, which is a funny thing, cuz I was like, I don't wanna do art math.

Ranza: What's art math?

Marty: It's just complica...like, when you're trying to come up with something that...like, I was working on these weavings, and it's like, there was art mathematics that was involved in figuring out the scale, and I was like, I just can't figure this out! It's not working. (laughs) And it took me so much longer. Um, but, yeah. (Interview 2)

We see here a common occurrence demonstrated by Marty, as she categorizes her rich mathematical practices as "figuring it out without the math." This reflects not only Marty's narrow perceptions of what counts as legitimate mathematics, but also the limited ways that students are often trained with a classroom setting to identify what types of problem solving are mathematical and which are free of mathematics.

Implications of this Study

Findings of this study provide invaluable information for mathematics teachers, not only about how we can support the development of positive mathematics identities within school settings, but also how certain mathematics experiences may serve to de/humanize students by limiting their perceptions of what "counts" as legitimate mathematics, in turn creating situations that lead them to believe their experiences, interests, and problem solving do not count as mathematics. This leads students to believe that they are not learners and doers of mathematics, when in fact they very well are. It is our responsibility as mathematics educators to support an expansion of what we center as legitimate mathematics within our classrooms and schools and support students in seeing themselves and their interests as mathematical. For example, in Marty's situation, we see how engrained her invalidation is as a user of mathematics—her

experiences and messaging over a lifetime have led her to believe that the mathematics activities in which she engages are not legitimate mathematical practices. This tells us one story of how important it is to value students' mathematical knowing and doing, even when their mathematics may look different than that within the narrow gaze of the U.S. mathematics textbook.

Outcomes of the larger study help us to gain an awareness of both the patterns and unique qualities that are present within students' lived experiences around mathematics; to use this awareness to continue exploring and centering student voice as a means to creating knowledge regarding how mathematics teachers can champion their students in accomplishing the goals they set out for themselves; and to use this awareness to continue experimenting with and developing appropriate mathematics pathways and support structures so that mathematics coursework acts as a humanizing mechanism in students' lives.

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