Classroom Experiences of Students in a Community College Intermediate Algebra Course

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There is little understanding of the ways in which students experience developmental mathematics courses at community colleges (Crisp, Reyes, & Doran, 2015). This study investigates the instructional experiences of students in an Intermediate Algebra course using qualitative methods that rely on interviews, surveys, classroom observations and classroom artifacts. I aim to understand (1) what are the experiences of students in a developmental mathematics class at a community college and (2) how students make sense of particular experiences. The findings from this study will support college mathematics departments by providing evidence of the classroom instructional experiences of students.

Keywords: Developmental Mathematics, Student Success, Classroom Experience, Postsecondary Instruction, Community Colleges

Developmental mathematics is an important area of postsecondary mathematics education. Nearly 60% of first-year students at public two-year colleges take developmental mathematics (Radford, Pearson, Ho, Chambers, & Ferlazzo, 2012). Community colleges offer more developmental courses than any other type of postsecondary institution (Nora & Crisp, 2012; Parsad, Lewis & Greene, 2003; Radford et al., 2012). Developmental courses are often viewed as a gatekeeper for students to make progress to degree completion (Attewell, Lavin, Domina, & Levey, 2006; Bettinger & Long, 2005), but are also a pre-requisite for many students aiming to enter technical fields (e.g., science, technology, engineering, and mathematics [STEM], business). Historically, Intermediate Algebra has been the bridge between developmental courses and college courses (Lutzer et al., 2007). To be able to increase persistence, to provide a valuable learning experience and also to keep students in the STEM track, it is essential to know how parts of the "black box" work and student classroom experience is one that is often overlooked.

The most common way to measure student success in higher education is through academic achievement, such as GPA, course completion, the need to repeat courses, student persistence, and degree attainment (Howard, 2010; Valencia, 2015). This scholarship also seeks to predict such "success" using students' previous academic preparation, socio-economic status, mathematics placement test scores, and SAT scores (e.g., Bahr, 2010; Crisp & Delgado, 2014; Crisp & Nora, 2010; Nora & Garcia, 2001). Although such studies attempt to understand what contributes to the low success rates for developmental mathematics students, they, however, do not help us to understand what happens *while* students are enrolled in their math class, undermining the mathematical influence we as instructors can have on student success. The interactions and experiences that students have in a classroom can impact student learning (Cohen & Lotan, 1997) and those experiences in turn, can shape students in ways that can affect the quality of other subsequent educational experiences they may have (Dewey, 1938). Unfortunately, to this date, we know very little about how classroom experiences contribute to the success of developmental mathematics students.

The purpose of this study is to better understand the mathematical experiences of students enrolled in a developmental mathematics. This paper will address two research questions: 1) What are the instructional experiences of students in a developmental mathematics class at a community college? and 2) How do students make sense of these particular experiences? This qualitative case study focuses on how students experience the instruction in a developmental mathematics course, attending to their perception of these experiences, and to the ways in which these experiences influence their mathematical understanding.

Theoretical Framework

I define instruction as the interactions that occur between instructors and students with the mathematical content (Cohen, Raudenbush, & Ball, 2003). Teaching and learning are essential aspects of instruction that occur within a specific environment, in this case, a developmental mathematics classroom at a community college. The roles of both student and teacher are supported by different resources (e.g., previous educational experiences, classroom environment, technology) and constrained by specific institutional requirements (e.g., classroom assignment/layout, covering preset mathematical content, having periods of 50 minutes) (Chazan, Herbst, & Clark, 2016; Cohen et al., 2003). In order to characterize students' experiences, I choose to focus on instruction. The classroom is an important space within a community college campus because it is the space in which the most interaction occurs for many students and is also where many students draw from when reflecting on their educational experiences (Wood & Harris III, 2015). Given the high attrition rates for STEM fields (69 % of associate's degree students who entered STEM fields between 2003 and 2009 had left these fields by spring 2009; see Chen, 2013), it is particularly important to understand classroom experiences. For example, in a literature review of reasons for dropping out of engineering programs, more than half of studies identified the classroom as a factor for why students leave (Geisinger & Raj Raman, 2013). I believe that the experiences of students, while interacting with their instructor and the mathematical content, significantly impact the success a student has in mathematics.

Methods

The study takes place at Clear Water Community College[1], a Hispanic serving institution in California, during Fall 2016. Around 90% of the student population at this college enroll in developmental mathematics. I observed one section of Intermediate Algebra taught by a part-time faculty member, following nine focal students throughout the semester. The class met three times a week for 95 minutes. Table 1 describes information about the nine focal students. All students identified as being of Latinx decent. I chose a part-time faculty member because oftentimes developmental mathematics courses are taught mostly by part-time instructors (Blair, Kirkman, & Maxwell, 2013). The instructor was a Black female, who graduated with a Bachelor's degree in Engineering and a Masters in Applied Mathematics. She has 2 and a half years of teaching experience, two of which were while she was a graduate student. During this semester, she is also teaching 3 courses at two other community colleges.

Table 1. Student Demographics

Student	Gender	Age	First Generation	First Year
Adriana	F	19	Yes	Yes
Chris	M	21	No	No
Guillermo	M	18	Yes	Yes

[1] All institutions and names in this study are pseudonyms

Layana	F	20	No	No
Marisa	F	18	No	Yes
Nancy	F	18	No	Yes
Raquel	F	18	Yes	No
Santiago	M	18	Yes	Yes
Teresa	F	18	Yes	Yes

The data sources that I used for this paper include interviews, classroom observations, and diary entries (surveys). I interviewed each student three times at the beginning, middle and end of the semester. I also observed the course 12 times, which included video-recording the lesson as well as taking fieldnotes. After each formal observation, the focal students filled out a survey, detailing their experience of that specific class meeting which included reflections on the math content, moments that went well/did not go well, interactions with peers, and ways that they participated in the course.

This study is a case study analysis of one intermediate algebra class. I engaged in open coding of the student interviews and surveys as well as the observation fieldnotes. I captured comments that related to the ways in which the students described the classroom instruction as well as how issues such as race/ethnicity, gender, culture, class, or language affected their classroom experience. To code the video-recordings, I used the *Evaluating the Quality of Instruction in Postsecondary Mathematics* (EQIPM) instrument (Author and colleagues, 2017), which assesses the quality of mathematical instruction at community colleges by providing ratings from 1 to 5 on various codes. In this paper, I will talk about two codes, specifically *Organization in the Presentation of Procedures* and *Mathematical Errors and Imprecisions in Content or Language*. *Organization in the Presentation of Procedures* captures how complete, detailed, and organized the instructor's (or students') presentation (either verbal or written) of content is when outlining or describing procedures, or describing the steps of a procedure used to solve problems. A rating of 1 on this code implies that the instructor's (or students') presentation of the procedure is disorganized, incomplete, illegible, or unclear. A rating of 5 indicates that the teaching is not only clear, but it is also exceptionally organized and/or detailed. *Mathematical Errors and Imprecisions in Content or Language* capture events in the segment that are mathematically incorrect or that have problematic uses of mathematical ideas, language, or notation. A rating of 1 on this code implies that there were no errors or imprecisions in the segment while a rating of 5 implies that content errors and/or imprecisions occur in most or all of the segment or muddle the opportunity for students to make sense of the procedure. I rated the video in 7.5-minute segments using the EQIPM instrument. Given that there are both good and bad moments within our teaching, I averaged the ratings among the segments.

Preliminary Results

I will describe preliminary findings from Observation 2, which occurred during week 3 of the semester. There was a total of 12 7.5-minute segments in this observation. In particular, I will first describe ratings and evidence given for *Organization in the Presentation of Procedures* and then for *Mathematical Errors and Imprecisions in Content or Language*. I will also describe how students specifically made sense of their experiences in relation to those particular codes.

There were 38 students in the class meeting and all of the focal students were in attendance. The students sat at long table rows, each seating about eight students, with an aisle down the center. Some students sat in chairs at the back of the room as they walked in late. The lesson covered topics such as solving one-variable linear inequalities, absolute values, and solving absolute value equations and inequalities.

Instruction. The modes of instruction during this meeting were lecture, individual student work, and student presentations. Out of the 95 minutes of class, the instructor lectured for 60 minutes (63.2% of class time), students worked individually at their desks for 20 minutes (21.1%), three students presented at the board for 13 minutes (13.7%), and two minutes were devoted to classroom business (2.1%). The classroom was considerably quiet with very little interaction, and the instructor sat at the document camera for the entire class session.

Organization in the Presentation of Procedures. The mean rating for *Organization in the Presentation of Procedures* was a 2.5. A rating of 3 indicates that the teaching of the procedure is acceptable, complete, and mostly clear, but not exceptionally organized or detailed. I noted two general areas where organization greatly affected the instruction. First, the instructor used a set of guided notes to lecture from.

The instructor created online note packets for every chapter in the textbook. She lectured from these packets every class meeting. Some say that there are affordances of using such guided note packets in that problems are pre-selected providing scaffolding or that by providing guided notes, students can spend more time focusing on the lesson while also having a set of coherent notes (Montis, 2007). Upon review of the video, it was difficult to follow the notes throughout the lesson: the instructor jumped around from page to page, often left directions or entire problems out of view of the document camera while working on a problem, and also appeared to run out of space when working on a problem. From fieldnotes, I noted that only a handful of the 38 students had the notes printed out. Therefore, the organizational affordances of providing lecture notes were not capitalized during the lesson.

The second area of organization that was evident during instruction is related to the way that the instructor selected the problems in the lesson. Specifically, the instructor did not scaffold the problems so as to set up student success, leaving the students to work individually on very difficult problems. There were three moments when students were asked to work on problems individually at their desks. In each of these instances, the instructor first worked on one to three examples, and then selected a problem within the same section of notes for students to work on.

At one point in the lecture, the instructor assigned the students to work individually on an absolute value problem where the directions said to "Solve the equations". Prior to this moment, the instructor worked through two examples at the document camera, $|y| = 8$ and also $|4x + 1| = 9$. She asked the students to solve the following: $3\left|\frac{3}{2}a + 1\right| + 2 = 14$. The increase in the level of complexity in this problem jumps quite quickly. Students were given three and a half minutes to find and check the solutions to this problem. Later in the class period, the instructor gave students a set of three absolute value equations to solve and indicated that she would ask students to volunteer to present their work at the board. One of the problems in this section was particularly challenging: $\left|\frac{4w-1}{6}\right| = \left|\frac{2w}{3} + \frac{1}{4}\right|$.

Throughout the lesson the instructor selected challenging problems for students to work on, when the problems she selected to use during the note-taking were uncomplicated. In particular, the instructor did not work on any problems in the notes that involved fractions. In the class surveys, five students mentioned these individual practice problems as extremely challenging. Layana said that she felt uncomfortable, "when [the instructor] involved fractions and didn't give examples and kind of let us do it on our own." Teresa said, "when we began to deal with fractions I started to get confused and compared my notes with my partner but turns out we were both confused."

Mathematical Errors and Imprecisions in Content or Language. The mean score for *Mathematical Errors and Imprecisions in Content or Language* was a 3. This implies that there were on average content errors or imprecisions in every segment. This is extremely problematic given the already possible set of misconceptions that students in developmental mathematics classes may already have (Author, 2014). One particular segment scored a rating of 5. In this segment, the instructor says phrases that overly simplify a complex idea. For example, when solving an equation, she tells students to "remember, no matter what, in Algebra the goal is to isolate the term or the variable." This phrase appears to simplify all work done in Algebra down to one notion: solving. By framing mathematics in such a way, students can begin to lose sight of the purpose and utility of mathematics beyond simply solving.

At another point in the segment, the instructor solved an equation and was left with a solution of $x = \frac{-10}{4}$. She asks the students, "What's the LCD between 10 and 4?" A few students say "2". The instructor continues on talking about how she can simplify to $\frac{-5}{2}$, however, catches herself and says, "Sorry, Greatest Common Factor between 10 and 4. The answer is still 2…Remember factors break down, multiples multiply out." It has been documented that developmental math students tend to struggle with the differences between least common multiples and greatest common factors (Stigler, Givvin, & Thompson, 2010). In this exchange, the instructor asks for the least common multiple, which would be 20, but students gave the greatest common factor. This could have been because students assumed what the instructor was asking for. However, later when the instructor catches her mistake, she tells the students that the answer would still be two, not correcting that the LCD between 10 and 4 is in fact 20. Later, when she checks that the solution $x = -\frac{5}{2}$ works for the absolute value equation, $|4x + 1| = 9$, uses inaccurate mathematical language. When simplifying the term $4\left(-\frac{5}{2}\right)$, she indicates to students that they can reduce the fraction by "cross cancel[ing] a little" such that the 4 in the numerator "cross cancels" with the 2 in the denominator to make the mathematics simpler.

Most students did not seem to catch the different mistakes during the lesson, and when they do they usually catch copy mistakes (e.g., missing a negative, not writing the correct number). In student interviews, some focal students indicated that they have overheard others correcting the instructor's mistakes and that they do not mind because it is useful to see your instructor make a mistake. For example, Chris mentions that he sees her making mistakes pretty regularly. Instead of outright correcting her, he tries to ask questions in order to help her catch them with the intention of not embarrassing her. Raquel and Adriana indicate how it really confuses them when she makes mistakes in her teaching. Raquel said,

> Her teaching methods, I'm just not feeling it. I mean, she tries but it's like, she makes too many mistakes. And it's like, you're a professor. You're supposed to know what you're doing. And I, everybody makes mistakes, but not like constantly, when we're trying to really learn and pass this class…I notice 'em, but I don't want to like, say it. Because what if I'm wrong too? So I don't want to look dumb. But I do notice.

Adriana says that that every time the instructor makes a mistake, she feels like they are doing all of the work for nothing, which both confuses and frustrates her.

Questions. At the talk, I aim would like to ask participants: 1) What are your thoughts on the mathematical errors that the instructor demonstrates? 2) The participants in my study are all Latinx students. In the larger study, I intend to use Critical Race Theory, specifically Latino Critical Theory to investigate these experiences further. In what ways have audience members used LatCrit theory in their work in undergraduate mathematics education?

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