PST LEARNING TO FACILITATE ARGUMENTATION VIA SIMULATION: EXPLORING THE ROLE OF UNDERSTANDING AND EMOTION

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The present study focuses on examining transitions in elementary pre-service teachers (PSTs)' understanding of, and skills in, leading argumentation-focused discussions in mathematics during participation in a sequence of three different practice-based activities, collectively referred to as the Online Practice Suite (OPS). We will examine 14 PSTs' responses to post-activity surveys targeting their understanding of argumentation-focused discussions and emotional experiences, over the course of a single semester. From this initial coding, we will select three to four cases that represent a range of understandings and emotional experiences and conduct in-depth analyses on the patterns of engagement in the OPS, drawing on records of practice from their experiences in the OPS. We discuss ways that teacher educators can scaffold PSTs' experiences as they develop the skills to facilitate argumentation-focused discussions.

Keywords: Instructional Activities and Practices, Preservice Teacher Education, Classroom Discourse, Technology, Approximations of Practice, Simulation

Purpose of the Study

This study is situated within a larger project focused on examining how participation in a sequence of three practice-based activities, collectively called the *Online Practice Suite* (OPS), supports PSTs in facilitating argumentation-focused discussions in elementary mathematics. The larger project aims to address two challenges simultaneously, one acute and the other longer-term. The first challenge is COVID's impact on teacher preparation, which has pushed methods courses online and limited preservice teachers' (PSTs) access to field work (e.g., Reich et al., 2020; Saenz-Armstrong, 2020). The second is the endemic challenge of providing PSTs authentic and appropriately scaffolded opportunities to engage in the work of teaching—ideally across different contexts and diverse student populations (Grossman, 2018; Lampert et al., 2013; Sleeter, 2001; Whitaker & Valtierra, 2018). The OPS is designed to allow PSTs to experience a carefully scaffolded set of approximations of practice (Grossman, Compton, et al., 2009), all via an online environment that is resilient to COVID-induced constraints and provides teacher educators with an alternative resource to access field placements for PSTs. It is also designed to be appropriate as a future tool for teacher development across multiple contexts, including to complement field placement, and with a goal of supporting PST learning in ways that are easily adaptable to what teacher preparation comes to be in a post-pandemic world.

In the larger project, we will study teacher educators' use and adaptation of the suite across elementary and secondary mathematics and science teacher preparation and measure PST learning via a pre/post design. The study described here draws on pilot data from implementation of the elementary mathematics OPS to explore the research question: *how do PSTs' understandings of, and skills in, leading argumentation-focused discussions emerge over the course of an OPS engagement semester*?

Perspective(s)

The Importance of Argumentation-Focused Discussion

Communication is fundamental to mathematics teaching and learning. In mathematics education, there is a tradition of focusing on classroom discussions as a space to examine the teacher's role in facilitating communication among students (National Council of Teachers of Mathematics [NCTM], 2014; Stein & Smith, 2011). This line of research considers whose mathematical contributions the teacher takes up, how students are encouraged to talk about their ideas with one another and how the teacher moves the class toward collective meaning-making. With recent education standards, argumentation has taken the spotlight as a preferred discursive practice for students to learn and take up (National Governors Association & Council of Chief State School Officers [NGA & CCSO], 2010). Argumentation in mathematics involves students comparing, analyzing and critiquing one another's approaches to solving mathematics problems (NCTM, 2014; Smith et al., 2008). Facilitating these kinds of interactions among students in such a way that the outcome is, in fact, productive for students' sense making is difficult (Ball, 1993; Lampert, 2001). The combination of a focus on argumentation as a goal for students and the difficulty teachers have facilitating it has drawn recent attention to how pre-service and in-service teachers learn this practice (Gosek et al., 2018; Hallman-Thrasher, 2017).

Approximations of Practice as A Site for Teacher Learning

During the last decade, there have been increased calls for a focus on practice-based teacher education to address the widespread challenge of providing opportunities for PSTs to rehearse components of complex practice, like facilitating argumentation (Ball & Forzani, 2009; Francis et al., 2018; Grossman, Hammerness, et al., 2009; Lampert, 2010). Research has shown that teacher candidates are more effective when their preparation is directly linked to practice (Association of Mathematics Teacher Educators, 2017; Goodson et al., 2019). Approximations of practice entail immersing novices in the activities in which they routinely engage during instruction (Grossman, Compton, et al., 2009). More recently, technological advances have enabled the development of digital practice spaces and virtual classrooms (such as those used in this work) to engage teachers in rehearsals. These digital practice and classroom spaces, while simplified, contain core elements and behaviors typical of real classrooms (Brown, 1999; Dieker et al., 2014), thereby providing sheltered environments for PSTs to engage in repeated practice, (Badiee & Kauffman, 2015; Garland et al., 2016; Grossman, 2010; Straub et al., 2014), and can be customized to meet a teacher educator's instructional purposes (Herbst & Kosko, 2014).

Emotions are closely connected to cognition and action, and are considered influential on how teachers make, and enact, instructional decisions (Hargreaves, 2000; Oatley, 1991). Research around teachers' emotions has increased significantly over the last decade, with studies focused on understanding the relationship among emotions and other constructs more emergent, and very little focus on how these relationships unfold in virtual learning environment. Recent work (Cross Francis et al., 2020) has shown that elementary mathematics teachers experience a complex array of emotions that vary in fluctuation patterns as teaching unfolds. These patterns served to stimulate productive teaching practices (e.g., professional noticing; Cross et al., 2017) for some teachers, while for others, they exacerbated adverse physiological and cognitive responses non-conducive to effective teaching. Virtual classroom spaces afford opportunities to systematically investigate the relationships between teachers' emotions and instructional practices and provide a supportive space for PSTs to hone their emotional regulatory skills.

Methods

Study Context: The Online Practice Suite

The practice-based activities that make up the OPS include: (1) Focused-Practice Spaces (FPS): interactive, online digital games that create targeted practice spaces to engage PSTs in considering and responding to students' content-focused ideas; (2) Avatar-Based Simulations (ABS): performance tasks that provide opportunities for PSTs to practice facilitating discussions with a group of five upper elementary avatars; and (3) Virtual Teaching Simulator (VTS): a virtual reality environment that allows for verbal, textual, and non-verbal interactions between a teacher avatar (played by the PST) and 24 student avatars in an immersive whole classroom.

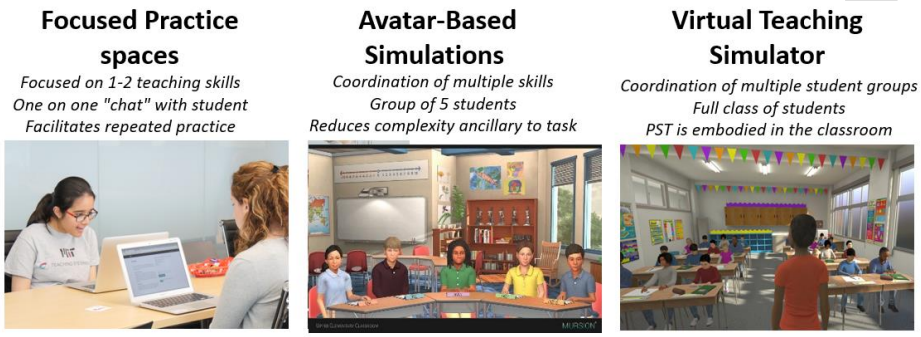

Figure 1: Activities that make up the Online Practice Suite

Participants

For the purpose of this paper, we focus on data from a pilot study involving PSTs enrolled in elementary mathematics methods courses at two different university sites in the Northeastern United States. All enrolled PSTs (24) engaged in three practice-based activities sequentially over the course of a single semester. A subset (14) consented to have their records of practice retained for research purposes; among those eight completed all required research activities.

Data Sources

Selected responses to post-activity surveys. Each PST completed a post-task survey after each activity (three time points), including a combination of Likert and open-ended responses. We analyzed items focused on PSTs' perceptions of discussions and argumentation (e.g., how they define discussion and argumentation) and items focused on PST's emotional experiences during engagement (e.g., what emotions they report feeling).

Records of practice. Each activity generates records of the PST's practice. For FPS this includes transcripts of PSTs' responses that are typed or spoken into the system; for ABS and VTS, the records are video-recordings of the PSTs facilitating small and whole-group discussions with student avatars.

Analyses

There are two phases of analyses, the first of which is complete as of the submission of this brief report. In phase one, PSTs' responses to the post-activity surveys across the three time points were coded to capture their ideas about argumentation-focused discussion and their emotions as they engaged in the activities. We looked across these responses for patterns present in the data set to select two cases for further investigation in phase two.

During phase two, we examined the records of practice for the selected PSTs, attending in particular the degree to which their stated understandings of what teachers should to do support

argumentation-focused discussion are observable in the actual teaching moves they make during the simulations, and the degree to which we can observe evidence of their reported emotional state hindering or supporting their engagement.

Results

Phase 1 Results

A total of eight PSTs consented to participate in research and completed all three surveys. PSTs described high quality discussions and argumentation as centered around "student-to-student interaction", and involved "critical thinking around math ideas" with a "focus on understanding". With respect to argumentation, PSTs additionally emphasized debate grounded in defense of claims, reasoning and justification of ideas. We observed different trends in emotional experiences across the activities. Half of the PSTs (four) experienced a consistent emotion across the three activities, with two experiencing anxiety (negative) and two excitement (positive). The other four PSTs experienced a mix of positive and negative emotions.

We selected two PSTs for deeper analysis, whose responses with respect to argumentation-focused discussion and what teachers should do to support it were both robust and similar, but whose emotional experiences were quite different. Their descriptions of the teaching moves that support argumentation-focused discussion included "asking effective questions", "promoting respectful student interaction", "guide discussion", "creating opportunities to hear and learn from other ideas". One PST consistently experienced excitement, making statements such as, "I was excited to take part of an innovative experiences like this one!" whereas the other expressed anxiety in comments such as "It was new and scary. I don't know who I am talking to".

Phase 2 Anticipated Results

We anticipate, based on initial observations of the OPS implementation, that understanding argumentation-focused discussion may be a necessary but not sufficient condition for success in leading such discussions, and that the case study PSTs may or may not consistently make the teaching moves they describe as important, although we expect to see more such moves across the time points. The role of emotion in PST learning is complex, and we hope, from this analysis, to develop provisional hypotheses about whether and how the nature of the observed emotional pattern may hinder or support learning that can then be tested in later analysis of the broader set of PST data.

Discussion

As the world recovers from COVID-19, teacher education will inevitably re-normalize, but will likely never be completely the same. It is critical that we capitalize as a field on the innovation sparked by necessity, incorporating the best inventions borne out of crisis into our future work. Technology-based interventions, such as the OPS, designed to focus on complex, content-intensive teaching practices, not only afford us a bridge to the end of the pandemic, but also a way of thinking about deliberately scaffolding PST learning around the very practices that are most difficult to learn to do well, and that PSTs are least likely to encounter by chance in field experiences. Understanding how PSTs learn from such experiences and how that learning intersects with emotion is critical in informing the design of such experiences and in helping teacher educators to make sense of and use such innovative tools effectively.

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