ANALYZING HOW REFLECTIVE DISCUSSIONS IN A CONTENT COURSE INFLUENCE PROSPECTIVE TEACHERS' BELIEFS

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An important challenge in math teacher education is helping prospective teachers (PTs) develop mathematical beliefs that support effective mathematics teaching. A growing body of research has established the potential efficacy of strategies that incorporate reflection with collaborative mathematical problem-solving. However, previous studies tended to collect data only at an individual level and analyze change at an aggregate, whole-class level. This brief research report uses frame analysis of individual, written reflections and small-group and whole-class reflection conversations to provide insight into the reciprocal relationships between individual PT beliefs, small-group interactions, and the whole-class classroom culture in a math content course designed to support PTs in developing productive beliefs about mathematics.

Keywords: Teacher Beliefs, Teacher Education – Preservice, Classroom Discourse

Teachers' beliefs about mathematics teaching and learning can influence their instruction and either support or undermine student opportunities to learn (Conference Board of Mathematical Sciences, 2012; Wilhelm et al., 2017). As a result, mathematics teacher education programs have a long history of trying to develop more productive mathematical beliefs in prospective teachers (PTs) before they begin teaching (Schram et al., 1988). This work remains an ongoing challenge, however, because PT beliefs about mathematics are multi-faceted and based on years of emotionally-charged experiences (Ambrose, 2004; Holm, 2019) and are therefore often resistant to change (Grootenboer, 2008). Shilling-Traina and Stylianides (2013) suggested, therefore, that "it is important that beliefs be explicitly addressed not only in methods courses, but in mathematics courses as well" (p. 404). This report focuses on a content course that was designed to initiate the process of supporting PT belief change with an emphasis on collaborative, small-group problem solving—small groups were consistently identified as important aspects of successful belief interventions (Shilling-Traina & Stylianides, 2013; Szydlik et al., 2003). Based on open-ended reflections, PTs identified groupwork as central to their learning in the course, so it seems likely that group interactions influenced their experience of the class and therefore its effects on their beliefs. This report uses frame analysis to begin to explore the relationships between PTs' small-group interactions and their understanding of mathematics learning in a course designed to influence their beliefs about mathematics.

Literature

Many PTs enter their teaching programs with beliefs that are likely to hinder effective mathematics instruction (Grootenboer, 2008). They tend to hold procedural views of mathematics (Shilling-Traina & Stylianides, 2013) and to be skeptical of the possibility of solving novel problems (Szydlik et al., 2003), though there is significant variation within the PT population, and many PTs hold a mix of beliefs that may align with both more traditional and reform instruction (Ambrose, 2002). Ambrose (2004) identified a number of criteria that could potentially stimulate belief changes in PTs, including emotionally-resonant experiences, chances to reflect on their beliefs and experiences, and participating in a community that embraces such beliefs. Similarly, Szydlik and colleagues (2003) were able to support PT belief change by creating a classroom community that facilitated active problem solving and PT autonomy. The course that is the subject of this brief report followed similar design criteria.

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One challenge in researching change in PT beliefs, however, is that beliefs can be difficult to measure directly. Survey items may be misinterpreted by PTs (Szydlik et al., 2003), and when students are asked directly about their beliefs they may say what they think their instructor wants to hear without truly examining their beliefs or modifying their work with students (Grootenboer, 2008). Surveys and interviews also tend to focus analysis at the level of the individual and fail to address the importance of reciprocal relationships between classroom culture, individual beliefs, and group interactions in the classroom (Cobb, 2000). This brief research report uses frame analysis to begin to examine beliefs at the individual, small-group, and whole-class levels. Frames are the underlying, often implicit, structures of expectations that organize how people understand and react to events, and frame analysis investigates how groups come to a common understanding of a frame or frames that invite a particular type of action or change (Benford & Snow, 2000). Frame analysis can be particularly appropriate for attending to the roles that power and authority play in frame negotiations (Hand et al., 2012), which in the context of collaborative mathematics work often manifests as differences in status—perceived competence, levels of participation, and influence—between group members (Nasir et al., 2014). Frame analysis has been used to explore how particular frames became prevalent in a school community initiating instructional change (Coburn, 2006) and to examine collective belief change about mathematics learning in a collaborative group of teachers (Bannister, 2015). The analysis in this report will focus on identifying frame resonance (Benford & Snow, 2000; Coburn, 2006), which occurs when a frame that one individual offers is taken up and reinforced by others in a group. In particular, this report will investigate the following research question: What relationships can be seen between the frames that resonate in small-group and whole-class reflection conversations, and the frames that PTs use in their individual reflection responses across multiple time periods?

Methods

Context and Participants

The data analyzed in this paper were collected as part of a larger project analyzing PT beliefs about mathematical ability and learning—what Boaler (2016) labeled mathematical mindsets—in a required math content course for PTs in a large, urban, public university in the United States. Aligning with current recommendations to use active learning in content courses for PTs (Litster et al., 2020), the course used "group-worthy problems" to support students in developing their mathematical knowledge and productive beliefs about mathematics and mathematical learning (Nasir et al., 2014). The participants in the current study were drawn from two concurrently offered sections of the course—referred to as Class A and Class B. The author of this report was the instructor of Class B and planned collaboratively with the other instructor so that students in both sections had the same assignments and assessments. There were 65 PTs enrolled between the two sections, and 57 consented to have their classwork analyzed for research purposes.

Data Sources and Analyses

The data used in the current analyses were drawn from reflections that PTs completed in class during weeks 6, 12, and 15 of a semester course—T1, T2, and T3 respectively. The dates aligned with the two midterm exams and the last class session before the final exam for the course. The reflection prompts asked PTs to do the following:

1. Describe a significant or "Aha!" moment from class and explain why it was significant
2. Reflect on their work/participation in the class so far
3. Make or update a goal for themselves
4. Create a plan to move towards their goal
5. Reflect on how their learning in this class might apply to future teaching (only in T3)

PTs responded to the prompts individually and then discussed their memorable moments and goals in small groups. One PT from each group shared their response as part of a whole-class discussion. The small-group and whole-class discussions were audio-recorded. The written, individual reflections were entered into NVivo 12 and group reflections were imported into InqScribe. Individual and whole-class data were analyzed for all consenting participants from both sections, but the small-group analyses focus on the 29 participating students from Class B because a larger proportion of PTs in that class consented to the analysis of their audio data and because their groups for the group reflections were more consistent across timepoints.

The individual reflections were coded for whether they framed important mathematical learning as active, interactive, passive, or unclear. Responses were coded as using an "active" learning frame if the PT described learning through individual problem solving—either in a significant past experience or as part of their goal moving forward. Responses were coded as using a "passive" learning frame if they described learning from listening to an explanation, practicing rote memorization, or taking or reviewing notes. They were coded as using an "interactive" learning frame if the PT framed interaction with others as central to learning, describing a combination of listening, questioning, and problem solving or describing the actions of the group as a whole rather than their actions as an individual. Finally, responses were coded as "unclear" if there was not enough information to tell how the PT was framing learning. Each PT's response included multiple frames, so a given PT could be coded as using multiple types of frames in a given response. Responses were also coded to identify the most common categories of learning goal, which included some goals that were implicitly aligned with active, passive, or interactive frames for mathematical learning. For example, goals focused on participation in class tended to align with an active frame for learning, while goals focused on asking questions or going to office hours tended to imply a passive frame that assumed that the best solution to a challenge is for someone to provide an explanation. (In practice, interactions during office hours were supportive of active learning, but most of the PTs who made office hours attendance their goal did not actually attend them.) The audio-recorded small group reflections were analyzed to identify examples of frame resonance—interactions in which one PT presented a particular frame and other PTs or an instructor endorsed and reaffirmed the frame. These examples of resonant frames were then compared to the data from the individual reflections to look for patterns.

Findings and Implications

Preliminary analyses of these data found that the two classes and the small groups in Class B showed different frequencies and trajectories of particular frames in the individual responses, and many of those differences aligned with examples of frame resonance from the small-group and whole-class discussions from the preceding time periods, especially when those frames were endorsed by high-status individuals. For example, while both classes showed similar distributions of active frames over time, Class A showed a gradual increase in interactive frames, while Class B showed a gradual decrease. Class B's decrease could be traced to some groups having a particularly high frequency in T1 (100% of PTs in Group 3 used an interactive frame in T1) and to other groups (Groups 5 and 6) showing a marked decrease in interactive frames combined with an increase in passive frames. An initial review of those groups' discussions shows that a binary frame of correct versus incorrect strategies resonated particularly strongly in Groups 5 and 6—in contradiction with the course's goal of framing diversity of strategies as desirable, which appeared to resonate with the majority of PTs in both classes.

Another difference between classes was that Class A showed an increase in identifying participation as a focal goal, while in Class B that goal decreased to become almost nonexistent. The contrast may be related to the fact that in Class B's whole-class discussion one of the PTs shared participation as their goal and received minimal acknowledgement from the instructor (the author of this report), in contrast with more enthusiastic responses to other shared goals. While the lack of reinforcement was not intended as a value judgement, the instructor's position of authority within the classroom may have given it unanticipated weight. Frame resonance may have also played a counter-balancing role at the group level: in the two groups in which some PTs did create participation goals in T2 and T3 the conversations in T1 showed strong resonance for that goal. For example, in Group 3 two PTs shared that their goal was to participate more. A high-status PT affirmed the goal as "smart to do" and credited her own understanding of class material as "because I've participated and, like, gone up to the board." She then suggested that her groupmates share in the whole-group discussion to act on their goal.

Finally, both Class A and Class B had relatively low frequencies of goals that focused on grades and passing the class, and Class B's frequency decreased over time, but Group 2's frequency started at roughly twice the class average and stayed roughly constant over time. There are multiple examples in Group 2's discussions that show how strongly a focus on grades resonated with the group members, especially with the PT who seemed to have the highest social and mathematical status within the group. In the group's T1 conversation they encouraged one another to aim for As and Bs rather than just passing the class, which illustrated how the goal became associated with the supportive social relationships within the group. Their T3 conversation also highlighted the ways that larger school frames about the evaluative function of finals week and exams could overshadow the frames and experiences that our course tried to cultivate. In the words of the high-status PT: "So far I'm doing pretty well, but, you know, after this [final] that's probably not the case anymore…It's always the final that's going to break you down, so I'm going to let that go ahead and just be it. So, we're going to pray."

While these analyses are only preliminary, there are some potential implications. The examples all reinforce how important it is for instructors to pay attention to the implications of status during small-group and whole-class discussions, even when the topic is self-reflection rather than mathematical problem-solving (Cobb, 2000; Nasir et al., 2014). Group 2's T3 conversation illustrates why it is so important that PTs are exposed to multiple courses and experiences that support positive belief change over time rather than a single course. It also serves as a reminder that the pressure and structure of finals may make it so that studies that only take measures at the end of courses may underestimate the changes that PTs experience during the courses. Future studies could examine whether this regression is localized to the time around exams or persists after them. Researchers could also examine how the frames around goals and active/autonomous learning that are the focus of this study relate to other PT beliefs about mathematical ability (Boaler, 2016) and math instruction (Ambrose, 2004).

References

Ambrose, R. (2002). They all hate math: Getting beyond our stereotypes of prospective teachers. In Annual Meeting of the American Educational Research Association, New Orleans, LA.

Ambrose, R. (2004). Initiating change in prospective elementary school teachers' orientations to mathematics teaching by building on beliefs. *Journal of Mathematics Teacher Education*, 7(2), 91-119.

Bannister, N. A. (2015). Reframing practice: Teacher learning through interactions in a collaborative group. *Journal of the Learning Sciences,* 24(3), 347–372. https://doi.org/10.1080/10508406.2014.999196

Benford, R. D., & Snow, D. A. (2000). Framing processes and social movements: An overview and assessment. *Annual Review of Sociology*, 26, 611–639. Retrieved from http://www.jstor.org/stable/223459

Boaler, J. (2016). *Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages and Innovative Teaching*. John Wiley & Sons.

Cobb, P. (2000). The importance of a situated view of learning to the design of research and instruction. In J. Boaler, (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 45-82). Westport, CT: Ablex.

Coburn, C. E. (2006). Framing the problem of reading instruction: Using frame analysis to undercover the microprocesses of policy information. *American Educational Research Journal*, 43(3), 343–379.

Conference Board of Mathematical Sciences. (2012).*The mathematical education of teachers II*. Providence, RI: American Mathematical Society and Mathematical Association of America. http://cbmsweb.org/MET2/index.htm

Grootenboer, P. (2008). Mathematical belief change in prospective primary teachers. *Journal of Mathematics Teacher Educatio*n, 11(6), 479-497.

Hand, V., Penuel, W. R., & Gutiérrez, K. D. (2012). (Re) framing educational possibility: Attending to power and equity in shaping access to and within learning opportunities. *Human Development*, 55(5-6), 250-268.

Holm, Jennifer. (2019) Supporting the development of future mathematics teachers: Mathematics as healing. In S. Otten, A. G. Candela, Z. de Araujo, C. Haines, & C. Munter. (2019). *Proceedings of the forty-first annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* [pp. 1203-1207]. St Louis, MO: University of Missouri.

Litster, K., MacDonald, B., & Shumway, J. F. (2020). Experiencing active mathematics learning: Meeting the expectations for teaching and learning in mathematics classrooms. *The Mathematics Enthusiast*, 17(2), 615-640.

Nasir, N.S., Cabana, C., Shreve, B., Woodbury, E.,& Louie, N. (2014*). Mathematics for equity: A framework for successful practice*. New York, NY: Teachers College Press; Reston, VA: National Council of Teahers of Mathematics.

Schram, P., Wilcox, S., Lanier, P., & Lappan, G. (1988). Changing mathematics conceptions of preservice teachers: A content and pedagogical intervention. Research Report No 88-4. East Lansing, MI: NCRTL, Michigan State University.

Shilling-Traina, L., & Stylianides, G. (2013). Impacting prospective teachers' beliefs about mathematics. *ZDM Mathematics Education*, 45, 393–407.

Szydlik, J. E., Szydlik, S. D., & Benson, S. R. (2003). Exploring changes in pre-service elementary teachers' mathematical beliefs. *Journal of Mathematics Teacher Education*, 6(3), 253-279.

Wilhelm, A. G., Munter, C., & Jackson, K. (2017). Examining relations between teachers' explanations of sources of students' difficulty in mathematics and students' opportunities to learn. *The Elementary School Journal*, 117(3), 345-370.