CREATING A COMMUNAL CULTURE WITH LINKED-COURSE COMMUNITIES

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INTRODUCTION

It has been well established that higher education needs to improve in our work with Students of Color, first-generation students and female-identifying students majoring in STEM fields in order to support their student success (Diekman et al., 2010; Hatfield et al., 2022; Kezar & Holcombe, 2017; Riegle-Crumb et al., 2019). This chapter shares the results to date of a two-year project utilizing linked-course learning communities as a strategy to support the success of students from a range of diverse identities enrolled in STEM majors at Bridgewater State University.

The strategy described in this chapter integrates attention to students' academic growth and academic sense of belonging — both key to the success of students attending our campuses (Healey & Stroman, 2021). Cultural mismatch theory helps to inform this intervention. This theory purports that colleges and universities foster a culture of independence, which disadvantages students from more interdependent, communal cultures (Stephens et al., 2019). For example, when students first begin college, they are typically expected to choose a major based on their own preferences with little input from others. They then choose a slate of classes for their first semester, often from a long list of varied options, again prioritizing their own personal preferences. Traditional college classes then expect students to learn mostly on their own, in the many unstructured hours outside of class, with only a few hours of class time each week. First-semester students rarely know any peers in their classes, and each class is a wholly new set of peers with a different professor. While acclimating to a college culture can be challenging for all students, the independent norms fostered in higher education by the emphasis on personal preferences are consistent with the socialization of upper-class, White men. Meanwhile, other students, such as Students of Color, first-generation college students, and women, are often socialized in interdependent, communal cultures (Boucher et al., 2017; Diekman et al., 2010; Guiffrida et al., 2012; Stephens et al., 2012), and thus a cultural mismatch emerges.

Previous research provides strong evidence of this cultural mismatch and its negative impact on equitable student outcomes (Diekman et al., 2017; Phillips, 2020; Stephens, Fryberg et al., 2012; Stephens, Townsend et al., 2012). For example, first-generation college students are more likely to identify interdependent motives for pursuing a college degree (e.g., "give back to my community") whereas continuing-generation students were more likely to endorse independent motives (e.g., "expand my knowledge of the world" Stephens, Fryberg et al., 2012; Phillips, 2020). Women are more likely to identify communal goals for pursuing STEM fields compared to men (Diekman et al., 2017). Further, students who endorse interdependent or communal motives report a decreased sense of belonging and motivation at universities (Phillips et al., 2020) and particularly in STEM (Diekman et al., 2012), which in turn relates to poorer academic performance (e.g., Stephens, Fryberg et al., 2012; Stephens, Townsend et al., 2012).

MICROSCOSMS – A STRATEGY FOR EQUITABLE STUDENT SUCCESS

MicroCOSMs (small Communities Of Science and Mathematics) are linked-course learning communities wherein first-semester students take a first-year seminar that emphasizes the social relevance of STEM alongside two other courses with the same group of peers. While linked-course learning communities have previously been used in a variety of ways at a large number of institutions (Fosnacht & Graham, 2022; Stassen, 2003), we designed MicroCOSMs specifically for the Bartlett College of Science and Mathematics (COSM) at Bridgewater State University (BSU), a medium-sized Master's Comprehensive public university serving southeastern Massachusetts. We chose a classroom-based model in order to be inclusive of commuter students, who constitute about a third of our first-time, first-year students. We also aimed to create stronger connections for first-year students with the College of Science and Math enhancing their sense of academic belonging (Healey & Stroman, 2021), as about half of our incoming students are ineligible for courses in their chosen major due to their math placement scores.

These communities offer a shift in the curriculum and registration processes of first-semester students toward a more communal culture of STEM, as a way of shifting the culture of the university to be more similar to the cultures of students from minoritized populations, including first-generation students (e.g., Stephens et al., 2012), women (Diekman et al., 2010), and Students of Color (Guiffrida et al., 2012). Importantly, we conducted a randomized controlled trial of these microCOSMs wherein we randomly assigned incoming STEM majors to a microCOSM or a control group with comparable unlinked courses. To our knowledge, no other linked-learning communities have been subjected to a randomized controlled trial to determine their efficacy beyond selection effects. Prior to recruiting any participants, the BSU Institutional Review Board (IRB) approved this project.

Prior to starting microcosm, low-income students enrolled in the introductory STEM courses were retained into junior-year STEM studies at a rate 5.0% points lower than non-low income students, and Students of Color were retained 9.6% points lower than White students. A 2017 analysis found that at BSU, 41% of all college freshmen were Students of Color, but the percentage of college sophomore Students of Color was only 29%. Focus groups conducted in spring 2015 found that college Students of Color felt alienated by faculty and their peers. Further, women in the college were overrepresented in low-income and first-generation populations, pointing to an intersectionality of class and gender issues prevalent in STEM fields. Interestingly, a 2019 Graduating Senior Survey conducted by our Office of Institutional Research showed that only 67% of respondents indicated that they had made important friendships at BSU, with even lower percentages for first-generation, commuter, and transfer students. These concerns all point to the need to develop a more inclusive community.

By creating a more communal culture, our linked-learning communities bridge students' home communities with their new academic environment while building an inclusive community in the classroom. This is especially powerful for students from underserved groups, such as first-generation students and Students of Color, who are both more likely to have fewer social connections and lowered sense of belonging on many campuses (e.g., Good et al., 2012; Johnson et al., 2007; Rubin, 2012). The communal framing can draw these students in by correcting the cultural mismatch that occurs in college environments that are too individualistic for underserved students who are more likely to come from interdependent and communal cultures (Diekman et al., 2017; Stephens et al., 2019; Yosso, 2005).

Classroom-based interventions that develop and utilize faculty member's cultural sensitivity have been shown to create more equitable and inclusive STEM environments, as have using high-impact practices such as first-year seminars (Duncan et al., 2023; Ives et al., 2023). These linked-course learning communities are a key mechanism for reshaping the college to meet the needs of these students, rather than requiring students to assimilate to a curriculum structure that was originally designed by and for upper-middle class White men (Cabrera et al., 2017). Thus, these communities can drive structural and transformational change in higher education.

Students in each microCOSM take three courses together. The central hub of the microCOSMs is a three-credit First Year Seminar (FYS) that engages students in inquiry-based learning related to the UN Sustainable Development Goals. These wide-ranging goals address everything from eliminating poverty to ensuring access to quality education, while also including more explicitly STEM-focused goals, such as access to clean water and care for life below water and life on land. These goals make explicit the connection between scientific work and critical social problems facing our world today, and thus they offer a communal orientation to academic work connected to this clear vision from the UN. The goals are broad enough to capture the expertise of our faculty in a wide variety of ways, while still being unified around social themes that offer motivating weight to projects developed around one or more of these themes. Across two years of microCOSMs, four different FYSes have been offered: Clean Water, A Basic Human Right; Math for Social Dynamics; HIV: Knowing is Everything; Sustainable Nanotechnologies.

The other two courses in the linked-course community depend on a student's math placement test score prior to starting at BSU. One course is a math course, ranging from intermediate algebra (a non-credit-bearing course for students needing support prior to taking a college-level math course) to single-variable calculus. For students whose math placement makes them eligible to start their major right away, the other course is an introductory STEM course, such as General Biology I or Computer Science I. For students whose math placement does not allow them to start their major courses, the other course is a general education requirement, such as Introduction to Public Speaking.

Therefore, while everyone in the First Year Seminars is part of microCOSM, the other linked courses contain both microCOSM students and non-microCOSM students. Importantly though, each of the microCOSM students has peers from their First Year Seminar course in the other two courses. In this way, microCOSM students are seeing familiar faces amongst their peers in multiple courses, as opposed to the typical first-semester student experience of having a different set of peers in each course.

Setting up the microCOSMs this way required relatively few alterations to the typical college schedule, as the communities were mostly built out of courses that already existed rather than requiring new courses to be created for this program, with the exception of the First Year Seminars. We did need to coordinate with the registrar's office to reserve seats in certain course sections for microCOSM students, and the First Year Seminars were enrolled by special permission only.

We worked closely with Academic Advising to offer the microCOSM schedule to eligible students by sending them emails with instructions on how to register and recommendations for the exact course sections in which to register. This style of more proactive advising has been shown effective by other equity-minded practitioners (e.g., Watson, 2019), but it was a departure from BSU's previous advising protocols, which relied on recommending certain courses or even groups of courses and then students had to find and enroll in the exact sections they wanted. In this way, a hidden benefit of microCOSM was revealed: there was less room for error in first-semester student registration, and thus more students were placed into the courses they really needed to take to be on track for their major.

With support from an NSF-IUSE (National Science Foundation – Improving Undergraduate STEM Education) grant, we conducted a randomized controlled trial to test whether the linked-learning communities impacted student success. Data from the first two cohorts (N=201) clearly shows that the microCOSMs are effective in promoting STEM retention, especially for Students of Color, first-generation students, and academically underprepared students (i.e., students who did not score high enough on the math placement test to meet the co-requisite requirement for the first course in their major).

In **Table 1**, we see the impact of participating in a linked-course community. Overall, students who participated in the community were retained at the university within STEM in the spring semester at higher rates across all groups. We see statistically significant differences in spring STEM retention for multiple groups, including for Students of Color, first-generation students, and academically underprepared students.

Community members also seemed to be retained at the university (not just in STEM) at higher rates and earn higher overall grades with a higher percentage of their credits resulting in A or B grades (Fall AB Rate) and a lower percentage of their credits resulting in D, F, or W grades (Fall DFW Rate) in the fall semester. However, these differences did not reach statistical significance, perhaps due to statistical power. Regardless, it does not seem to be the case that the students retained by the communities performed worse than the control group, which would have put them at greater risk for lower retention later on.

Table 1: Fall to Spring Retention and Grades of Students in MicrosCOSMs and Control Students

	Spring Retention	Spring STEM Retention	Fall AB Rate	Fall DFW Rate
Overall				
Community (n=86)	93.9%	**91.5%**	.67(.35)	.18(.27)
Control (n=115)	87.9%	**78.5%**	.59(.35)	.25(.35)
Students of Color				
Community (n=34)	97.1%	**97.1%**	.64(.34)	.22(.29)
Control (n=43)	86.0%	**67.4%**	.57(.33)	.29(.36
First Gen Students				
Community (n=32)	96.9%	**90.6%**	.65(.35)	.17(.23)
Control (n=53)	83.0%	**67.9%**	.56(.35)	.31(.39)
Low Income Students				
Community (n=26)	92.3%	88.5%	.58(.34)	.28(.30)
Control (n=33)	87.9%	69.7%	.56(.32)	.27(.33)
Academically Underprepared				
Community (n=33)	97.0%	**93.9%**	.61(.33)	.20(.25)
Control (n=33)	87.9%	**75.8%**	.49(.33)	.33(.39)
Commuter Students				
Community (n=28)	92.9%	92.9%	**.77(.33)**	.14(.30)
Control (n=40)	85.0%	80.0%	**.55(.38)**	.27(.37)
Women				
Community (n=32)	96.9%	93.8%	.77(.31)	.09(.22)
Control (n=45)	88.9%	82.2%	.66(.31)	.20(.31)

Note. Student success outcomes in the first two cohorts of microCOSM students, comparing success for students randomly assigned to community or control group schedules. Statistically significant differences at the $p<0.05$ level are marked in bold print. AB Rate and DFW Rate refers to the percentage of credits attempted that resulted in grades of A or B and D, F, or W. The standard deviation of the grade rates are provided in parentheses.

To analyze the connections between students, we utilized Social Network Analysis (Wasserman & Faust, 1994). Connections were analyzed based on course registrations; a student was considered connected to a peer if they were in the same section of a class together. Based on initial work studying the connections between students prior to the introduction of communities (Ramsey et al., 2023), it was determined that the best variables to analyze were the number of peer connections a student has made through registration in shared classes (which would be called “degree” in the parlance of social network analysis) and the number of repeated connections (the number of times a student has had classes with another student a second or more time). MicroCOSM strongly impacted these variables, showing that students in the communities had significantly more connections and repeated connections than students in the control group, as intended.

Table 2: Number of Connections with Peers of Students in MicrosCOSMs and Control Students

	Fall Connections	Fall Total Repeated Connections
Community	**26.3(8.0)**	16.3(8.7)
Control	**18.0(5.8)**	7.52(5.2)

Note. Fall Connections (also known as "degree" in the parlance of social network analysis) refers to the average number of fellow STEM first-year students that students saw in their first-semester classes. Fall Total Repeated Connections refers to the average number of times students in each group saw a peer in one class that they had already seen in another class. The differences in both variables are statistically significant at the $p<0.05$ level, showing that the creation of linked-course communities increased both the connections (degree) and number of times a student was in multiple classes with the same peers (total repeated connections).

Altogether, we conclude that the microCOSMs enabled students to connect with more fellow STEM majors in their courses and, importantly, repeat more of those connections so that students saw familiar faces in each class. Thus, we were able to create a more communal STEM culture for microCOSM participants, via both the curriculum in the first-year seminar and increased connections with peers. Furthermore, the microCOSMs positively impacted STEM retention, especially for Students of Color, first-generation students, and underprepared students. These groups likely come from more communal cultures, so this increased retention could be due to a better match between their home culture and the culture they encountered in their first semester in the College of Science and Math at BSU. The use of a randomized controlled trial allows confidence in these conclusions, as the rigor of the methodology allows us to eliminate alternative explanations for our findings, such as preexisting differences between the community and control groups.

LESSONS LEARNED

One lesson learned while implementing microCOSM focused on the challenges associated with placement testing. Eligibility for both the math and major courses relied on math placement test scores, and so we found ourselves carefully tracking math placement test taking prior to new student registration. What became alarmingly clear is that there is a clear equity issue in the timing of students completing placement testing. Students of Color and first-generation students are much more likely to delay taking their math placement until late June and throughout July, whereas nearly all White and continuing generation students complete placement testing by mid-June. Because students cannot register for courses until completing the placement testing, this puts Students of Color and first-generation students at a significant disadvantage when securing seats in needed courses at preferred times. This has not been a problem with microCOSM thus far because the linked-course communities have been offered in the context of a randomized controlled trial, in which enrollment in microCOSM was tightly monitored and controlled to ensure equitable participation in the community and control groups. However, as the randomized controlled trial ends and we move toward a more open enrollment in future microCOSMs, we are concerned that microCOSM seats will be filled at the start of registration, thus making equitable enrollment impossible. Campuses that wish to implement a similar linked-course community model should work closely with the registrar's office to guard against inequitable enrollment in the communities, as it is critical that the students who will benefit from the communities the most have a chance to enroll.

A great advantage of our model of linked-course learning communities is that they were made up of courses that were already required by the general education requirements or the student's major. No courses were created outside of the existing curriculum, which means that students were not taking anything extra from what they should have been taking anyway, and no new courses had to move through academic governance or other kinds of approval. In this way, the communities are a structure that can contain an existing curriculum, and thus can be implemented relatively quickly with some attention to the scheduling of courses and student registration processes. This also means that the communities can accommodate future equity-minded, systemic changes to the curriculum. For example, some readers may be familiar with debates regarding the use of non-credit-bearing, developmental mathematics courses for students with low placement test scores (Brathwaite et al., 2020). While BSU still utilizes this system to support students through the mathematics curriculum, it may evolve in the future, in which case the linked-course learning communities could be set up with co-requisite mathematics courses or some other model of increased support for these students. Additionally, the costs of running this program were very low. Grant funding was used to execute the randomized controlled trial, but now the communities are becoming institutionalized with some administrative work but no additional costs to the university.

DESCRIPTION OF LIMITATIONS

One limitation to the microCOSM model is that we did not fully link the courses, meaning there were some students in the math and introductory major courses that were not part of the linked-course communities. We also did not arrange for the instructors to coordinate assignments, activities, or content across linked courses, as is sometimes done in linked-course learning communities (Fosnacht & Graham, 2022; Stassen, 2003). On the one hand, these choices made it easy for us to set up the communities while maintaining professors' autonomy and little interference with the typical process for scheduling courses. On the other hand, the communities — and thus their impact — may have been significantly stronger if the linkages were more complete and more deeply integrated across all three courses. Campuses implementing this strategy will need to weigh out the pros and cons of different levels of community integration.

CONCLUSION

In conclusion, universities create additional barriers for underserved students when they solely embrace independent norms (Stephens, Fryberg et al., 2012), and thus it is up to universities to implement systemic changes to break down these barriers and create a welcoming culture for all of the students we seek to serve. Linked-course learning communities are one such mechanism for a culture change. While these communities transform the registration process and first-semester experience of first-year students, they can be implemented without much, if any, cost or disruption to the current curriculum requirements or schedule. The linked-course learning communities that we utilized and assessed are but one way to encourage community in the classroom; this project could inspire other strategies for creating community that better matches the cultural backgrounds of students who have traditionally been underserved in higher education, including Students of Color, women, and first-generation students. More broadly, finding ways to create connections among peers in the classroom could be an important strategy for equity-minded systemic change

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