

Board 249: Developing and Creating Affective Knowledge Spaces for Teachers as Advocates for Social Justice

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Work in progress: Developing and creating affective knowledge spaces for teachers as advocates for social justice and equity in informal STEM (poster)

Abstract

Broadening the talent pool in STEM fields starts with increasing social justice and equity for racially minoritized undergraduates and women. While the demand for STEM workers and high-earning wages provides an excellent opportunity for upward socioeconomic mobility, women and people of color remain significantly underrepresented in most STEM fields [1], [2].

Centering middle and high school students with racially minoritized backgrounds, the *Catalyzing Inclusive STEM Experiences All Year Round* (CISTEME365) initiative aims to better understand practices that increase students' motivation and capacities in pursuit of careers in STEM fields. Overall, the project aims to develop transformative paradigms for advancing interests, self-efficacy, abilities, and pathways in STEM with a set of three interconnected strategies.

- School-based teams of classroom teachers and academic advisors participate in year-round professional learning experiences focused on diversity, equity, and inclusion in STEM, as well as a project-based electrical engineering curriculum.
- Participating schools receive resources and technical assistance to establish or expand a STEM club using the strategies and content from the professional learning experiences.
- Students from these schools are eligible to receive scholarships to attend the University of Illinois' summer programs for pre-college students interested in STEM.

This paper focuses on the professional development component of the CISTEME365 initiative, which supports the creation of affective and knowledge spaces among guidance counselors and teachers as advocates for social justice and equity in STEM education.

Using a qualitative case study approach [3], we examine what happens when a pair of middle school educators (science teacher and dual language science teacher) develop an after-school STEM club with a specific goal of creating an equitable and inclusive environment for girls and students from racially minoritized backgrounds. Further, we use inductive thematic analysis methodology [4] to identify propositions on professional development aspects of CISTEME365 programming and its influence on STEM Club design and student experiences.

Background

Social justice and equity issues for racially minoritized undergraduates and women in STEM must be addressed; promptly as the demand for STEM workers increases. The

underrepresentation of women and racially minoritized workforce remain significantly low in most STEM fields [1], [2]. These high-earning positions provide an excellent opportunity for upward mobility. Businesses and communities benefit from its citizens moving to higher income levels.

CISTEME365 is a multi-year initiative seeking to improve the rates of female, minoritized, and/or low-income students entering STEM majors and careers. We are building a network of school-based teachers and counselor teams called IDEA (Inclusion, Diversity, Equity, and Access) Teams across the state focused on addressing STEM inequities at the school level. The initiative's key components include educator professional development focused on creating equitable and inclusive STEM advising and learning environments through non-competitive STEM clubs.

Over the course of three years, this initiative provided year-long cohort experiences to 17 IDEA Teams from middle schools (N=3), high schools (N=12), and community colleges (N=2). This three year period was one of constant transition as COVID-19 and lessons learned from previous cohorts pushed us to revise the professional development models we used. Cohort 1 received 2-weeks of an in-person summer institute followed by monthly Zoom network meetings to touch base about implementation and strategies being put into practice at each school. Cohort 2 was all online with concentrated synchronous workshops spread across a two week period in the summer, followed by half day monthly synchronous sessions during the school year. Cohort 3 participated in fewer days of online professional development in the summer, followed by monthly network meetings and a fall 2-day hybrid session with some participating online while others met in-person. The content of the professional development also evolved over time. In year one, the equity content was covered in isolation from the engineering projects with one week of equitable and inclusive STEM environment content followed by a week of technical experiences with the project-based engineering curriculum. In each subsequent year, the leadership team recognized the need to better integrate these topics in future years to better emphasize the need for equity work to be embedded in STEM pedagogy, and not as something entirely separate. Perhaps the most important component of the professional development model was the Action Research for Equity Project (AREP) that all participants engaged in as a capstone project for the year. Through the winter and spring months, the participants engaged in an action research project where they investigated the impact of implementing one or more targeted strategies for creating equitable STEM environments in their STEM Clubs or classrooms. These projects required that the educators put their professional learning into action to solve an equity in STEM problem that they identified in their home contexts.

The ultimate goal: students with marginalized identities gain access to safe spaces in which educators actively engage in equity and inclusion work. With intentionality, educators gained awareness of implicit bias and micro-messaging, and were provided with strategies to create more inclusive and equitable spaces.

Methodology

Using qualitative case study methodology, we investigated how a single IDEA Team experienced the CISTEME365 initiative, and what this looked like in their school context [3]. Drawing from focus group transcripts, observations, pre- and post-survey responses, and artifacts from the professional development activities, we conducted an inductive thematic analysis to iteratively identify codes and thematic categories to best illustrate the experiences of these educators in the CISTEME365 program [4]. These codes will continue to be further defined as we broaden the research to capture the experiences of more participants involved in the program. To establish intercoder reliability, two researchers independently identified codes relevant to the experiences of the identified case. These researchers then meet to negotiate the similarities and differences to arrive at an agreed upon taxonomy [5]. The narrative below highlights the experiences of a single IDEA Team consisting of two middle school educators' and their colleagues as they implement strategies to support equity in their developing STEM club during the 2021-2022 school year (Cohort 3).

The Case

In a Midwest middle school that serves a student population of 880 with 70% low income, 41.5% Black, 18.4% Hispanic, and 16.7% English Language Learners [6]. Melissa, Isabella, Luisa, and Marcia (not their real names) signed up to participate in the CISTEME365 program with a focus on the dual language efforts at the middle school. Luisa was a district leader of the dual language program, Melissa was a 7th grade science teacher, and Isabella and Marcia were two dual language science instructors. As a result of this team, the engineering curriculum and many of the professional development materials for the CISTEME365 program were translated into Spanish, both for the benefit of the dual language instructors and their students. Due to health issues, Luisa, the district leader, was unable to participate in the team activities, and one of the dual language science teachers, Marcia, dropped from the team early in the semester when the team was unable to secure funding for a third instructor for the team's afterschool STEM club. As the two remaining instructors, Melissa and Isabella, began the roll-out of the STEM Club. When the time came to identify their AREP project for the year, they noticed that despite their best efforts, the STEM Club's registration was overwhelmingly male with only six of the twenty-five registered students identifying as female. With this in mind, Melissa and Isabella chose to focus their AREP efforts on increasing the self-efficacy of female students in STEM classes and activities.

Creating Equitable and Student-Centered Environments

Isabella and Melissa chose to strategically focus on building growth mindsets in their students for their AREP. Melissa and Isabella developed a pre- and post-survey to measure student self-confidence before and after a project. They then strategically praised student efforts and processes rather than intelligence. They noticed positive responses from the students when they encouraged a natural learning process, providing support

more than instruction as students mastered the activities. Melissa and Isabella described efforts to tailor the electrical engineering content to the students' ability levels, making sure that the activities were challenging, but not impossible. The educators saw positive results from structuring the activities in such a way that it allowed students to master small activities that then built up toward the more complex projects and toward mastery.

Their collected data provided a clear glimpse at the disparity between female's confidence in themselves before performing STEM activities in comparison to male confidence in themselves before performing STEM Activities. They found that on average, female students developed more confidence post-activity compared to the male students.

Although male students showed, on average, more confidence at the beginning of the activity (47%) than the female students (6%), the female Students after the activity felt more confident on average (84%) compared to the males (71%).

Based on their AREP study, Melissa and Isabella concluded that one of the main reasons the STEM club had lower female student participation was because most of them experienced very low confidence in their STEM skills and abilities. Female students responded well to the micro-affirmations; their confidence significantly grew, surpassing that of the male students after the STEMS activities.

Because of their lessons learned through the AREP process, Melissa and Isabella are making plans for putting students in more control of club recruitment and activities. Based on their observation that the participation of girls increased when the female students brought in their friends, Melissa and Isabella hope to increase the number of female students in the STEM Club in year 2 by encouraging the females to spread the word within their social circles to try out the club. This places the students in a position of leadership with influence on the club's success. Additionally, Melissa and Isabella found that many students in the STEM Club were interested in pursuing engineering careers but unsure which engineering field. This uncertainty lends itself well to plans for future STEM Club content with a focus on exploration and experiences associated with the different engineering fields.

Resource Availability

Resources from the CISTEME365 grant, as well as within the school context had an impact on the experiences of Melissa and Isabella. One of the benefits of CISTEME365's year-round professional development model was the ability for each team and individual to apply the lessons of the professional development in ways that are unique and most relevant in their own settings, and then come back together on a regular basis to share successes and challenges. At times, Melissa expressed uncertainty as to whether or not they were meeting the administrative requirements of the project and sought reaffirming clarifications during the regularly scheduled Networked Improvement Community sessions. This was also a time when Melissa and Isabella could express concerns about feeling understaffed and stressed. One regular concern that was expressed during these sessions was that of needing to significantly adapt the materials to be more age appropriate for their middle school students since the original curriculum was developed

for high school. This adaptation required additional time on their part, when they had hoped to have a curriculum that was ready to implement in its original form. When discussing concerns about the time and effort, they would often refer back to how they had entered the CISTEME365 program intending to work as a four person team, but the funding allotted to the club by the school district could only support two club leaders. To add to those challenges, the stipends provided to them for their participation in the CISTEME365 project were excessively delayed by the University's bureaucratic systems, which added additional frustration. Despite these frustrations they often expressed appreciation to the grant program's leadership for their flexibility in supporting their participation, such as offering one-on-one professional development when they were unable to attend the previously scheduled training session for program participants. These missed sessions were often a result of substitute shortages in the district that was an issue even before COVID-19, but has been more extreme ever since.

Discussion

Melissa and Isabella faced significant systemic challenges, yet their deep and insightful reflection created hope and excitement. We found similarities across the CISTEME365 cohorts with other IDEA Teams wrestling with similar issues such as obtaining fiscal resources to offer STEM extracurriculars and teams identifying their own strategies to make the engineering content accessible for the specific students engaging in their programs. Based on these patterns from across the participating cohorts, the leadership team invited IDEA Teams from the previous years back to dive deeper into their own unique challenges in the hopes of offering additional time and support to strengthen and sustain what they had started during their initial year in CISTEME365. We are currently in the middle of this additional year of support, and we look forward to reporting on this experience in the future. Meanwhile Melissa and Isabella are excited to be continuing with their STEM Club into the next year. This IDEA Team plans to be purposeful in continuing the many strategies learned to decrease the confidence gap, and they are committed to increasing exposure and experiences in different fields of engineering.

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