A FRAMEWORK FOR THE FACILITATION OF ONLINE PROFESSIONAL DEVELOPMENT TO SUPPORT INSTRUCTIONAL CHANGE

Un marco para la facilitación del desarrollo profesional en línea para apoyar el cambio instruccional

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In this research report we discuss the development of a framework regarding the facilitation of online professional development geared at supporting instructional change at the undergraduate level. The research in undergraduate mathematics education includes various large-scale projects aimed to support individuals or departments in reforming their instruction to align with recommendations from professional organizations and existing mathematics education research standards. One area that needs attention is the use of online synchronous environments to match faculty across the world and form collaborations to support the inclusion of student-centered activities in their mathematics classrooms. This research report discusses the actions that facilitators take in these environments and lays the groundwork for the use of this framework in our and other contexts going forward.

Keywords: Post-Secondary Education; Teacher Education – Inservice / Professional Development; Systemic Change

Instructional shifts towards student-centered pedagogies are taking place throughout North America within mathematics departments. This change is oftentimes centered around individual faculty (e.g., Author, 2019; Speer & Wagner, 2009) but also from the perspective of larger groups of faculty (e.g., Author, under review; Hayward & Laursen, 2016) or even departments at-large (e.g., Apkarian & Reinholz, 2019; Laursen, 2016; Reinholz & Apkarian, 2018). Notably, professional communities also call for this instructional reform (Mathematical Association of America [MAA], 2015). The research in undergraduate mathematics education community has embarked upon numerous large-scale research projects to investigate how to support instructional change (e.g., Author, under review; Kuster et al., 2016), namely to make instruction more student-centered. Additionally, this community has engaged in large scale projects to support departments in improving instruction and student outcomes (e.g., Association of Public & Land-Grant Universities [APLU], 2016).

Our multi-institute collaborative grant, BLINDED, is one such project in which we aimed to not only support mathematicians in reforming their instruction with various support models but to research those support models' impact on the mathematicians and their communities. Our support model consisted of instructional materials (both for the student and faculty), a summer workshop, and online professional development, which we classified as an online working group (OWG). The OWG offered an opportunity for faculty to collaborate on their instruction through a lesson study model (Demir et al. 2013) in online synchronous environments. In this OWG, participants engaged in lesson studies on multiple units of Inquiry-Oriented (IO) materials (Rasmussen & Kwon, 2007) by doing the mathematical tasks from those units, anticipating student thinking that could arise from

those units, filming and then subsequently bringing video clips from that instruction to the OWG to share and discuss.

In previous research, we have discussed the development and usage of a framework to categorize and understand the conversation that occurs when OWGs are discussing the sharing of instructional video as a means to support their instructional change (Author, under review). However, the next step that emerged from that work was to analyze the role that the facilitator played in that OWG. Given the importance of the role of a facilitator in professional development settings (van Es et al. 2014), our next research steps were to develop a framework to categorize and understand how facilitation occurs of these OWGs. In this endeavor, we sought to understand the facilitation of OWGs when facilitators initiate discussions about the mathematical content of novel IO curricular materials. We will discuss the development of a framework to understand the facilitation of these OWGs. The research question for this research report is: *What actions do facilitators take within online working groups focused on doing and understanding the mathematical content of novel IO curricular materials?*

Methods

Research Setting and Data Collection

Data from this research report comes from a large NSF funded project, BLINDED. BLINDED recruited mathematicians in 2015-2017 who were interested in changing their instruction to be more student-centered and specifically use one of the IO curricula: differential equations, linear algebra, or abstract algebra. During the first year of the project, the three Principal Investigators led their respective OWG. In subsequent years, the project team was able to double the number of OWGs that could be facilitated by recruiting the previous year's participants to lead their own OWG. Consequently, in 2016 and 2017, 4 facilitators, who were previously participants, each led their own OWG. The development of our framework comes from these 4 individuals' OWGs. Each OWG was screen recorded using QuickTime and all OWGs were transcribed. Each of these OWGs consisted of 3-4 participants. As this analysis focuses on when the facilitators were leading discussion on doing the mathematics from the novel IO curricula, this yielded 14 transcripts for analysis.

Data Analysis

The creation of the framework followed an iterative process of revision and refinement via individual open coding and comparison between the researchers (Creswell & Poth, 2017). Altogether, 14 transcriptions of videos were investigated, coded and compared by at least two researchers in each iteration. During the first iteration, we analyzed two video transcriptions and proposed descriptors for the action that the facilitator took. In crafting our descriptors, we consulted the work from van Es and colleagues (2014) to look for common threads. In their work they focused on developing a framework on *how* facilitators could use in-the-moment moves to support productive discussion while viewing video of instruction (van Es et al., 2014). We then convened and compared our suggestions for each of the corresponding facilitator's actions, by grouping similar descriptions in one category and assigning that category a code. For instance, the expressions *chose participant to start, called on participant* and *called on a participant to share their thoughts* were grouped under *asked participant to share their mathematical work* and assigned the code SHARE; *brought experience from the classroom to the conversation, related it back to what students would do* and *tried to make sense of why students have made mistakes in the past* were coded as PAST to indicate that the facilitator reported on what students have done in the past. This process generated a first draft of the codebook.

Following this step, the remaining twelve video transcriptions were assigned to two researchers each. Every pair individually coded their assigned portions and then came together to compare their

results and agree on one code per statement. Then, the three coders convened to discuss the overall results. We saw the need to distinguish between *what* the facilitator is claiming or asking, and *how* they were doing it. In particular, we focused on the type of statement that was being made (imperative, interrogative, exclamatory, and declarative).

This led to the second iteration of coding for the same initial two transcripts, where each statement was assigned a *what* and *how* code. We subsequently reconvened to compare individual results. Additional codes were suggested, initial ones were redacted and eventually we noticed a commonality between some codes which allowed us to create the elements of the framework, the *facilitation (how)* and *conversation (what)* themes. Within the facilitation theme, we generated five categories and two actions that pertain to each category. Additionally, we realized that only imperative and interrogative statements were meaningful in certain actions that the facilitator made under the *gathering* and *verifying* categories.

Results: Facilitation Framework

Figure 1 is the framework for facilitation of online professional development. The framework contains two overarching elements: facilitation and conversation. Facilitation is the element of the framework that would transcend the context of the OWG. The conversation categories emerged from our previous research as well as this analysis and would be different if this framework was applied in different contexts. While we believe the conversation codes could serve as a starting point for other groups, the nature of the content under consideration will largely determine these categories.

Framework Elements	Categories	Action	Description
Facilitation	Progressing Session	Transition	Transitioning to a new or different mathematical task/subtask
		Think	Giving individual think time
	Gathering**	Individual	Asking for a specific individual to share or contribute
		Open	Opening the floor to the group for a response
	Verifying**	Elaborate	Asking for an elaboration or clarification from an individual
		Restate	Inquiring about a participant's contribution by restating that contribution
	Contributing	Provide	Providing input, advice, or insight
		Restate	Restating a participant contribution
	Supporting the Group	Encourage	Encouraging statement
		Acknowledge	Acknowledging or thanking participant(s) for contribution(s)
Conversation	Content	Pedagogy	Teacher instructional moves or ideas about teacher instructional moves
		Goal	Learning goals of task/subtask/lesson
		Time	Timing information about lesson
		Past	Previous students' mathematical reasoning and/or work
		Anticipate	Anticipation of students' mathematical reasoning and/or work
		Mathematics	Mathematical content or mathematical technology

**Subcode for Gathering and Verifying	SubCode	Description
	Imperative	Makes a request or gives a command of some sort
	Interrogative	Asks a question, inquires for more information

Figure 1: Framework for Facilitation on Online Professional Development

Here, we focus on the categories within the facilitation element of the framework. There are five categories of actions that our facilitators did in online working groups. Namely, they Progressed the session, Gathered information, Verified information, Contributed their own thoughts to the session, or Supported the group. Each category yielded two actions, or codes. For example, under the Gathering category, we find two actions: Individual and Open. Individual was a code used to describe when the facilitator was asking a specific individual to share their thoughts whereas Open was used to code for when a facilitator asked for any volunteer to share their thoughts. While both actions concern gathering information, they are clearly two distinct actions a facilitator can take during an OWG. It is worth noting that Restate is an action under the Verifying and Contributing categories as a facilitator would Restate for different purposes. For example, a facilitator would Restate a participant claim with the (implied) intention being to inquire about a participant's contribution. That is, the facilitator would Restate what the participant said for the purposes of having that participant expound on what they had just said. Whereas, a facilitator would also Restate

a contribution, potentially in paraphrased ways, as a means to contribute to the conversation with no (implied) intention of getting a response from the original commenter of that statement.

Another important aspect of the framework to note is the inclusion of the subcodes for Gathering and Verifying. All four of the actions under those two categories are about the facilitator doing something that desired a response from someone, whether that be a specific Individual, Opening the floor to a question, asking for an Elaboration, or Restating for the purposes of further explanation. However, in our analyses, it became clear that there were always two different ways to achieve those goals. We used terms from the field of linguistics. Namely, imperative requests are ones in the form of a sort of command; whereas, interrogative requests are ones that ask for more information. For instance, a facilitator would call upon a specific Individual to share or contribute by making a request or giving an Imperative command (e.g., "Participant, tell me what you were thinking about.") This would contrast with the same action, Individual, but could have been asked in the form of an Interrogative question: "Participant, what mathematical theorem led you to that conclusion?" We treated instances such as these as both falling under the action of asking a specific Individual to contribute, but the means the facilitator went about that were different. This was the case for the Gathering and Verifying codes so for all of those codes they received the subcode of either Imperative or Interrogative.

Some coded examples of this are:

Facilitator - Imperative: "So, keep going with that [line of thought] Participant."
Facilitator - Interrogative: "So, I, we are talking about … the Sudoku property and each symmetry appears at most once and each symmetry appears at least once. Is the hint here, so what are students going to approach and how are they gonna approach this question?"

Conclusion

Through our iterative coding process, we developed a framework that captures the actions facilitators take in overseeing online professional developments. These categories including Supporting the group, Progressing the session, Contributing to the discussion, Gathering information, and Verifying information. Part of our framework, within the Gathering and Verifying categories, also notes the different ways in which facilitators can gather or verify information. Namely, we differentiated between imperative requests (e.g., "participant, tell me what you think about that") and interrogative ones (e.g., "participant, do you agree with the other participant's claim?"). Our future work will consist of in-depth case studies of each facilitator to enhance this understanding. Importantly, as noted, the framework we developed shares many similarities to that of van Es and colleagues (2014). The implications from this are important. Characteristics and actions of facilitators are key to understanding how facilitation occurs and how facilitation techniques can be trained and learned, while the content may be salient.

Acknowledgments

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