

A CULTURE OF CHANGE: STUDENTS STORIES IN UNDERGRADUATE REFORM MATH

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A student's perceptions of, feeling towards, and beliefs about mathematics have long been known to be associated with their learning and performance in mathematics. But how might we observe and document changes in these attitudes and dispositions? How might a student's affects respond when the nature of mathematics changes? To answer these questions, we adopt a life stories theoretical perspective and read these stories through an affect lens. In so doing, we observe patterns of change in students' affects that correspond to milestones in their concurrent mathematics course. We present a vignette that illustrates one student's redemptive story of her transformation towards productive affects. Taken together, we suggest that curricula can be enacted in ways that afford such redemptive changes.

Keywords: Affect, Emotion, Beliefs, and Attitudes.

Introduction

In 2017, in the California State University (CSU) system, over 25% of entering, full-time freshman (16,628 students) were placed into a remedial mathematics sequence. Their stories within remedial mathematics courses were bleak, with students describing experiences of increased anxiety and negative dispositions towards mathematics (Maciejewski, Tortora, & Bragelman, under review). A change to this placement system was needed.

Later that year, the CSU Chancellor's office issued Executive Order 1110, which abolished remediation across its 23 campuses, leaving the institutions to individually determine reform of their general education mathematics curriculum for the 2018 academic year. San José State University embarked on a curricular redesign, Math 1, that emphasized four principles: an inclusive environment where students were no longer tracked by ability; content emphasizing contemporary mathematics rather than the traditional algebra sequence; a student-centered classroom experience; and a curriculum that also targeted non-cognitive components to support students' disposition towards mathematics (Maciejewski et al., accepted). In short, the reform targets multiple processes of the instructional dynamic (Cohen, Raudenbush, & Ball, 2003). In this work, we orient on the interactions between students and the reform curriculum by exploring students' change in affect towards mathematics as evidenced in their emergent life stories during Math 1.

Life Stories

We approach learners' experiences through a life narrative or life story methodology (McAdams, 1985, 2008; McAdams, 2018; McAdams & McLean, 2013; McLean et al., 2018). Indeed, "stories are the best vehicles known to human beings for conveying how (and why) a human agent, endowed with consciousness and motivated by intention, enacts desires and strives for goals over time" (McAdams, 2008, p. 244). They capture both consistent and inconsistent patterns over time (McAdams, 1985), such as a person repeatedly identifying as 'bad at math' across interviews or as a person describing what sequence of events led them to changing their major. Stories evolve over time, implying individuals' meanings attributed to important events may also change (Singer & Salovey, 2010). Last, stories are contextual (McAdams, 2013), suggesting stories are both created and discontinued within established cultural norms and traditions.

Affect and Stories

The affective domain in mathematics education encompasses varying concepts and theories and manifold approaches to its study (Goldin et al., 2016), and there is a clear alignment between life stories as a methodology and affect as a theoretical lens. Di Martino and Zan (2010) provide an entry point to examining students' affects towards mathematics through stories, with the Three-dimensional Model of Affect (TMA) having been developed from thousands of students' life stories with mathematics. We approach affect in this work through the TMA of Di Martino and Zan (2010); in particular, we restrict our attention to the categories of emotion and competence. Rather than approaching students' affect towards mathematics through more traditional life stories approaches (cf. McAdams and McLean, 2013), we explore students' change in affect by capturing multiple narratives across a semester of a reform introductory university mathematics course, in situ. Unlike Di Martino and Zan (2010), we explore change in affect across multiple narratives from each participant.

Method

In this multiple case study, we draw on empirical data collected during the first semester implementation of Math 1 in Fall 2018 at San José State University. The case study focus was twofold: an examination of students' mathematics experiences and affect in a reform general education mathematics course and an examination of a specific institutional implementation of a new curriculum (Yin, 2009). Within a life story methodology, qualitative methods were employed for the inquiry, most notably classroom observations and semi-structured interviews. Data was collected across two course sections of Math 1, and a subset of this data, ten students' stories about their mathematics learning experiences, is the primary unit of analysis here.

Setting and Participants

Under Executive Order 1110, incoming freshmen at San José State University are no longer required to take a basic skills assessment, which would normally have determined the starting point in their course sequence. Rather, multiple academic indicators are used to place students into the mathematics sequence appropriate for their degree focus. Math 1 served as the first of several mathematics courses for mathematics-intensive degree programs. However, students in non-mathematics intensive programs had the option to self-enroll in Math 1 as it satisfied their general education mathematics requirement. Of the 288 students enrolled in Math 1 in Fall 2018, 10 consented to the interviews.

The first author conducted three to four interviews across the semester, depending on students' availability, with a total of 53 interviews. Interview questions focused on personal background and school experiences, with an emphasis on school mathematics experiences both before and during Math 1. The first set of interviews was conducted during Unit 1, before the first assessment. The second set was conducted during Unit 2. The third set was conducted during Unit 3, and the fourth set, if availability allowed, was conducted in the last week of the semester, before finals. This work focuses on the participants who interviewed at all four time points, amounting to five participants in total.

Coding

Interview data was transcribed using an online transcription service, and the results were transferred into Microsoft Excel for coding. The interview data was separated into time points by participant, and each time point was broken into narrative utterances between interviewer and interviewee. Di Martino and Zan (2010) inform our coding for affect. Drawing on their descriptors for emotion and competence, we assigned codes of emotion (positive or negative) and competence (high or low) to narrative utterances, when applicable. Each time point was reduced to a single descriptor of affect

dependent on the frequency of emotion and competence codes: more negative affect, less negative affect, less positive affect, and more positive affect. McAdams and McLean (2013) inform our coding for life story constructs.

Results

Table 1 displays participants’ change in affect across a semester of Math 1. Participants’ affect across the semester changes in relation to the reform curriculum and their perceived performance in the course. While changes in affect do not necessarily align with changes in perceived performance, emergent life stories seem to coincide with changes in participants’ affect and perceived performance. Whereas we identify three types of changes in Table 1, we discuss one in this proposal due to space constraints.

	Entering Affect	Test 1	Affect After Test 1	Test 2	Affect After Test 2	Test 3	Affect After Test 3
Brian	more negative	30	more negative	50	less negative (redemption)	80	less positive
Alejandra	more negative	50	negative (redemption)	80	less positive	100	more positive
Becky	more positive	86	more positive	84	less positive (contamination)	78	less positive
Cici	more negative	32	more negative	34	more negative	56	less negative (redemption)
Frank	more negative	100	less positive (agency)	75	less positive (contamination)	91	less negative

Table 1. Affect and perceived performance across a semester of Math 1

Redemption - Alejandra’s Story

Alejandra is the first in her family to attend college. While not required to take Math 1, she enrolled in it due to her more negative affect towards math, in her words, ‘to start anew’. Her narrative suggests her negative perception of math developed in high school. Moving into Math 1, she struggles initially, as the course’s focus on explanation and reasoning was difficult for her to understand. She explains that she felt lost with her first group. In her second interview, Alejandra describes how she felt during the first test:

Alejandra: I did feel more confident, after the end. Right, I knew I failed this. After the end I felt like, I don't even know if I could say for certain I did it, wrong or right. Cause I was like, this answer ... you can answer the question, you can answer really simply even with equations or make it as complicated as you want to. At the end of the day, I guess you could say it was a flip of the coin.

In the same interview, she later describes her work with a new group, newly assigned after the first assessment, particularly one member, who has a noticeable impact on her understanding of the concepts.

Alejandra: I think just surrounding myself with people who understand the material has made me understand that material more. The previous test, I think what happened was my group, we didn't talk about anything, so I was very confused, as were they.

Alejandra suggests the negative experiences of the first test and her first group pushed her to find what was missing for her success in the course. These narrative excerpts alone would not indicate a redemptive story; also necessary was her shift in performance and in her affect in the subsequent interviews. For example, in her fourth interview, she describes the end of her redemptive story:

Alejandra: I think when we were doing the disease population problem, and I was telling people where to move and stuff. And they'd be like, "I don't understand." And I would explain to them and in my head I was like, "You know this, like you're explaining to them. They're not explaining to you."

Alejandra experiences a change in perceived competence, part of her overall shift in affect across the semester. For her, Math 1 was the context for her redemptive story with mathematics.

Discussion

We highlight the theoretical underpinnings of our work as opening up potential new perspectives and approaches to understanding the development and evolution of students' affects towards mathematics. To assess change in affect, we could have used an established instrument with a pre/post design (e.g. the Mathematics Attitudes and Perceptions Survey (Code, et al., 2016)). However, any such instrument is inherently limited in scope: though they might capture the "first order" affects that bear on performance, say, they cannot capture the full lived experience of the students in mathematics. What's more, there are no objectively positive affects in mathematics, but rather productive affects; persistence during "effortful struggle", for example. A life story methodology captures these.

Participants' stories unfolded during a mathematics course that was intended to be a new mathematical experience, different from the traditional curriculum from high school. Our analyses demonstrate transformations of negative affects into productive ways of working with mathematics. This presents an opportunity: curricula can be designed and enacted to afford such productive transformations. The culture of a course can be a culture of change.

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