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Board 319: Inclusive, Asset-Based Instructional Strategies in Engineering Design: Empowering Faculty with Professional Development

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Inclusive, asset-based instructional strategies in engineering design: empowering faculty with professional development

Abstract: To better support engineering students and to create an inclusive and welcoming educational context, it is necessary to reimagine instructional methods and approaches. In contrast to deficit educational models that focus on perceptions of what students lack, asset-based practices focus on how students' lived experiences can be used to enrich and strengthen their educational experiences. There is a need to support faculty in adopting existing techniques or developing new techniques in undergraduate courses, as most existing literature related to asset-based practices is focused on K-12 settings. Engineering design courses provide an ideal context for asset-based practices because the design process requires a diverse set of knowledge, experiences, and skills. Guided by self-determination theory, an understanding of implicit bias and stereotype threat, and the large existing body of research on asset-based pedagogy, we seek to support engineering student outcomes by empowering faculty with tools and strategies to incorporate asset-based practices in their courses. We are engaged in a three-year project focused on assessing the impact of asset-based practices in engineering design courses a large, public, land-grant, Hispanic-serving institution in the southwestern United States, funded by the NSF IUSE:EDU program. Here, we will summarize the design and results from our professional development for faculty, including theoretical frameworks and evidence guiding our work. We share content from our professional development, summarizing learning objectives, presentation content, and activities. Additionally, we present comments shared by instructors related to our professional development, including common barriers to implementing educational innovations in their courses. Our work will provide insights to practitioners interested in promoting inclusive classroom practices in engineering education and researchers who are translating research to practice, especially through professional development.

Keywords: Faculty professional development; inclusive pedagogy; asset based practices

Introduction

Despite many years of effort to increase participation, engineering suffers from unequal participation based on race and gender [1], [2] and efforts to improve teaching and learning have only been met with only modest success in changing the status quo [3]. Asset based pedagogy (ABP) is part of an emerging body of educational concepts that includes culturally relevant pedagogy and funds of knowledge that view students' culture as a strength and promote critical consciousness [4]–[6]. To assess the impact of ABP in a range of engineering course contexts, it is necessary to collaborate with a range of engineering instructors to customize implementation based on teaching style and course content. With funding from NSF's Improving Undergraduate STEM Education: Directorate for STEM Education (IUSE:EDU; formerly Education and Human Resources program) program, we are starting a three-year project at the University of Arizona to grow the limited body of knowledge of how to best implement ABP in post-secondary engineering contexts [7], [8]. To this end, we are developing professional development to promote evidence-based inclusive instructional practices guided by ABP.

A review and analysis of change strategies related to STEM instruction identified several attributes and lessons for creating change in instructional practices [3]. These include:

- Opportunities to challenge and change faculty beliefs and conceptions.
- Concerted and focused efforts over an extended period time (e.g., four weeks to a semester or even a year). One-time workshop sessions are generally ineffective.
- Feedback mechanisms such as consultation, coaching, and/or external evaluation.
- Innovative recognition and incentive systems for instructional innovations.

The vast majority of approaches to impact change in engineering education are focused on dissemination of evidence and curricular materials, which has been shown to be least effective [3]. There are limited theoretical frameworks and perspectives to inform faculty professional development (PD) related to instructional innovations in science and engineering. For example, Ferris et al studied whether organizational citizenship behaviors (OCBs) such as altruism, compliance (or conscientiousness), and civic behaviors are relevant and important for understanding engineering faculty participation in PD and change efforts [9]. They found that OCBs are not critical to understanding how or why faculty participate in PD activities, suggesting that the OCB framework may not be an appropriate framework for our work. Borrego et al applied the Diffusion of Innovations (DOI) theory to understand factors that influence adoption of educational innovations in engineering departments [10]. This study highlighted faculty attitudes and time as one of the barriers to change in teaching practices. While the evidence and results from this study are not insightful, the five-stage adoption process of DOI (creating awareness; growing interest; deciding on an innovation; piloting the innovation; adopting the innovation) is quite relevant to designing PD strategies related to ABP and perhaps, even a prime theoretical framework for our work.

Structure of our professional development

The pilot of our PD workshop was held in January 2023, after the start of the semester. We invited nine faculty members from a range of departments in the College of Engineering. Due to scheduling conflicts, a total of five faculty members attended the first session. Both non-tenure track-track and tenure-track faculty members attended. The session was scheduled for two hours. There were three stated goals presented at the start of the workshop:

1. We will learn about our students' experiences before they come into engineering and our courses.
2. We will learn about how to put those experiences into context, i.e., share a framework on how we as engineering educators influence outcomes of engineering students.
3. We will try to unlearn some concepts as needed and then learn/brainstorm ways to improve our programs and courses by recognizing strengths within students.

The structure of the session was aligned with these goals. The first part of the session introduced research undergirding ABP. The second part provided definitions and examples of the impact of ABP. Next, the role of self-determination theory and its relation to ABP was introduced. The final 20 minutes of the session were focused on actionable suggestions that faculty could implement in their classes, many drawn from a literature review of ABP in engineering [7].

The PD session was followed by several other interactions with the participating instructors (Fig. 1) throughout the Spring 2023 semester. We asked to meet with each instructor to plan the implementation of ABP into the instructors' courses early in the spring semester. Additionally, we recruited an instructor to allow us to collect data in his course so we could gather information on students' responses to ABP.

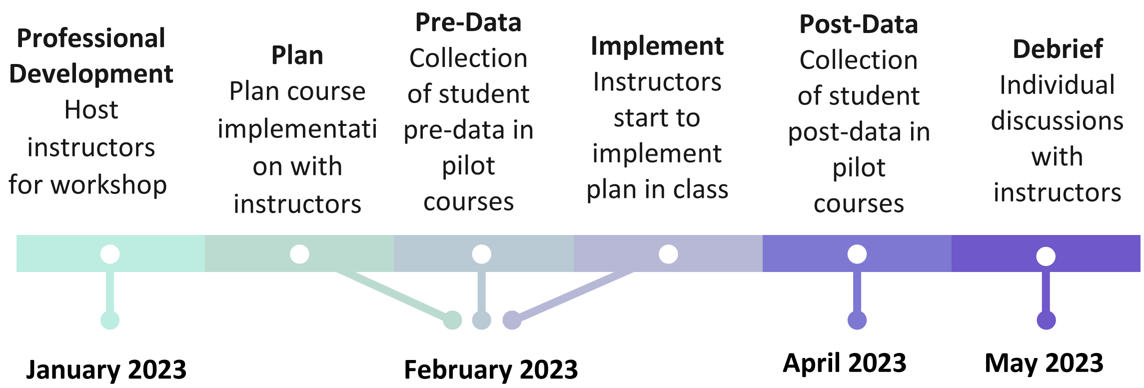

Figure 1. Summary of components of professional development conducted in Spring 2023

Results from first professional development session

We asked faculty at the start of the PD session to respond to the question: *In what ways do you consider student success or incorporating educational innovations in your teaching? Please share any examples or ideas you have attempted in your courses*. Several of our faculty shared that they were already engaged in inclusive or innovative pedagogical practices. The responses varied widely. One participant described using "immersive technologies" in a course. Another participant focused on scaffolding, such as "incorporating a feedback session for a first draft of a report; requiring certain tables to help analyze results in lab report." Another described being open to learning about new innovations, "specifically for subjects that difficult to teach (dry content that is typically not popular)." Another participant described focusing on industry-relevant content, but also getting to know students individually (emphasis added):

> "I consider what students will need to do and know in jobs after they graduate. I consult industry professionals to help me guide the content of courses. I believe when students are engaged with industry-relevant content that they are more successful learners, so I try to engage students with challenges, issues, or problems that they work on in pairs or small groups. I invited industry speakers to present on relevant topics, and I take students to construction sites. I also believe students are more successful learners when they are respected and **feel like they are known**. So, I try to get to know what their interests are and help them find internships and full-time jobs if that is something they are interested in."

We asked participants to rate the extent to which various issues (e.g., time for various tasks, cooperation of other staff or faculty) posed a challenge as they implement evidence-based teaching practices in their courses, adapting a survey from [11]. The most challenging issues, based on average ratings, were recognition or reward for teaching, balancing teaching with other responsibilities, time to develop or adapt materials, and time to grade or give adequate feedback, results which align with findings from prior work [3]. The design of our PD countered these barriers in some ways: we offered to provide feedback to instructors' department heads and peer review committees summarizing their innovations to ensure their efforts were recognized; and we tried to offer co-design of instructional innovations with peer mentorship to offset the limitations with instructors' limited time.

In Spring 2023, we worked with two instructors from our initial cohort who were interested in implementing ABP into their current courses. In the poster that will accompany this paper, we will summarize additional data which will be collected throughout the Spring 2023 semester, including feedback from instructor check-ins.

Future work and conclusions

Given this paper was written during the first year of a three-year project, we have focused on describing our piloting efforts and preliminary results. In Fall 2023, we plan to offer a revised version of this PD program, recruiting a new cohort of engineering instructors. Data collection will be expanded to additional courses. We plan to collect data across all levels of the engineering program (e.g., first, second, third, and fourth-year courses) and across all departments.

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