Reconceptualizing Smartness: Student Perspectives in the Mathematics Community College Classroom

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This study investigates how students at a Southern California Hispanic Serving Institution (SCHSI) perceive and define smartness in the mathematics classroom. We employ a qualitative approach, analyzing narratives from an open-response survey question that asked students, "What do you think it means to be smart at [SCHSI] in math?" The findings challenge the traditional binary categorization of dominant and counter narratives, revealing a more nuanced understanding of smartness. The analysis identifies a spectrum of student perspectives, ranging from those emphasizing performance outcomes (e.g., grades, passing) to those prioritizing process-oriented approaches (e.g., understanding, effort, seeking help). The results underscore the importance of recognizing and valuing diverse forms of smartness in mathematics education, particularly within community college settings serving underrepresented student populations. By fostering an inclusive learning environment that acknowledges and supports various conceptions of smartness, educators can empower students to develop a positive mathematical identity.

Keywords: Smartness, Mathematics, Community College, Hispanic Serving Institution, Dominant Narratives, Counter Narratives, Student Perspectives

Vignette

In Ms. Fernandez's precalculus class, students were engrossed in a test. One student finished early, standing up and turning in their paper. The teacher looks at the student and says "nice work!" This action triggered a wave of anxiety in other students, who interpreted the early completion as a sign of superior intellect and began to question their own abilities. Many students began to focus on the unfinished portion of their own test, feeling increasingly overwhelmed and doubting their own smartness.

Introduction

As educators, we possess the authority to shape or influence students' perceptions of themselves and their relationship with mathematics (Turner et al., 2013). Considering the relationship a student has with mathematics is very important to a student's identity and the role colleges serve in giving access and opportunity to STEM careers. Investigating how students learn mathematics in college, community colleges, in particular, is especially relevant to how college students are enculturated into mathematics.

Within the field of STEM specifically, the President's Council of Advisors on Science and Technology reported in 2012 that fewer than 40% of students in U.S. colleges who begin a STEM degree graduate with a STEM degree; for women and students of color who entered college as STEM majors, this number was only 20%. Indeed, community colleges alone educate half of all undergraduate students in the United States (Down et al., 2006, as cited in Mesa et al., 2014) and nearly half of all undergraduate mathematics students (Rodi, 2007, as cited in Mesa et al., 2014). Given the community college enrollment of minoritized learners and their experiences in mathematics classrooms, more broadly, understanding these students' perceptions and experiences about what it means to do math and who can do math is valuable.

Of particular interest in this study is how students at a community college perceive smartness in their mathematics classes. In this study, we analyze narratives in an open response question from a survey meant to capture students' experiences at a Southern California Hispanic Serving Institution (SCHSI) to address the following research questions: The research question that guides this study is: *How do SCHSI students define smartness in mathematics?*

Literature Review

The way we position students within mathematics learning environments directly impacts their learning process and their self-perception as mathematics learners. Recognizing students as holistic individuals with lives extending beyond the classroom is important for understanding their identity, which is crucial for effectively supporting their success both within and outside these learning environments (Wilkes & Ball, 2020). Positive dispositions towards mathematics– where one's identity is in harmony with the field as opposed to clashing with it– can lead to persistence, agency, and confidence, all of which are useful qualities for navigating everyday life (Bishop, 2012; Brown, 2004). A key part of one's identity in mathematics is understanding the role of intelligence.

Historically, intelligence was quantified psychologically through IQ tests, which were developed in the early 1900s to identify individuals who might need additional support (Carroll, Kramer, & Dringenberg, 2019). Once adopted in the US, intelligence became a construct that was viewed as innate and fixed meaning it couldn't be changed over time (Dweck & Molden, 2000). Though not initially intended, this ultimately became a way for white privileged people to uphold their power and create and reinscribe beliefs and narratives about the intellectual inferiority of African Americans (Hatt, 2012; Darby & Rury, 2019). This perspective reinforced the idea that to be smart, used interchangeably with intelligence, means to perform identities that meet the standards of white middle-class males (Carrillo & Rodriguez, 2016). We use smartness to contrast the idea that intelligence is something that is innate as a social construct.

Smartness: A Theoretical Framework

Though smartness is something that is often perceived as "non relational, impersonal, rational, and scientifically objective," (Hatt, 2012, p. 456), many researchers consider smartness to be a social construct that give rise to the existence of its "denigrated other" (Leonardo, 2013, p. 2008) through the process of stratification and oppression of marginalized groups. When an individual is assigned smartness by an institution, it automatically affords them human capital (Hatt, 2012). Furthermore, because being good at mathematics is so intrinsically linked to smartness, and smartness is a prerequisite for personhood under the racial contract, the perception and beliefs surrounding smartness in the math classroom is of the utmost importance. One way to disentangle the features of smartness as a cultural construct is to explore the narratives surrounding it (Leonardo, 2013).

Smartness can be categorized as a dominant narrative or a counternarrative. We define dominant narratives to be the ways in which smartness often gets defined narrowly and often negatively affects learning outcomes. One dominant narrative found commonly in the literature surrounding smartness in math is that students must quickly and correctly identify solutions (Dunleavy, 2018; Boaler & Staples, 2008; Wickstrom, 2015). The most common dominant narrative is the attainment of good grades (Boaler & Staples, 2008; Louie, 2018; Wickstrom, 2015); Berry, 2008; Chang, 2017). Bishop (2012) and Louie (2018) found that a common narrative linked to smartness in mathematics is that of students not seeking help. Reinholz (2021) also found that it is common for students to perceive intelligence in mathematics to be linked to innateness.

Counternarratives are defined as the ways through which historically oppressed populations tell their own stories in order to challenge dominant narratives (Delgado, 1998, as cited in Reinholz, 2021). Dunleavy (2018) identified the ability to help one another as a disruption to dominant narratives. Bishop (2012) found that "Needing help, making mistakes, and asking questions can be perceived as face-threatening acts if those actions are seen as inconsistent with mathematics identities of being smart" (p. 53). Reinholz (2021) and Wickstrom (2015) found that some students were able to shift narratives of mathematics being innate toward the recognition of the importance of hard work.

We argue that dominant and counter-narratives are not only instantiations of the ways in which smartness is enacted, but they can also be defined as attending to process and/or outcome, which nuances how smartness is enacted. While the construct of intelligence or smart is not new, there is a dearth of research that investigates the construct of smartness in higher education explicitly and particularly in community college. In studies that do, they tend to focus on engineering and other STEM-related fields. This work contributes to the field by focusing on smartness in mathematics in the context of community colleges and addresses the nuance of how students describe what it means to be smart in mathematics classes.

Methods

Participants and Context

The study took place at SCHSI, a comprehensive two-year community college (Blind, 2018). The community college serves an ethnically, racially, and culturally diverse community in which almost 85% of the student body is from minoritized groups and Latinx students make up over 60% of the total enrollment. Despite the large number of Hispanic students, 244 STEM degrees were awarded, with only 127 (52%) of them being awarded to Hispanic students. This study is part of a larger project that aims to understand the impacts of gateway math course reform at SCHSI as a result of state legislation.

Participants included students taking mathematics classes taught by five instructors who participated in PD sessions facilitated by the [blinded] professional development team. The students were enrolled in one of the following courses: elementary statistics, pre-calculus, college algebra, and mathematics for general education majors. 103 students completed the survey. Sixty percent of the respondents identified as male and 40% as female; 63.8% of the respondents identified as Hispanic, 16.3% identified as Asian, 11.4 % identified as White, and 7.6% identified as Black; 49% of participants identified as first-generation (i.e., neither parent nor guardian completed a Bachelor's degree); and 40% of the participants declared or intended to declare a STEM major, 39% of the participants were non-STEM intending majors, and 19% were unsure.

Data Collection

Students were given a survey designed to capture their experiences in math classes. The initial survey used was modified from the Student Postsecondary Instructional Practices Survey for Mathematics (SPIPS-M). To increase students' response rates, the first author modified the initial survey used on the project to clarify questions that were ambiguous and to include openended questions that focus on students' identity. The free response question being analyzed from this survey is "What do you think it means to be smart at SCHSI?" The five instructors who participated in professional development were asked to distribute the survey via email to their students. Each instructor determined incentives for students to complete the survey. Some instructors provided no incentives. Other instructors awarded points to students (i.e., extra credit on their test score). The exact choice of incentive depended on each instructor's preference, and some instructors encouraged students to complete the survey during class time, which was intended to attain a high response rate. All surveys were administered online through Qualtrics.

Data Analysis

Coding. Open coding in MaxQDA 2024 (VERBI Software, 2024) was used to analyze all data. New codes were added and old codes were refined as coding proceeded through multiple rounds. The development and use of a coding scheme were organized around the themes of smartness. Three coders collaborated, utilizing a spreadsheet to manage the data throughout seven rounds of coding. Some examples of codes that emerged from the data were: (a) good grades; (b) participation; (c) making mistakes; (d) memory; and (e) application. Some of these codes were in alignment with dominant narratives such as good grades and memory. In contrast, codes such as participation, making mistakes, and application were in alignment with counternarratives.

As we delved deeper into the analysis, we observed greater nuance than anticipated within the binary categorization of dominant and counternarratives, specifically with respect to process and outcome. To better capture this complexity, we created an axis to map the range of responses, expanding our understanding beyond a simple dichotomy of dominant and counternarratives. We then created a heat map to visualize the density and distribution of student responses across the different categories and identify areas of concentration or overlap (Figure 1).

Creation of a coordinate system. In our analysis, we found that responses involved process and/or outcome. Thus, we established a two-axis coordinate system, one of which was a continuum of process (e.g., helping others, working hard) and the other a continuum of outcome (e.g., good grades, passing class). We defined process as a dynamic and active nature of mathematical learning and outcome as a means to an end. We created a coordinate system to visualize this, with the horizontal axis representing the process spectrum from dominant to counter-narratives – left to right, and the vertical axis representing the outcome spectrum in the same way – bottom to top.

Along the process continuum (horizontal axis), the far end on either side represents the most extreme narrative associated with either dominant or counternarratives on process. For example, on the left extreme (dominant narrative) along the process axis are codes associated with learning quickly and memorizing. On the far right side along the process axis (counter narrative) are codes associated with making mistakes and helping others. Similarly, the outcome continuum (vertical axis) is structured the same way. For example, on the top of the outcome axis (counter narrative) are codes associated with applying concepts. At the bottom of the axis (dominant narrative) are codes associated with getting good grades and innateness of mathematical ability.

Each response was plotted in this coordinate system using a specific method. First, the core code of each response was identified and classified as either process or outcome-focused, and whether it aligned with dominant or counter-narratives. This initial classification determined the starting point on the coordinate system. The placement was then refined by considering additional codes present in the response, which could shift the point along either axis. For example, the response "Passing your classes with high grades, being able to conceptualize problems and follow along with lectures" was coded as the core code of good grades (dominant outcome), but then was also coded with understanding and participation (both of which were counternarrative process). This ultimately landed the response in the lower third quadrant. To ensure consistency, we continually referred back to previously plotted responses in the same area, comparing their codes to maintain a cohesive interpretation of the data.

Findings

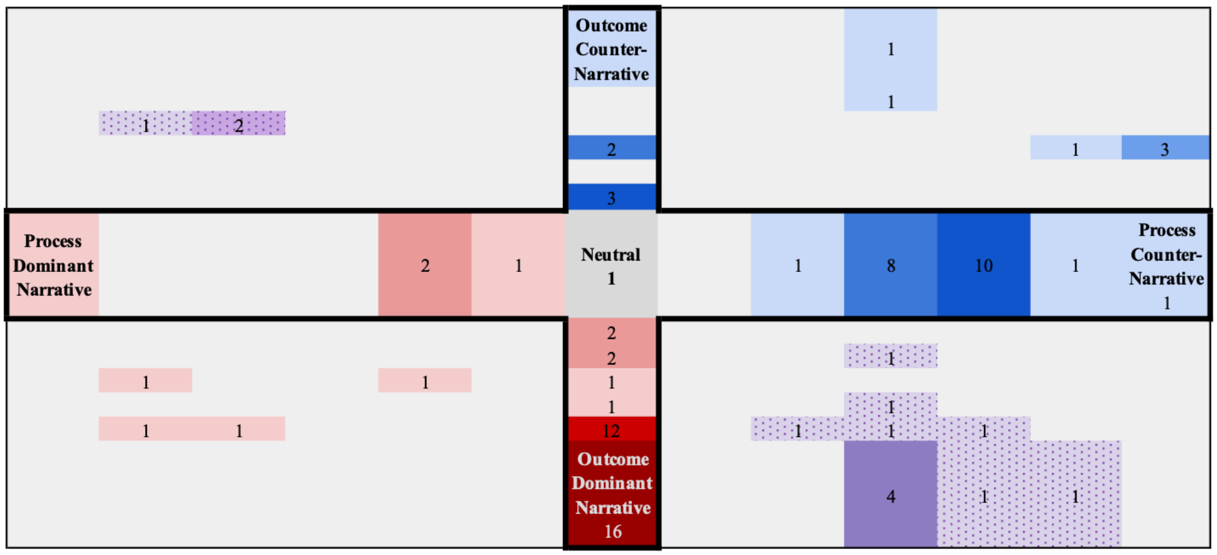

Figure 1. Heat Map generated from the responses

Axis

The highest concentration (N=28) of responses clustered along the axes themselves, rather than within the quadrants. This indicates a prevalence of simpler responses that primarily focused on either process or outcome, but not both in a complex way. Notably, the lower half of the outcome axis, towards the dominant narrative, had the highest density of responses. This signifies that the majority of responses were solely outcome-oriented and aligned with dominant narratives. For example, "getting good grades," or "Being able to get straight A's with ease." Additionally, the right side of the process axis was populated (N=18), signifying that many of the responses were solely process-oriented and aligned with counter narratives. For example, "To be willing to put in the work and learn."

Quadrant I

Quadrant I aligns with responses that contain elements of counter process narratives with outcome counter narratives. For example, one response was "To be smart in math means to understand math and be able to teach math to others." In this response, understanding math is a process toward ultimately being able to teach math to others (the outcome). Another student stated, "Be able to understand concepts and use those concepts in combinations with others to solve problems." Here, understanding concepts is the process toward the outcome of application. Quadrant I was the second most populated quadrant (beside quadrant IV), indicating that several of the responses were indicative of alternative conceptions of smartness from both the process and outcome lens.

Quadrant II

Quadrant II aligns with responses that contain elements of dominant process and counter outcome narratives. For example, one student stated that smartness was "memorizing equations and how to apply them." This student seems to think that memorization of math is not a means to an end (an outcome) but more so is a process toward application. This quadrant had very few responses highlighting that students who tended to have dominant process narratives were unlikely to have a counternarrative outcome narrative.

Quadrant III

Quadrant III aligns with responses that contain elements of dominant process narratives and dominant outcomes narratives. There were only four responses that were placed in quadrant III. An example of one of the responses is "What I believe what it means to be smart in math is that the student is able to learn quickly and adjust quickly and be able to get the correct answers without needing homework." Here, the process is quick comprehension and adaptation of ideas and concepts with minimal help or practice (process) that leads to getting the correct answer (outcome).

Quadrant IV

Quadrant IV aligns with responses that contain elements of the counter process narratives and dominant outcome narratives. This was the most populated quadrant. Examples of responses in this quadrant are "Being able to grasp and understand the material being taught and retaining it," and "Passing your classes with high grades, being able to conceptualize problems and follow along with lectures." In the last example, the process was grounded in understanding and following along with lectures, but it seems that the outcome was to ultimately pass the class. Responses here indicate that students had counternarrative processes with respect to their ideas of smartness, however they still relied upon dominant outcome narratives.

Discussion

The analysis of student responses with respect to process and outcome revealed a significant concentration along the axes, suggesting a predominance of simpler views of mathematical smartness, focused primarily on either process or outcome. The lower half of the outcome axis, aligned with dominant narratives, was particularly populated, indicating a widespread focus on achieving specific results, such as passing classes or getting good grades. However, a notable presence on the right side of the process axis demonstrated that several students valued alternative processes like understanding concepts, putting in the work, asking for help, or helping others.

Interestingly, Quadrant I, representing counter narratives for both process and outcome, was the second most populated. This suggests that a considerable number of students held alternative views of smartness, emphasizing understanding and application over rote memorization and high grades. Quadrant II, combining dominant process narratives with counter outcome narratives, had the fewest responses, highlighting the rarity of students associating traditional learning processes with alternative notions of smartness.

The sparse population of Quadrant III further indicates the lack of an association between dominant process and dominant outcome narratives. Finally, Quadrant IV, the most populated, revealed a tension between counter process narratives and dominant outcome narratives. This suggests that while many students may appreciate alternative learning approaches, they still may feel confined to dominant conceptions of smartness. This analysis provides valuable insights into the complex and often conflicting perspectives on mathematical smartness held by students.

Conclusion

The way that educators implicitly and/or explicitly talk about smartness in the mathematics classroom is deeply influential in the way that students then conceptualize their own smartness. As illustrated in our initial vignette, the way we communicate about smartness in the math classroom, whether implicitly or explicitly, holds significant influence over students' self-perception and learning experiences. Our research underscores the importance of recognizing and valuing the diverse forms of smartness that students bring to the mathematics classroom. With an awareness of the often conflicting narratives students have of their own smartness in the mathematics classroom, educators can empower students to develop a positive mathematical identity. This is particularly crucial within community college settings, which serve a large proportion of underrepresented students in STEM fields.

By actively desettling the traditional idea of smartness in math and emphasizing the value of hard work, conceptual understanding, collaboration, and application, educators can help students move beyond narrow definitions of smartness. This shift empowers students to develop a more inclusive and expansive understanding of what it means to be mathematically capable. This approach fosters a more equitable learning environment where every student feels recognized and supported. Furthermore, we recognize that neither process nor outcome is inherently good or bad. Students operate within a system where achieving high scores is often necessary for advancement. However, integrating process-oriented approaches can enrich their experiences, broadening their understanding of smartness beyond a singular, potentially limiting perspective.

Limitations

A key limitation of this study lies in the one-dimensional nature of the data, stemming from its reliance on a single open-response question. Without the opportunity to probe for deeper insights or follow-up with participants, our analysis relied heavily on inference and interpretation. This constrains our ability to fully capture the rich complexities and nuances of student perspectives on smartness in mathematics. Future research could address this limitation by incorporating multiple data sources or employing methods that allow for more in-depth exploration of individual experiences and beliefs.

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