Instructional Characterizations of Foundational Math Coordinators with Attention to Instructor-Student Interactions

Kimberly Cervello Rogers, Bowling Green State University
Camryn Grey, North Carolina State University
Nicholas Long, Bowling Green State University

We aimed to get a better understanding of participants' (eight foundational math course [FMC] coordinators') teaching approaches. In the first year of this grant project, we primarily gathered data (through surveys, self-reflections, and class observations) on these individuals as instructors. These data were compiled into narrative summaries for each participant and analyzed and compared. We discuss our findings from this analysis, using the instructional triangle as a framework, and particularly focusing on instructor-student interactions. This project aims to develop an understanding of what is needed to support instructional change in FMCs by evaluating how math-specific professional development (PD) cycles affect FMC coordinators' teaching practices and perspectives. We seek audience feedback on potential next steps towards fostering effective instructor-student interactions and future PD cycles.

Keywords: Foundational Math, Course Coordinators, Professional Development

Introduction

College math instructors typically work in isolation, negatively affecting quality of instruction and sustainability of evidence-based teaching practices in college math classrooms (Bressoud et al., 2015). Few instructors have access to or utilize explicit communities of support (Reinholz, 2017). This paper reports on data from the first year of a 3-year grant project (Rogers, 2022-2025) that ultimately aims to test and refine a community of practice (CoP; Wenger et al., 2002) among eight faculty members who coordinate and teach foundational math courses (FMCs, e.g., College Algebra, Precalculus, Quantitative Reasoning, Introductory Statistics, Math for Elementary Teachers, & Calculus). Course coordinators are a key population within college math education because they teach and supervise instruction of thousands of undergraduate students each semester. A CoP can provide a means for them to share and manage professional knowledge, in this case about math-specific professional development (PD) opportunities.

The overarching objectives of this grant project evaluate how math-specific PD cycles affect FMC coordinators' teaching practices and perspectives and contribute to theory about supporting meaningful instructional change in FMCs. The hypothesis is that by designing and implementing PD opportunities about teaching undergraduate math using active-learning (AL) strategies (Freeman et al., 2014; Laursen & Rasmussen, 2019) with FMC coordinators, they will develop their mathematical knowledge for teaching and become more effective instructors. Ultimately, this project will develop an understanding of what is needed to support instructional change in FMCs. Our first step toward these goals is to understand the current beliefs, practices, and competencies of the FMC coordinators in our study, use these findings to inform future PD decisions, and elicit feedback from the RUME community to consider moving forward. In this paper, we aim to answer, what are the prevailing characteristics (e.g., beliefs, competencies, classroom practices) of these FMC instructors?

Literature Review

Over a decade ago researchers (Speer et al., 2010) conducted a literature review on collegiate math teaching and concluded that instructors' practice (i.e., their pedagogical actions and

reasoning related to those actions in the context of instructional activities) remains largely unexamined in the research literature. Research on PD in college math education is still sparse, especially when the focus is on instructors and tenure-track faculty (Florensa et al., 2017). Within the context of our larger research project, we first seek to better understand who these participants are as instructors and as a community of instructors. When we say community of instructors, we are examining this group of instructors as a CoP.

In a 97-paper meta-analysis of change theories in STEM higher education, the most prevalent change theory was CoPs (Reinholz et al., 2021). A CoP strives to create, expand, and exchange domain knowledge to develop individual capabilities and cohesion dependent upon passion, identity, and commitment (Wenger et al., 2002). These cohesive properties align with the model used in this study because all participants share the FMC instructor and coordinator identities, a commitment to teaching (per employment), and passion to support student learning outcomes.

To consider these CoP components, we note how the MAA Instructional Practices Guide (MAA, 2018) emphasizes student-centered teaching practices and pushes us to move away from direct instruction. This push is due to research findings that highlight how student-centered practices help increase access to learning opportunities for diverse learners (e.g., Laursen & Rasmussen, 2019). We specifically conceptualize student-centered instruction through the instructional triangle. Instead of solely emphasizing the teacher, Cohen et al. (2003) defined teaching as "what teachers do, say, and think with learners, concerning content, in particular organizations and other environments, in time" (p. 124). In their definition, four critical aspects of teaching become apparent- teachers, students, content, and environment- which are situated in a model that represents instruction as interaction where teacher, learners, and content create a triangle of interaction, existing within the environment (i.e., the instructional triangle). This framework for instruction is appropriate for our study because it allows us to look at participants' self-report data and classroom observation data and consider how their responses and practices emphasize components of the instructional triangle.

Method

Context: University and Course Coordinator Backgrounds

At a rural, public, liberal arts college in the Midwest, participants are eight FMC coordinators. Course coordination duties include (but are not limited to) deciding on, designing, and distributing course materials (i.e., syllabi, lecture notes, pacing calendars, example assessments, and activities) to maintain consistency across sections of the course that semester. They also include facilitating meetings with all course instructors, adjusting assessments so they align with learning outcomes, providing observation feedback for novice college math instructors (i.e., graduate student instructors and faculty), and addressing student concerns. Our campus has a main (4-year) location and secondary location less than an hour away. The secondary location focuses on the first 2-years of undergraduate course work, and providing explicit pathway supports for students. Table 1 lists participants' course names, years coordinating (self-reported), and campus location. For College Algebra, both campus locations utilize a math emporium instructional style[1], a computer-based opportunity to fill in gaps for content knowledge, while the other FMCs are taught in in-person lecture formats (pseudonyms are used throughout this paper).

[1] Math emporiums use adaptive learning systems to individualize student pathways (Cousins-Cooper et al., 2017).

Table 1. Participants' backgrounds and course coordination details.

Pseudonym	Course(s) Coordinating	Yrs Coordinating	Campus
Alaina	College Algebra	9	Main
Alexis	College Algebra	0	Main
Camille	(1) Calculus I, (2) Calculus II, & (3) Calculus III	15	Main
Madeline	(1-3) Math Ed Elementary Math Content Courses	4	Main
Patrick	(1) College Algebra & (2) Pre-Calculus	3	Secondary
Pricilla	Pre-Calculus	4	Main
Reema	(1) Math for Architectures & (2) Quantitative Reasoning	12-15	Main
Stella	Introduction to Statistics	4	Main

Community of Practice Context

Before this grant project began, Author 1 met with the FMC coordinators at least twice a month for course coordination meetings to address administrative and policy needs of the FMCs, department, and university. By utilizing these pre-existing meetings, we implement PD activities, learn about one another's teaching practices, and collect self-report and survey data without adding additional time commitments.

Data Collection and Analytical Approach

During project year 1, FMC coordinators completed surveys[2], answered reflection questions, completed an empathy map, and were observed teaching. These data points informed our understanding of their professional history, beliefs both as an individual instructor and as part of the FMC coordinator group, and typical classroom practices. We created narrative summaries of each participant's quantitative and qualitative responses. We analyzed the narratives to examine participants' beliefs and classroom practices, specifically regarding participants' teaching approaches. We conceptualize "teaching approaches as actions and strategies described and enacted by instructors when they talk about teaching mathematics or when they actually teach mathematics (Mesa et al., 2014, p. 122). We coded the data for student-, content-, or instructor-centered approaches, defined as instructor descriptions and strategies that are driven by…

1. …"instructors' interest in attending to students' cognitive, social, and emotional needs, seeking to give students a more prominent role in classroom activities" (Mesa et al., 2014, p. 122): Student-centered.
2. …"instructors' interest in emphasizing the content over students' cognitive, social, or emotional needs and involvement" (Mesa et al, 2014, p. 123): Content-centered.
3. …instructors' teaching or learning plans, goals, or decisions that do not explicitly attend to student- or content-centered aspects: Instructor-centered.

[2] The surveys included items from the Collective Teacher Efficacy Instrument by Goddard et. al. (2000), and the (self-) Efficacy Instrument by Enochs & Riggs (1990)

Findings: Characterization as Instructors

After analyzing each individual case study and comparing them across the group, we report on our initial findings of the identities of these FMC coordinators.

Beliefs

Based on their survey responses, we examined the participants' beliefs about self-efficacy and collective teacher efficacy. Each coordinator's response indicated a high level of self-efficacy in terms of their ability to teach mathematics. For most, this ability included self-assessed strength in terms of their content knowledge (content-centered). The self-efficacy instrument also highlighted the coordinators' beliefs on how influential instructors are to the learning and success of math students. Specifically, all but one coordinator said the instructor (instructor-centered) significantly impacts student learning. Only Alaina's survey responses indicated she believes classroom practices need to be organized to help students be the mechanism for their success in learning (student-centered).

Every participant also indicated a high level of collective teacher efficacy, with survey responses that suggest they believe the other individuals in their FMC CoP are effective in their teaching of mathematics (instructor-centered). Even so, the coordinators were not in consensus as to whether further training was needed for the group to "know how to deal with undergraduate students" (Enochs & Riggs, 1990). When responding to this Likert-scale question, Patrick, Madeline, and Stella all somewhat agreed more training was needed, Alexis somewhat disagreed, Alaina, Camille, and Reema disagreed, and Pricilla was not sure. Interestingly, those who somewhat agreed more training was needed have only been in their roles for 3-4 years, however those who disagreed with the statement have between 9-15 years of experience as a coordinator. We interpret that result to mean that individuals with more course coordination experience feel like they, along with their CoP, do not require further training.

Competencies

Self-reported data was collected during two different group meetings. In one meeting, participants reflected on their areas of strength and struggle as instructors. They described some strengths/struggles that were more instructor- or content-centered, however, most strengths/struggles described were student-centered. All but one participant explicitly discussed strengths related to their students and interactions with students (e.g., engaging students in discussion), and every coordinator described a student-centered area of struggle (e.g., difficulty motivating students to come to class). These student-centered aspects indicate that as a group, the coordinators place value on their students' role in the classroom and interactions with them.

We also asked the coordinators to reflect on what a typical day in their class is like. Alaina stated practices that are primarily content-centered but are implicitly student-centered by design of the emporium class she coordinated (e.g., creating problems for certain students based on their current content). We are gathering this data from the recently appointed emporium coordinator, Alexis, on her intended practices to compare with Alaina's (emporium director and former coordinator). Camille, Madeline, and Stella all described student-centered approaches including dedicating class time for students to engage in the content and interact with classmates. Stella, specifically, reports having a mostly student-centered class, while Camille and Madeline spoke to both instructor- and student-centered aspects of their class time. Patrick, Pricilla, and Reema all described a lecture-based environment (instructor-centered) and focused somewhat on the content aspect of their classes (content-centered). We therefore conducted observations to investigate how these reported practices aligned with what happens in their classrooms.

Classroom Practices and Observed Interactions

Each coordinator was observed twice in the same semester, except for Stella who was observed once (due to scheduling constraints). When comparing the coordinators' stated practices to what was observed, their reported practices mostly aligned with what they did during observations of their class. Instances where there were discrepancies between the stated and observed practices were mainly things that they articulated did not occur every class session. For example, Pricilla stated she occasionally gives students an exit slip or a quiz, however, neither of these were observed.

The observations also allowed us to analyze instructor-student interactions. For some coordinators, particularly those with a more student-centered classroom environment, students tended to give affirming body language (e.g., nodding their head, actively writing) during these interactions and appeared engaged in the math. However, in other coordinators' classrooms, students were observed having negative body language (e.g., turning away from the instructor, dissociating) and appeared to disengage with the conversation or content. These instructors did not react in a way that would indicate their acknowledgement of the students' negative body language. This observation shows a disconnect between the interpretation of these interactions by the instructors and the students we intend to investigate further.

Discussion and Questions for the RUME Audience

From their survey responses and self-reflections, it is clear this group of coordinators care about the quality of their interactions with students. During committee meetings, some of the coordinators discussed not being able to get through to some students, or not understanding why their interactions with students were not as fruitful as they wanted them to be. After considering their observations, however, we gained insight into the differences in reported perceptions between students and instructors.

With this finding, we are interested in hearing any ideas from the RUME audience about how to illuminate this discrepancy to the group as well as what interventions or PDs could be used to promote affirming instructor-student interactions. We attempted to make some initial headway in this area in year 1 when we guided the coordinators through developing *empathy maps* (Aldrup et al., 2022; Gibbons, 2018) about personas of students in the FMCs they teach. Given the student-centered approaches documented in this study, we were surprised to be met with an unwillingness to participate by a few participants who felt the empathy map was not appropriate in the educational setting. Discussing this pushback with the RUME audience and exploring factors underlying this pushback could provide avenues for future PD with this group.

Additional specific questions we plan to ask the audience during our presentation include:

- What research-based, but practitioner-focused papers or resources should we be aware of that could inform how we help instructors consider students' perceptions about instructor-student interactions?
- This paper focuses on the participants as *instructors* of FMCs. During this second year of the project, what suggestions do audience members have regarding data we should prioritize gathering about these participants' perspectives as coordinators? And why?

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