COLLEGE INSTRUCTORS' PERCEPTIONS OF BARRIERS & DRIVERS THAT IMPACT THE IMPLEMENTATION OF ACTIVE LEARNING

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College mathematics instruction that leverages evidence-based instructional practices, such as productive group work, can lead to many positive outcomes for students. In order to support instructors in adopting more evidence-based instructional practices, it is important to understand what barriers and drivers can impact their decision to implement such practices. In this study, we interviewed four introductory mathematics instructors teaching the same course in order to understand, in context, what aspects served as barriers and drivers. Transcripts were analyzed using thematic analysis. Initial results highlight how course coordination and weekly project meetings served as drivers, and the impact of the pandemic was seen as both a driver and a barrier to implementing evidence-based instructional practices.

Keywords: Instructional Activities & Practices, Undergraduate Education, Faculty Perceptions

Instruction that actively engages students in their learning has been shown to have many positive outcomes for students. Specifically, research at the college level has revealed that this type of instruction can increase student learning and students' conceptual understandings, as well as reduce achievement gaps (e.g., Freeman et al., 2014; Kogan & Laursen, 2014; Theobald et al., 2020). As such, there have been numerous calls to increase student engagement in college mathematics classrooms (CBMS, 2016; PCAST, 2012). Yet, didactic lecture still remains the most prominent form of instruction (Stains et al., 2018). To support college instructors in adopting more evidence-based instructional practices (EBIPs) that actively engage students, it is important to understand, both locally and globally, what barriers might be getting in the way of instructors' implementation of these strategies. It is also important to understand what drivers, aspects that mitigate barriers, foster instructional change and the adoption of EBIPs.

Previous research has examined various aspects that can impact an instructor's decision to implement EBIPs (e.g., Apkarian et al., 2021; Henderson & Dancy, 2007; Shadle et al., 2017). Although this work has helped to identify barriers, drivers, and individual or situational characteristics that may come into play, more work needs to be done to understand how institutions, departments, and individual mathematics educators can encourage the adoption of EBIPs by college mathematics instructors. Further, in order to foster instructional change locally, by mitigating barriers and leveraging drivers that have the most impact, it may be important to examine instructors' thinking about EBIPs at one's local institution (Henderson et al., 2011). As such, our work seeks to understand how college instructors at one institution think about the implementation of EBIPs in their classes. Specifically, we aim to answer the research question: What do college mathematics instructors consider to be barriers and drivers for implementing practices that engage students in active learning in their teaching?

Theoretical Framework Guiding Our Research

We examine our research question in the context of a larger project focused on transforming the teaching of introductory mathematics at one institution. The theoretical underpinning of this project is the Ethic of Practicality proposed by Doyle and Ponder (1977). This framework describes instructional change as a matter of how practical instructors find the proposed changes.

The Ethic of Practicality consists of three components: (1) *congruence* (compatibility with the instructor's classroom, setting, and instructional goals), (2) *instrumentality* (clearly articulated procedures for ease of implementation in the instructor's classroom), and (3) *cost* (potential benefits outweigh the effort and other costs of implementation). Motivated by this framing, we structured the project to maximize congruence and instrumentality and minimize cost for instructors. Specifically, instructor-participants were given a course release to make time for participation in the project, and the facilitators guided participants in implementing the Continuous Improvement (CI) model for instructional improvement (Berk & Hiebert, 2009), in a manner reminiscent of lesson study cycles (Dick et al., 2022). In CI, participants identify two or three different mathematical concepts and implemented the following cycle each semester: (1) design a task that targets a particular mathematical concept; (2) develop hypotheses about anticipated student responses; (3) collect data in the form of student work and classroom recordings, then analyze the data for evidence of the desired student learning outcomes; and (4) reflect on their own and their colleagues' instructional decisions in the implementation of the task, and revise the task as appropriate. In this way, instructors retain control of the congruence and instrumentality of the resources and materials that they themselves produce.

Methods

Participants were four fixed-term faculty teaching an introductory mathematics course at the same institution. Two participants, Shay and Nicholas (pseudonyms), were experienced instructors who had taught the course multiple times and served as course coordinators, and two participants, Alex and Ivy, were in their first semester teaching the course at this institution.

For this proposal, we focus on data collected in a 60-minute semi-structured interview with each of the instructors during the first semester of this larger project on instructional improvement. The interview protocol included questions to elicit details about each instructor's experience teaching, what a typical class period looked like, how their instruction has changed over time (if at all), and what factors supported or hindered them in implementing EBIPs (e.g., active learning activities). Interviews were transcribed verbatim. To answer our research question, we used thematic analysis of the transcripts to identify instructor reported barriers and drivers to implementing EBIPs (Braun & Clarke, 2006). We coded segments from the interviews, using the 18 barriers (e.g., Time Constraints) and 15 drivers (e.g., Aligns with existing resources) identified by Shadle et al. (2017) as a priori codes. We then created additional codes when instructors described barriers or drivers that were not represented in Shadle et al.'s (2017) findings.

Results

In this section, we describe two drivers, course coordination and weekly CI project meetings, that impacted all four participants decisions to implement EBIPs. We also discuss the impact of the COVID-19 pandemic, which was identified by participants as both a barrier and a driver to implementing EBIPs. In our talk, we will share additional barriers and drivers that arose in our data, including those that align with Shadle et al.'s (2017) findings.

Drivers to Implementing EBIPs: Course Coordination & CI Project Meetings

Course coordination played an important role in creating an environment that fostered the implementation of EBIPs. The course coordinators (Nicholas and Shay) created the course structure, outlining activities that would be done during class and building the homework sets and lecture videos that could be used to support students' learning outside of class. Ivy discussed

how she appreciated having someone with departmental and course-specific knowledge in this role, especially when there was disagreement amongst the instructors. She said:

> So having somebody there that I know has the broader perspective … You've got to have somebody that's taking that leadership role and putting stuff into practice and saying this is the way it's going to be. But they have been extremely open with input.

Ivy also emphasized, in this quote and throughout the interview, that she appreciated how the coordinators took instructors' ideas as input when making decisions that impacted the entire instructional team.

All four instructors also emphasized that the resources that were created and made available as part of the course coordination contributed to their decision to implement more EBIPs in their teaching, which was also identified as a driver in Shadle et al.'s (2017) work (i.e., Aligns with Existing Resources). Ivy emphasized how these available resources prompted her to incorporate activities she had never quite been comfortable with implementing before. She said,

> I've got all these resources. My experience was lecture, and now I get to try the things I've always wanted to try. So I'm loving it. I love the activities. And I'll be honest, at the start of the semester I was like, 'Oh, we're going to do this now?' Because I didn't know how powerful it was. … It's just cool to see everything that we can do with [the activities], and it really helps the students understand.

These resources were initially created by the course coordinators, but as the semester progressed, other instructors began to add to this shared repository of course resources.

Weekly project meetings, which focused on developing materials as part of the CI cycle, also served as a driver for instructor implementation of EBIPs. These meetings created time and space for instructors to talk about best practices and pedagogy as they developed class activities. Notably, these meetings were separate from course coordination meetings (where the focus was primarily on logistics such as upcoming assessments, content, or due dates). All instructors shared how these weekly meetings were important for developing and implementing activities that centered student thinking, with the meetings also serving as a space for collaboration and as a form of accountability to ensure progress on shared objectives. Nicholas said,

> I think a lot of it's the kind of dedicated collaboration time. … It's kind of nice to just sit around for an hour and be like, 'What do you think about this? And how would you approach this? And how would you do that?'

Additionally, these weekly project meetings also created space for the facilitators to share related educational research as the instructors expressed an interest in learning more about EBIPs. As such, opportunities for professional development arose organically during these meetings.

COVID-19: Both a Barrier and Driver to Implementing EBIPs

Instructors discussed the impact of the COVID-19 pandemic both as a barrier and as a driver for implementing more EBIPs in their classes. On one hand, Shay described COVID as a driver because it challenged instructors to think carefully about how they were presenting material when the course modality shifted to online. Shay said,

> The idea that COVID kind of opened your [eyes] - you have to look for other ways to be able to present material to them. And so, oh! We'll make these videos. … Why can't we just make the video and they can watch it on their own time, and then come in and then do this

[activity]? … I want them to - instead of just sitting there blankly looking at me while I'm talking - being able to interact.

This quote highlights the way that the pandemic enabled her to try new things in her class because she realized that she could create videos covering the content she would normally lecture on for students to watch on their own time. This freed up time during class for students to engage in activities and interact with one another.

Another instructor, Alex, pointed to how the COVID-19 pandemic was a barrier for him incorporating more EBIPs. He described how it was challenging to facilitate student discussions in breakout rooms on Zoom because he could not listen in on student discussions as easily. He felt as if there was not the same collaboration and excitement that happens in the classroom when one can hear other groups discussing and laughing together during student work time. Even when courses shifted back to being in-person, the pandemic continued to impact student interactions. Alex said:

> But on the very first day [of being back in person], some students are acting like everything's normal and sitting together, but others are sitting really far away, wearing their masks. And I'm not going to tell them [to get into a group]. … So that's brought me to where I'm a little bit less sure about how it can operate right now.

Discussion

In this study, instructors identified many of the same barriers to implementing EBIPs that were reported by Shadle et al. (2017). However, most of the drivers that were identified in our work differed from those raised in that study. This could be because Shadle et al. (2017) focused on faculty's perceptions of what "will help make change occur" (p. 10), whereas our study sought instructors' reflections as they were in the midst of a project designed to promote instructional change. Nonetheless, we do see some alignment between the drivers identified in both studies. Specifically, we see the drivers of course coordination and the weekly CI project meetings as aligning with the driver "Encourages collaboration and shared objectives" identified by Shadle et al. Critically, Shadle et al. describe this driver as an outcome of "increased emphasis on teaching and student success" (2017, p. 6), whereas in our work course coordination actually served to enable instructors in their adoption of EBIPs. Other recent research has also highlighted the important role course coordinators can play as change agents and drivers for instructional change (Williams et al., 2021). Two years before the start of this project, the mathematics department had embarked on a campaign for improved coordination and alignment across multi-section courses. This required instructors to meet and discuss their goals for and their teaching of the course, increasing collaboration. Then when course coordinators started experimenting with incorporating active learning in their own teaching, this led to the creation of a course structure that fostered the inclusion of more EBIPs.

As shown by the preliminary results of this study, the disruptions to university teaching that resulted from the COVID-19 pandemic complicated instructors' use of EBIPs in the expected ways (e.g. complicating the use of small-group work when social distancing was also encouraged during in-person classes), but they also provided instructors with opportunities to rethink their beliefs about their role in the classroom. As this project progresses, we anticipate that instructors will continue to interrogate their previous assumptions about mathematics teaching and learning.

Acknowledgements

Support for this work was provided by the National Science Foundation's (NSF) Improving Undergraduate STEM: Hispanic-Serving Institutions (IUSE: HSI) program under award #2116187. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

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