Promoting Student Agency and Engagement Through Student Partnerships: A Case of an Introduction to Analysis Course

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Most advanced mathematics courses are taught via lecture, in which it is hard to foster meaningful student engagement, agency, and community. In this paper, we discuss an academic support resource called The Students as Partners Program that was implemented in an Introduction to Analysis course with 26 students at a private institution in the Northeastern United States. This model of support positioned three currently-enrolled students in this course as "Student Partners" who were tasked with communicating information to the instructor about student experiences that the instructor could then use to respond dynamically to student needs. In this exploratory study, we examined how student-partnerships can promote student agency, which allowed instructors to implement instructional design structures that supported and facilitated student engagement in- and out-of-class and classroom community.

Keywords: agency, engagement, advanced mathematics, undergraduates, student partnerships

Introduction

Students often have unpleasant experiences in upper-level, proof-based mathematics courses like real analysis. Most advanced mathematics courses in the United States and internationally primarily utilize lecture-style instruction (Fukawa-Connelly et al., 2016; Artemeva & Fox, 2011) in upper-level courses. Most of these courses employ a "definition-theorem-proof" instructional style, during which students tend to be passive during class time, participating primarily through note-taking (Weber, 2004). Paoletti, et al. (2018) found that while lecturers in advanced mathematics courses asked students a number of questions, lecturers failed to provide students with authentic opportunities to construct or co-construct mathematical content and reasoning. Learning mathematics requires student engagement, but most advanced mathematics courses do not allow much opportunity for engagement; and the normative passive nature of students in advanced mathematics classes can contribute to decreased outcomes for students.

Trowler and Trowler's 2010 meta-analysis on student engagement in higher education found that student engagement is correlated with student achievement. Student engagement is also correlated with particular positive outcomes for students including critical thinking, self-esteem, productive racial and gender identity formation, improved grades, and persistence. We agree with Trowler and Trowler's claim that student engagement is a shared responsibility among students and institutions and their staff. While ultimately, students must exercise agency in choosing to engage and the quality of engagement, institutions and staff are responsible for instituting structures that allow for, encourage, and incentivize student engagement.

In this paper, we discuss one way to construct productive structures for student engagement called student partnerships. In these partnerships, select student(s), called Student Partners (SPs) are invited to be collaborators in the educational process. Each week, they meet with their instructor to provide ongoing feedback on teaching practices, discuss the learning needs of the students in their class, and directly engage in pedagogical conversations surrounding student learning. Positioning students as active participants in the shaping of the course design lifts the curtain to allow students to see the process of developing and delivering a course, promotes metacognitive and communication skills, and encourages active community participation.

Moreover, student-faculty partnerships provide students a means to have anonymous (and thus, hopefully authentic) input on the ways they can engage with the course material and with each other in the classroom which, in turn, and can help the instructor construct and refine structures for students that promote greater engagement in, and responsibility for, their own learning (Cook-Sather and Luz, 2014).

This is an exploratory case study about student partnerships and their impact on student engagement and agency. The central goal of this paper is to illustrate how student partnerships can promote student agency, which allows instructors to implement instructional design structures that support and facilitate student engagement through interaction and participation, time and effort, and belonging.

Theoretical Frameworks

Our study employs two theoretical frameworks: student agency and student engagement. Our conception of student agency draws on Emirbayer and Mische's (1998), who define agency as a response to structure - the set of forces that either facilitate or constrain an individual's progress towards a goal. Given an element of structure, whether that structure is facilitating or constraining an individual's goal, agency encompasses the individual's choice to respond and the quality of response to that structure. Agency is not a quality individuals have or do not have, rather agency is something an individual achieves in particular situations. In an advanced mathematics class, many students have the goal of learning mathematics or participating in meaningful mathematical activity. Traditional class structures may limit the ways students can achieve agency by constraining the ways in which they can respond to structures that facilitate or constrain their learning, but alternative structures may give students more opportunity to achieve agency. In this study, we are focused on student agency as a student's response to instructional design structures (classroom structures over which an instructor has control) towards the goal of learning mathematics or participating in meaningful mathematical activity.

Our framework for student engagement is adapted from Kahu's (2013) framework for student engagement in higher education. There are six dimensions to this framework: the sociocultural context; the structural and psychosocial influences; engagement; and the proximal and distal consequences. We have modified this framework to focus on the aspects of student engagement salient to our study (see Figure 1). As we are focused on the classroom level and only collected data from one semester, have only retained psychosocial influences, engagement, and proximal consequences. In our framework, psychosocial influences include teaching, teachers and staff, and support at the university, along with student identity and skills. In this context of this study, staff includes the university employees in the Center of Teaching and Learning (CTL) who helped facilitate the student partnership and support includes teaching assistants assigned to this course. We have also added student agency to this dimension, by which we mean the degree to which they respond - and the quality of these responses - to instructional design structures; the agency a student can achieve influences their engagement. In Kahu's framework, a student's individual experiences are influenced by qualities of both the student and the institution to emphasize that student engagement comprises "more than just an internal static state," (Kahu, 2013, p. 13).

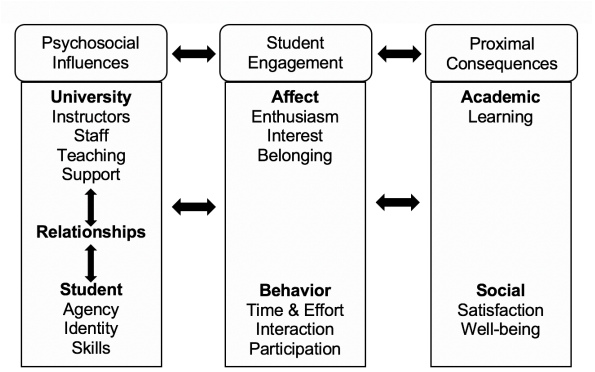

Figure 1: Student Engagement Framework; adapted from Kahu, 2013.

Methodology

Background

In spring 2020, the CTL at a small northeastern liberal arts college in the United States of America introduced a pedagogical program that was modeled after the Students as Learners and Teachers program at Bryn Mawr and Haverford Colleges. Each instructor was teamed up with at least one student partner and had autonomy in selecting their partners. Student Partners (SPs) met with instructors weekly and with CTL staff and other student partners every other week. SPs were paid for their time. In this paper, we highlight the partnership between the mathematics faculty and three SPs in an upper division introduction to analysis course that is required for all students majoring in mathematics at the institution and was supported by two undergraduate teaching assistants who had already completed the course.

Study Participants

Participants were 26 undergraduate students enrolled in an introduction to real analysis course that met for four 50-minute class periods per week, three of whom served as SPs. One of the researchers was also the instructor of the course, Dr. T, and served as a participant reflecting on their experiences. We gave all interviewees pseudonyms: Nico (a student partner), Milo, Rory, Sun, and Jaime.

Data Collection

Data was collected in the spring 2020 semester. The data consisted of 1) five synchronous classroom observations over Zoom, 2) five 30-minute student interviews, 3) Dr. T's reflections, and 4) SP reflections. Generalized Observation and Reflection Platform (GORP) (Center for Educational Effectiveness, n.d.) was used to observe five classes towards the end of the semester. In March 2020, the course transitioned to remote teaching due to the COVID-19 pandemic and observations occurred after this transition. The two researchers who observed were muted and their videos were turned off and they did not interfere with the class. Of the five student interviewees, one was a SP. Interview questions reflected student experience in- and out-of-class, their interactions with the instructors and peers, and student perception of themselves in the context of mathematics and real analysis.

Analysis

Using our framework for student agency, we used open and axial coding to analyze interview data for references to structures implemented by the instructor control (instructional design

structures - IDS) and student responses to these structures (Braun & Clarke, 2006). Classroom observation data and student interview data were used in the analysis of student engagement within our framework for engagement described above. In order to examine student and faculty interaction in the classroom, the researchers noted the number of times a student interacted with the faculty and used an open coding thematic analysis to categorize the different types of faculty-student interactions, namely answering a question, asking for clarification, asking follow-up questions, stating conjectures, and other, occurred during a 50-minute class time. We used open and axial coding to analyze interview data for evidence of student engagement, as defined in our theoretical framework. Dr. T's and SPs' reflections were used to triangulate and validate results.

Results

We first present evidence of IDS referenced in the student interviews and student responses to these structures. Next, we present themes of student engagement in the course and connect these to themes of IDS.

Themes of Instructional Design Structures

Assignments. One element of IDS referenced in several student interviews was a Theorem-Definition sheet assignment. Nico (a SP) described this assignment: "you basically just type up or write up all of the theorems and definitions that we had done that week." While Dr. T implemented this assignment without input from the SPs, after implementation, SPs validated the value of this assignment for him. Nico reported that this "mandatory assignment" helped them study for the course and Milo reported that even though this assignment was "extra work," it helped them understand the "ideas more concretely." Jaime initially thought this assignment "would be annoying," but "in the end, … it out-weighed any drawbacks. And I thought that was really helpful." The student partnership provided a mechanism through which students could respond to the class structure. This feedback helped reaffirm for Dr. T the value of this assignment for students' learning.

Class Format. When the onset of the COVID-19 pandemic interrupted physical instruction, the instructor had to make decisions about adjusting the instructional design to the remote learning environment. In their interview, Nico described how the instructor leveraged the student partnership to help make these decisions. Nico reported that "before the switch to remote learning, our [SPs] main focuses were making sure that we could cater to the needs of everyone in the class," while after the switch, "it was more focused on structuring the class in a remote setting." They reported that they discussed different formats for exams, live versus recorded instruction, and the use of breakout rooms with Dr. T. Through the student partnership, students had an opportunity to respond and provide input on the class format during an uncertain time. This direct student feedback helped Dr. T make informed decisions about structuring class in the new remote modality.

Themes of Student Engagement and Connections to Instructional Design Structures

From the five student interviews, we identified three themes of student engagement: interaction and participation, time and effort, and belonging.

Interaction and Participation. Nico noted that participation in class after the switch to remote learning was noticeably different than before the switch, "... most people before remote learning would feel free to jump in and propose different ideas. ... now it's mainly just getting questions answered based on the material and clarifications on stuff that we're doing right now." This suggests that the class format before the switch to remote promoted student participation in

class. Even after the switch to remote, students still regularly asked questions during class time. Sun reported that they typically do not ask questions during class time, and while they did not ask questions via audio during remote learning, they were able to ask more questions using the chat feature in Zoom than they would have during physical instruction. During all five class observations, Dr. T used a tablet to write and lecture, something he had used for instruction even before the switch to remote, and frequently paused to ask and answer questions. Classes that were observed mostly consisted of lecture and some Desmos demonstrations. We observed a high amount of student participation during these observations, especially for a remote environment at the onset of virtual instruction. On average, there were 13 student interactions in a 50-minute class. We also observed that students were actively listening and taking notes as most of the student videos were available. The SPs were highly involved during class; their interactions comprised almost half of the total number of interactions (asking or answering questions) during class time.

The class format, informed by conversations between Dr. T and the SPs, allowed for students to ask questions in-the-moment and helped promote interaction and participation, aspects of the behavioral dimension of our framework for student engagement. Thus, through the student partnership, students achieved agency by responding to the class format. From this information, Dr. T was able to make choices about the class format that increased student engagement.

Time and Effort. For Nico (a SP), the "Theorem-Definition Sheet" assignment provided a structure which incentivized spending time and effort on course material. They noted that continuously refreshing course content is an important practice, but "it's always hard to kind of remind myself to do it on my own. So [the theorem-definition sheet assignment] was a super helpful way to do it no matter what." Despite its value, Nico doubted that they would continue this practice in the future as they were unlikely to complete an assignment that was not mandatory (i.e. part of their grade). This suggests that this assignment increased Nico's general course engagement by incentivizing the expenditure of time and effort in refreshing course material. Even though Jaime they thought this assignment "would be annoying" or "hand-holding, in a way," in the end, they decided that it was really helpful and provided a lot of value in their learning. This assignment provided a structure that promoted this behavioral component of engagement. While this assignment originated from Dr. T without input from the SPs, SPs helped reaffirm this assignment's value for Dr. T.

Belonging. From the outset, Dr. T put a lot of effort into establishing a community-oriented class. During instruction, he invites students into the process of constructing mathematical knowledge through scaffolding questions that encourage and build on student contributions. In their reflections, SPs noted that Dr. T emphasized that student participation was valuable and welcomed, despite the "correctness" of answers or suggestions, and that this helped them feel more comfortable participating in class. Dr. T was also using a tablet for instruction before the switch to remote, which allowed him to face his students during instruction and establish a stronger connection with students during class than if he were writing on the board with his back to students. The atmosphere in this course promoted a sense of belonging for Nico so that, in spite of the switch to remote learning, they maintained connection with classmates and the instructor. They reported that "Dr. T always stressed in this class is it's important to build a sense of community, and so try to keep that." As a student partner, Nico worked closely with Dr. T in structuring the course. In their statement above, Nico reaffirmed Dr. T's valuing of classroom community. While the transition to remote learning certainly impacted the atmosphere of class, other interviewees reported that Dr. T worked to maintain the classroom community after the

switch. While building community and belongingness are core teaching values that Dr. T had at the start of the course, feedback from his conversations with SPs helped reaffirm these pedagogical decisions. Data from student interviews and Dr. T's reflections indicate that many students experienced a sense of belonging, especially before the switch to remote learning. Thus, through the student partnership, students could respond to Dr. T's choice to emphasize classroom community. This choice promoted a sense of belonging for students, which is reflected in the affective dimension of our engagement framework.

From interviews with students, classroom observations, and Dr. T's reflections, we identified three themes of student engagement from our framework: interaction and participation (behavioral), time and effort (behavioral), and belonging (affective). We connected these themes of engagement to their structural influences. Interaction and participation were influenced by the class format Dr. T established, which was informed by the student partnership. Time and effort were influenced by assignments Dr. T chose, such as the Theorem-Definition sheets, which was reaffirmed through the student partnership. Belonging was influenced by the classroom climate Dr. T established through his teaching, which was reaffirmed by the student partnership.

Conclusion and Limitations

Student partnerships can increase agency by providing a mechanism through which students can respond to IDS. Using these responses, instructors can make choices that increase student engagement. Dr. T used SPs "as a bridge between the students and the professor" (a quote from Nico) to gather authentic and dynamic feedback about class structures. In their weekly meetings, Dr. T was able to discuss feedback with SPs, ask clarifying questions, and understand the reasoning behind the feedback SPs provided. Knowing the "why" behind this feedback helped him to make meaningful pedagogical choices to address student struggles. SPs served as a humanistic liaison between the students and instructor; this human connection was especially important for students during the transition to remote learning when in-person learning was interrupted. The SP program provided a continuous feedback loop (see Figure 2) of meaningful information that Dr. T could use to reaffirm, revise, or generate new IDS. Given this feedback, Dr. T could also, of course, choose to make no changes to IDS.

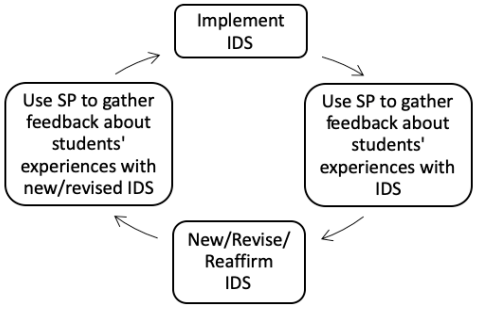

Figure 2: Feedback Loop Provided by SP Program

Some limitations include a small data set and only one interview with a SP (Nico). Other data was collected for this study, including student surveys, that is not reported in this paper as they have not been analyzed yet.

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