Conclusion

The primary aim of CB-STEM is to ensure that underrepresented students have the opportunity to successfully complete their degree in a STEM field at Saint Joseph's University. Beyond helping students feel academically prepared for calculus and a STEM major, CB-STEM also helps students acquire social-emotional skills, identify personal behaviors that may affect their success at the University, and identify and reflect on their goals for the future. Overall CB-STEM is important to creating a sense of belonging, a shared identity and stressing the importance of academic success in STEM.

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Course Redesign: Pathways Towards Transformation

Geillan Aly

Build a community to help inspire and thrive

The drive towards enhancing diversity is not just about righting sociohistorical wrongs, it is also about calling upon the strength of multiple perspectives to make larger advances towards a goal. We are smarter together and greater strides are made when multiple ideas, experiences, and knowledge bases come together to tackle a problem. A diverse group of individuals unencumbered by bias or asymmetrical power relationships are more creative, innovative, and productive (Smith-Doerr, Alegria, & Sacco, 2017; Wooley, Chabris, Pentland, Hashmi, & Malone, 2010). Thus, faculty looking to revamp their courses should look to others for guidance, advice, and input. Furthermore, if the overall goal is to support nonhegemonic students, faculty would benefit from learning to listen to, work with, and implement the suggestions of others who can provide valuable insights they may not have previously considered.

Build Communities Among Faculty and other Stakeholders

The larger university community can be a strong resource to tap as you endeavor to change your mathematics classes. As many mathematics classes, and in particular Calculus classes, are intended to serve other departments, these departments should be consulted to provide input into specific course objectives, programming, and to help provide real-world applications and problems for students (Kilty et al. (CS 15); Terry (CS 26); Zobitz et al. (CS 30)). Look to your institution's central resource for teaching to help develop revitalized pedagogical practices or to more objectively evaluate your program (Bennett et al. (CS 3); Canner et al. (CS 6); Chang & Chen (CS 7); Fuller et al. (CS 11)). Aligning with and educating academic advisors on the affordances of specific programs or special sections can increase student enrollment and participation (Mawhinney et al. (CS 18)). Your Office of Institutional Effectiveness and administrative support staff can help assess the effectiveness of policies on a longitudinal basis and potentially raise the profile of related endeavors. This in turn may lead to generating more institutional support and resources (Benken et al. (CS 2); Canner et al. (CS 6); Chang & Chen (CS 7); Oliver et al. (CS 21)). Bringing together a team of stakeholders, instructors, and experts from the mathematics department and the school of education can maximize individual investment and minimize objections to proposed changes (Johnson et al. (CS 14)).

Developing a community of practice strengthens and supports the pedagogical skills of participating mathematics faculty (Fuller et al. (CS 11); Jensen-Vallin et al. (CS 13)). When instructors work collectively, such as through weekly meetings, everyone has the opportunity to contribute to the process and feel invested in the changes. This also gives adjunct professors and instructors the opportunity to share concerns and suggestions, giving voice to those who often teach students but may have limited agency in the structure of their courses. At Lamar University, community interaction has been strengthened through social teas and luncheons with topical themes that are aimed at improving teaching, learning technology, and teaching towards equity (Jensen-Vallin et al. (CS 13)). Participants in California State University Channel Islands' professional development program gave adjunct professors who felt invisible and voiceless a supportive community in which they could interact and learn (Soto et al. (CS 22)). Having new or inexperienced instructors co-teach allowed instructors to master new teaching techniques and develop camaraderie (Byrne et al. (CS 5)).

When multiple sections of a course are offered, it is more difficult to standardize students' learning experience. Differences in instructor styles and expectations are certainly expected. However, it is only when these differences result in significant inconsistencies such as rigor or covered content, that students can be subject to an inequitable educational experience (Akin & Viel (CS 1); Chang & Chen (CS 7); Jensen-Vallin et al. (CS 13); Mingus et al. (CS 20)). Inequitable class structures may also result in an inequitable workload among the instructors. For example, one instructor may be favored because students have a better classroom experience with them or because they have lower grading

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expectations. Streamlining and synchronizing course content is an opportunity to make the course more uniform among sections. Coordinating a course can also provide an opportunity to develop a community among faculty if they are a part of the coordination effort by co-creating assessments, rubrics, and coordinating pacing (Mingus et al. (CS 20)). Variation across instructors provides an opportunity to collaborate, share best practices, and present a cohesive course to students. A dynamic calendar tracking course content, which can be edited easily by instructors and contain links to resources associated with each lesson, encourages instructors to coordinate schedules and lessons across different sections in a class (Oliver et al. (CS 21)). Materials specific to fostering equity in the classroom and ways to introduce "just in time" review topics (where prerequisite content is reviewed as needed) can also be highlighted and shared. Creating a repository of materials for instructors allows for more consistency across instructors and is an easy way to reference and share resources (Chang & Chen (CS 7); Johnson et al. (CS 14); Oliver et al. (CS 21)). This system works particularly well for inexperienced instructors or adjuncts who may not have the time to develop their own resources, be familiar with the nuances of the institution's specific needs and content or meet with faculty or course coordinators in their department.

Regular meetings among instructors can be used to discuss issues of pedagogy, assessment, pacing, design and use of activities, how best to provide effective support for instructors, and share resources (Bennett et al. (CS 3); Byrne et al. (CS 5); Chang & Chen (CS 7); Golden et al. (CS 12); Oliver et al. (CS 21)). These meetings are an opportunity to explore issues of equity including opportunity gaps in classes with multiple sections or differences in instructor grading criteria, and to discuss common readings on inclusive teaching and general strategies around creating a more equitable learning environment. These meetings can also allow instructors to celebrate their successes and support one another through challenges.

Build community between faculty and students and among students

There are various types of effective pedagogical practices in mathematics such as complex instruction, project-based learning, inquiry-based learning, and other forms of student-centered instruction. One unifying characteristic in how these practices compare with an instructor-centered lecture is the bilateral nature of the student-instructor relationship. Traditionally, an instructor lectures *at* students and students' responses are in passive forms of communication such as written homework, quizzes, and exams. In the aforementioned alternatives, the instructor works *with* the student to nurture their curiosity and foster the development of their knowledge.

One of the most common changes that was made in the Calculus classes in the above case studies is the inclusion of a program or aspect which recognized the importance of including the students as an active member of the classroom community. Giving students a voice, space, and agency to control their experience is a major component of many redesign endeavors. This may be as "simple" as redeveloping content so that classroom content is presented in a more student-centered manner, or as "radical" as giving students a larger role in building the overall mathematics community.

Student satisfaction and input can provide an indication that change is necessary. At times, students can provide insight into problematic policies or situations. At Duke University, students indicated that the grading scheme was both non-transparent and inequitable because final grades did not accurately reflect each student's individual knowledge or abilities. This left students feeling demoralized and discouraged from pursuing their intended STEM majors (Akin & Viel (CS 1)). Mentoring students and listening to them can illuminate some of the challenges and misunderstandings that students have which can result in students believing that they are not capable of completing a STEM degree (Terry (CS 26)). Personal interactions provide frank discussions on some of the limitations experienced by students. The resulting summer bridge program was designed to address problems that contributed to BIPOC students abandoning their STEM major. These conversations can initiate significant change. In another aforementioned example, a student was the catalyst for change when faculty realized that some students did not feel welcome in their mathematics class (Stacy (CS 23)). Student feedback can also help divert resources to address students' actual learning needs rather than simply focusing on mathematical remediation (Golden et al. (CS 12)). The department gave students agency through a bottom-up approach to change.

Messaging is an important component to community building. Emphasizing the creative aspects of mathematical practices can increase the self-efficacy of someone who does not believe they are a "math person" but can nevertheless succeed in mathematics based on their creative abilities (Stacy (CS 23)). Demonstrating students' worth demonstrates that the students are valued and are a part of the community—a critical factor in STEM attrition (Miller, Williams, & Silberstein, 2019). Small, conscious acts such as learning students' names and encouraging them to use chat features during online meetings, make students comfortable and can significantly increase their sense of belonging (Oliver et al. (CS 21)). Social events such as holding a tea can foster community (Soto et al. (CS 22)). In one case, students and teaching assistants are invited to a professor's home (Starbird et al. (CS 24)). Faculty can also help students navigate the hidden curriculum[2] (Stacy

[2]*The Hidden Curriculum is the concept that students learn more than the formal content when in a classroom. There are unwritten, unofficial, and at times unintended ideas, values, and perspectives that students learn. To further understand the hidden curriculum, see Portelli (1993). To see how the hidden curriculum is manifested in the classroom see Anyon (1980).*

(CS 23)). At the University of Texas at Austin, the students' ability to succeed is a fundamental belief for instructors. Students in their program are explicitly and repeatedly encouraged to major in mathematics and struggling students are actively supported (Starbird et al. (CS 24)). Professional development around student power dynamics also can help instructors reflect on how subtle messaging can have significant ramifications (Johnson et al. (CS 14)). One such exercise, which helps instructors consider which students they connected with, was designed to demonstrate how intentional and unintentional actions could affect students' sense of belonging, achievement, and persistence in mathematics. In other cases of professional development, instructors can be made aware of how their actions engage or alienate students (Oliver et al. (CS 21)). If an instructor calls on the same students, they deny others an opportunity to participate, illustrating how actions such as cold-calling should be discouraged.

Students can also feel valued if they are looked to as a source of knowledge and support. Programs that incorporate peer learning in and out of the classroom help build community and show the peer tutors that they are a valued resource (Benken et al. (CS 2); Chang & Chen (CS 7); Fuller et al. (CS 11); Mingus et al. (CS 20)). Peers can also support students' emotional well-being by acting as a role model and by helping others navigate their institution's hidden curriculum (Mingus et al. (CS 20); Zobitz et al. (CS 30)). There is also the added benefit that the tutors also gain academically from their assignments (Leung, 2019). The stretch Calculus class at Washington College assigns each student a learning objective from the course. Each student is then responsible for reviewing this objective with the class in the manner of their choice (Stacy (CS 23)). Culturally responsive teaching likewise underscores the personal worth of a student's knowledge base and experience and makes mathematical content more relevant, accessible, and meaningful (Fuller et al. (CS 11)).

A welcoming environment can take various forms. Recognizing that there is a lack of community in an HSI composed mostly of commuter students can provide insight into the types of small changes which can make significant differences to students' engagement and achievement (Benken et al. (CS 2); Chang & Chen (CS 7)). Other forms of messaging can be more subtle such as incorporating kindness cues (Soto et al. (CS 22)), cultivating a sense of pride in students' linguistic and cultural heritage and acknowledging that being bilingual is an asset and a source of strength can be very beneficial (Villalobos et al. (CS 28)). A welcoming environment can also recruit students to support programs. Specific language that lets students know they are included in a support program can be helpful. For example, inclusion based on a "nomination" process indicates that their presence is important and honored. Negatively-toned and deficit-based language about placement or progress should be eliminated in lieu of messaging that highlights benefits and the positive aspects of programs (Deshler et al. (CS 9); Mawhinney et al. (CS 18)).

Having students consistently work in groups can help advance mathematical knowledge while developing a sense of community (Deshler et al. (CS 9); Fuller et al. (CS 11); Mawhinney et al. (CS 18); Mingus et al. (CS 20); Zobitz et al. (CS 30)). Community can be further strengthened when students are assessed as a group and must rely on one another to be successful (Starbird et al. (CS 24)). Fostering community can also be a long-term endeavor such as at the University of West Virginia where one instructor dedicated themselves to teach all four Calculus courses in a sequence to a cohort (Deshler et al. (CS 9)). These faculty also provided small acts of meaningful support such as helping students with registration changes in their first semester, removing challenges faced by new students who are unfamiliar with how to navigate registration systems. Policies which hinder the development of community should also be reconsidered, as was done at Duke University when evaluations determined that the curved grading scheme increased competition among students and decreased student camaraderie and sense of belonging (Akin & Viel (CS 1)).

The mathematics classroom can also be a way to help students feel welcome in the larger campus community. Students can be required to complete assignments where they interact with various services on campus, such as the university writing center and library (Starbird et al. (CS 24)). Such purposeful acts teach students that success comes from taking advantage of all opportunities and available resources.

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