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Prospective elementary teachers' motivation to participate in whole-class discussions during mathematics content courses for teachers

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Abstract Prospective elementary teachers' (N=148) motivation to participate in whole-class discussions during mathematics content courses for teachers, as expressed in their own words on an open-ended questionnaire, were studied. Results indicated that prospective teachers were motivated by positive utility values for participating (to achieve a short-term goal of learning mathematics or a long-term goal of becoming a teacher), to demonstrate competence (to achieve performance-approach goals), or to help others (to achieve social goals). Negative utility values for participating were expressed by those who preferred to learn through actively listening. Five motivational profiles, as composed of interactions among motivational values, beliefs, goals and self-reported participation practices, were prevalent in this sample. Self-reported variations among participants' utility values and participation practices suggested that prospective teachers engaged differentially in opportunities to learn to communicate mathematically. Results provide pedagogical learner knowledge for mathematics teacher educators.

Keywords Mathematics · Motivation · Preservice teachers · Prospective teachers · Performance goals · Social goals · Self-efficacy · Task value · Whole-class discussion · Discourse

1 Introduction

The purpose of this article is to describe what motivates prospective elementary teachers to participate in whole-class discussions during mathematics content courses for teachers, as expressed through their own words. Participation is an important classroom activity to study because participating aloud during discussions can serve as a learning strategy to develop sense making of subject matter (Dillon 1994), such as the mathematics that

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prospective teachers will teach their future students. Also, participating in discussions during mathemetics content courses for teachers affords opportunities for prospective teachers to learn to communicate mathematically. Studying motivation from learners' perspectives can support mathematics teacher educators' development of pedagogical learner knowledge or knowledge of learners (Grimmett & MacKinnon 1992).

One reason to focus on prospective teachers' motivation to participate in discussions is that their involvement in classroom discourse provides opportunities to develop their conceptual understanding of mathematics knowledge for teaching. Classroom discourse practices have potential to provide structures for knowledge acquisition processes that support conceptual understanding of mathematics. Such practices include opportunities to explain using mathematical arguments rather than procedural descriptions, to make connections among multiple solution strategies, to engage with errors to reconceptualize problems and pursue alternative strategies, and balance between individual accountability and consensus seeking through mathematical argumentation during collaborative work (Kazemi & Stipek 2001). Resnick, Salmon, Zeitz, Wathen, and Holowchak (1993) extended the work of Vygotsky (1978) and suggested that discussions were opportunities to try out verbally what could eventually be internalized as private reasoning and knowledge representations.

Participating in classroom discussions also provides prospective teachers with opportunities to learn to communicate mathematically. In contrast to conceptualizing learning as acquiring knowledge, Sfard (1998, 2001) argues for an additional conceptualization of learning: learning to participate. Learning as participation emphasizes the development of the identity of the learner toward becoming a full participant in a community of practice. When classroom discussions in mathematics content courses for teachers are structured with opportunities to communicate about the meanings of mathematical procedures and connections among strategies, prospective teachers have not only an opportunity to acquire mathematical understanding but also to learn to communicate mathematically. Prospective teachers would benefit from developing strong mathematical communication skills in preparation for working with their future students.

1.1 Motivation

Following Hulleman, Durik, Schweigert, and Harackiewicz (2008), I define motivation to be a motive (e.g., a wish, intention, or drive) to engage in a specific activity. Motivation can be achieved through interactions of multiple values, beliefs, and goals. To investigate prospective teachers' motivation, I integrated three perspectives on motivation: (a) expectancy-value perspective (Eccles & Wigfield 2002), (b) achievement goal perspective (Ames 1992; Dweck 1986), and (c) a content perspective (Wentzel 2000). I use these perspectives at a task-specific level to understand prospective teachers' motivation to participate aloud during whole-class discussions rather than studying their motivation to learn mathematics generally. I consider participation to be a classroom activity that arises out of an interaction between students and their learning environment (Turner & Patrick 2004). Examining learners' motivation to participate allows for understanding one side of this interaction: how students' motivation can mediate their participation in discussions.

1.1.1 Expectancy-value perspective

Motivation to engage in particular behaviors can be explained through expectancy-value models (Eccles & Wigfield 2002). Expectancies include efficacy beliefs, which are beliefs about one's capabilities that address the question, "Can I do this?" Task values are an

individual's personal attributions of the importance, utility, or their degree of interest in an activity. Goals reflect students' values in action.

Self-efficacy is a student's belief about whether she or he can control or regulate her or his own learning and master academic tasks (Bandura 1993, 1997). Students with a strong sense of self-efficacy with respect to a particular domain or task may be more likely to attribute their success to their own efforts, and they may be more likely to put effort into activities in which they believe they can succeed (Pajares 1996). Efficacy beliefs have been found to influence goal setting, activity choice, willingness to expend effort, and persistence (Bandura 1997).

The value that an individual ascribes to a task is one indicator of her interest in the task. Eccles, Adler, Futterman, Goff, Kaczala, Meece, and Midgley (1983) described four task values: attainment value, intrinsic value, utility value, and cost. Attainment value refers to the relative importance an individual assigns to being successful at the task. Intrinsic value refers to personal enjoyment derived from the task. Utility value refers to whether the task helps the individual achieve short- or long-term goals. Cost refers to negative consequences resulting from engaging in the task. Bong (2001) found that task values have more variation across domains than other motivational constructs, which suggests that it is important to examine the role of task values as situated in a variety of subject matter and contexts.

1.1.2 Achievement goal perspective

When examining motivation, researchers frequently assess the following achievement goals: (a) performance goals, which include seeking positive evaluations of one's competence and avoiding negative evaluations of one's competence, and (b) mastery goals, which focus on mastering tasks and increasing one's understanding of content. These achievement goals have fallen under a variety of labels, including ego-involved and task-involved goals (Nicholls, Cobb, Wood, Yackel, & Patashinck 1990), performance and learning goals (Dweck 1986), and performance and mastery goals (Ames 1992). For this study, I adopted Ames's terms to describe these goals. Performance goals also have an approach and avoidance dimension. Students who hold performance-approach goals want to attain competence relative to others, and students who hold performance-avoidance goals try to avoid looking incompetent relative to others (Elliott & Dweck 1988).

In a study of undergraduates, a mastery orientation was positively related to self-efficacy, performance, and knowledge, whereas performance orientation was negatively related to performance and not self-efficacy (Bell & Kozlowski 2002). In general, higher performance goals, particularly performance avoidance goals, appear to be related to lower self efficacy among adolescents (e.g., Meyer, Turner, & Spencer 1997; Turner, Thorpe, & Meyer 1998), but results with undergraduates have not provided consistent results supporting this finding.

1.1.3 Content perspective on goals

A content perspective on goals addresses cognitive representations of what an individual is trying to achieve in a given situation (Wentzel 2000). From a goal-content perspective, relations between goals can be complementary, such that social goals *and* achievement goals can contribute to learning (Urdan & Maehr 1995; Wentzel 2000). One reason social goals are important to assess when studying motivation is that those who are concerned with self-worth in the academic domain are often simultaneously concerned with self-worth in the social domain. For example, students with mastery goals have been found to express little concern for social status, while those with performance goals evaluated cooperation for its impact on their social status (Levy, Kaplan, & Patrick 2004).

Warm relationships in the classroom have been shown to impact college students' involvement in discussions. A strong desire to maintain warm relationships predicted an avoidance of participating in argumentation among college students (mostly prospective teachers), as did low levels of assertiveness (Nussbaum & Benedixen 2003). In a study of factors that encourage and discourage participation in classroom discourse among college women, Salter and Persaud (2003) found that thinking-oriented students did not have a preference for a particular classroom structure, while feeling-oriented students preferred a classroom structured toward feeling.

1.2 Prospective teachers' motivation

Prior research on prospective elementary mathematics teachers' motivation in mathematics content courses for teachers has been conducted. A classroom discourse structure in mathematics content courses for teachers that included a pattern of scaffolding, pressing for understanding, and higher-order thinking was associated with prospective elementary teachers' perceptions of mastery goals (Morrone, Harkness, D'Ambrosio, & Caulfield 2004). Additionally, when prospective teachers experienced support from instructors when struggling to solve mathematics problems in the context of mathematics courses for teaching, their mathematics self-efficacy increased due to moving away from a belief that their ability to do mathematics (that they perceived to be weak) was fixed toward a belief that their effort mattered (Harkness, D'Ambrosio, & Morrone 2007).

With respect to task values and participation in discussion, Askell-Williams and Lawson (2005) found that middle school students and prospective teachers believed that discussion helped them learn, yet participants had a limited view of the purpose of discussions. The authors suggested the importance of teaching explicitly about the pedagogical purpose of engaging in discourse in conjunction with teaching subject matter content to prospective teachers.

More data are needed to understand what motivates undergraduate prospective teachers to participate in the context of discussions in mathematics content courses for teachers. If mathematics teacher educators are aware of their students' perspectives on their roles in class, they can build upon these perspectives to support prospective teachers' learning of mathematics concepts and skills for communicating mathematically.

2 Methods

This study was designed to address the following questions: What are prospective elementary teachers' self-reported motivations for participating in whole-class discussions during their mathematics content course for teachers? Which motivational values, beliefs, and goals interact in relation to prospective teachers' self-reported participation?

2.1 Context

All of the participants in this study were enrolled in the second of a series of three mathematics courses for teachers at a state university in the Mid-Atlantic region of the USA. The content covered in this course included rational number concepts, rational number operations, and proportional reasoning. These mathematics courses for teachers were designed to help prospective elementary teachers develop deeper conceptual understanding of mathematical ideas and meanings behind the mathematics procedures

that they will teach when they become elementary school teachers. Also, the courses were designed to help prospective teachers understand a wide range of strategies for solving problems based on these mathematics ideas so that they will be able to be proficient at understanding their future students' thinking. Enrollment for each section of these courses was capped at 35 students. Data were collected in this second of three mathematics courses for teaching to reduce a novelty effect. By the time they experienced the second course, they would be more familiar with the expectation of participating in whole-class discussions to develop their mathematical reasoning and understandings.

The structure of a typical class period for this course and all three courses in this series provided prospective teachers with opportunities to participate during whole-class discussions. During class, prospective teachers worked in groups on problem-solving tasks, including interpreting students' work or solving problems, and their instructor engaged them in whole-class discussions around these tasks. During these discussions, prospective teachers' mathematical explanations were discussed as a class, which provided opportunities to learn about communicating as well as about developing understanding for meanings of mathematical procedures and conceptual understanding. Additionally, whole-class discussions occurred when prospective teachers were asked to present their solutions to homework problems.

2.2 Participants

One hundred forty-eight prospective elementary school teachers completed the questionnaire administered for the purpose of this study (a 93% response rate). Participants were recruited from all sections of the second of three mathematics courses for teachers. Of the participants identified, 92.6% were female, and 7.4% were male. Of the participants, 92.6% identified as White, 2.7% as African-American, 2.7% as Latino/a, and 2% as Asian or Pacific Islander. This course was taken in the spring semester of their freshman year of college for most of the participants; 48% of the participants were 19 years old, 32.4% were 18 years old, 12.8% were 20 years old, and 0.7% were either 22 or 17 years old.

2.3 Data collection

It is important to study motivation through the use of multiple methods, including open-ended qualitative approaches (Urdan 2004), since closed-choice surveys may not fully capture learners' experiences. Participants responded to a questionnaire in which they were asked to reflect upon their experiences in their course in general and upon participating in mathematics classroom discussions in particular. Some items addressed participation in discussions because of the parallels with some of the activities of a teacher; teachers talk publicly about mathematics with their students.

The questionnaire items were clarified for word choice and readability through a pilot phase in which prospective teachers in another mathematics education course completed the questionnaire and were interviewed about their experiences completing the questionnaire. The questionnaire was administered during the 12th week of a 15-week-long semester.

Responses to the three questionnaire items that directly related to participation during classroom discussions were analyzed for this study:

- During mathematics class, to what extent are you likely to participate (share your thinking out loud during large group discussions)? (a) very likely, (b) somewhat likely, (c) neither likely nor unlikely, (d) somewhat unlikely, (e) very unlikely. Explain your response.

- Do you think of participating during mathematics class (sharing your thinking out loud during large group discussions) as: (a) very intimidating, (b) somewhat intimidating, (c) neither intimidating nor inviting, (d) somewhat inviting, (e) very inviting. Explain your response.
- How important is it for you to participate during mathematics class? (a) very important, (b) somewhat important, (c) neither important nor unimportant, (d) somewhat unimportant, (e) very unimportant. Explain your response.

These items focused on prospective teachers' reported frequency of participation, the degree of negative affect they experienced when participating, and how much they valued participating in whole-class discussions in the context of this course.

2.4 Data analysis

Codes were developed through a constant-comparative process (Glaser & Straus 1967). For the first pass of analysis, two coders, the author and a doctoral student in mathematics education, both of whom had experience teaching this course, read through a subset of the participants' responses and generated a list of potential themes for coding. Then, these coders revisited the data and developed definitions for these codes that indicated what counted as evidence for that code and what did not count as evidence for that code. Codes were consolidated if they were determined to be too similar to another code, and codes were eliminated if they were not found in the data for more than five out of the 148 participants. Appendices A and B in Supplementary Material (online) present codes for the eight most commonly expressed motivations that supported or inhibited prospective teachers' participation in mathematics classroom discussions. Percentages in these tables indicate the number of participants (out of 148) who mentioned these values, goals, and beliefs in their questionnaire responses.

For reliability, responses from each participant's questionnaire were independently coded by the same two coders, and consensus was reached between the two coders for all disagreements. Coding categories were nominal; that is, they were coded as either present or absent in the prospective teachers' responses. The unit of analysis was at the level of the response provided by the participant to one of the open-ended items. An entire response to an item provided context for interpreting the students' motivational values, beliefs, or goals. This set of sentences usually received more than one code. Participation practices mentioned by prospective teachers were coded as well.

Additional analyses were conducted to determine whether it was likely that individual participants would mention clusters of codes together. Once frequencies were calculated for the presence of each code in the data set, 2×2 chi-square analyses were conducted to determine whether there were relationships among any of the motivation codes. Significant positive relationships indicated that prospective teachers who reported one code were likely to report the other. These relationships are presented in Appendix C (Supplementary Material online). Additionally, loglinear analyses were conducted to determine whether there were any three-way relationships in the data set; none of the results from these analyses were significant.

3 Results

Prospective teachers' responses to the three forced-choice questions were as follows: 54.8% reported that they were either very likely or somewhat likely to participate aloud during whole-class discussions during their mathematics class; 40.6% responded that participating

aloud was either very or somewhat intimidating; 58.8% indicated that participating aloud was either very or somewhat important to them.

Prospective teachers' open-ended responses, in which they elaborated upon their forced-choice responses, revealed five motivational profiles in relation to participating in whole-class discussions during mathematics content courses for teachers. An overview of these motivational profiles, which consist of their motivational values, beliefs, and goals, as well as participation practices most frequently mentioned, is presented in Table 1.

The profiles were constructed by starting with the four most prevalent themes in the data: three motivations to participate (positive utility value, demonstrate competence, and help others) and one motivation not to participate aloud during whole-class discussions (negative utility value). Chi-square analyses revealed whether prospective teachers were likely to mention any other motivation to participate (or not to participate) concurrently with any of these four motivations. Additionally, there were variations in characterizations of their participation practices among participants with each motivational profile. Below, I describe the motivational profiles in more detail.

3.1 Positive utility value: participate to learn mathematics and to prepare for career

The most common motivation for participating that these prospective teachers reported (62.2% of the participants) was a positive utility value. An examination of the questionnaire responses from the prospective teachers who had a positive utility value for participating revealed insights about connections they perceived between learning mathematics and participating aloud during whole-class discussion. Those with positive utility values expressed the goals they were able to achieve through participating (a short-term goal of learning mathematics and, to a lesser degree,

Table 1 Prospective teachers' motivational profiles

Motivational profile	Motivational values, beliefs, and goals	Participation practices
Participate to learn mathematics and prepare for teaching career	Positive utility value	Seek feedback on strategies or ideas from teacher or peers
	Perceived teacher support for participating	Ask questions
	Career goal	Explain to others
Prefer to observe or work alone rather than participate aloud	Negative utility value	Observe classmates' or teacher's correct strategies or answers
	Shyness	Solve problems alone
Participate to seek help when struggling to learn	Combination of positive *and* negative utility values	Ask questions Observe peers' strategies
Save face when participating	Performance-approach goal Performance-avoidance goal Low mathematics self-efficacy	Provide answers
Participate to help others learn	Help others (social goal)	Provide solution strategies and share reasoning
	High mathematics self-efficacy	Provide answers

a long-term goal of becoming a teacher), which participation practices they enacted, and the role of their instructors in creating opportunities to participate.

3.1.1 Participating supports learning of mathematics through interaction

All of the participants who had a positive utility value for participating indicated that participating in whole-class discussions was useful because it helped them learn mathematics. One way that participating helped them learn was because they received feedback on their thinking. One of the prospective teachers wrote,

> In general, I participate because I've discovered that it helps me learn better. Once I understand a concept, I attempt to participate in hopes that I do in fact understand it. And if I don't, I can see why, because I learn better by seeing my work or idea being taken apart and discussed.

She reported that participating helped her achieve a greater understanding of a mathematical concept. She described a participation practice such that her thinking became an object of discussion and her thinking was "taken apart," which she found helpful for her learning.

Some of these prospective teachers sought feedback on their thinking primarily from the instructor, while others also sought feedback from their classmates. One of the prospective teachers wrote, "For myself, participating may help me gain a better understanding of what I already know by sharing my view with the class and letting them elaborate on it." This participant described learning of mathematics as gaining an increasingly elaborated understanding, and she sought support for learning from members of the class by "sharing [her] view." In contrast, other prospective teachers with a positive utility value for participating said that they looked for their instructor's feedback.

> I like to share so that the teacher can tell me if my own thought process is correct. I think it's easy to share my ideas. The biggest reason being, if I'm wrong, I get corrected and I know how to do it right the next time. I feel the need to participate because I like to know that I am correct in my thinking.

She explicitly mentioned feedback from the teacher rather than from the class. Most of the prospective teachers who participated to seek feedback said that they wanted that feedback from the entire class, but some of them specifically wanted the instructor's feedback, and this feedback addressed either how they talked about mathematical ideas or worked out mathematical procedures.

Prospective teachers also reported that they learned mathematics by asking questions. A prospective teacher wrote, "I feel that asking questions is the only way for me to learn..." Having the opportunity to ask questions was important to another prospective teacher who wrote, "It is very important for me to participate, because I have a lot of questions and I usually don't completely understand. It is important to get my questions answered." These prospective teachers expressed a relationship between asking questions and learning mathematics.

Additionally, some prospective teachers found participating to be valuable because talking aloud served to confirm and solidify their thinking for (and to) themselves, such as the prospective teacher who wrote, "If I can explain myself to the teacher or the class, it means that I understand what is going on." Another said that participating helped her "retain the concept," while an additional participant wrote, "I really know that I understand it when I can successfully teach it to someone else." Also, a prospective teacher wrote, "If you participate, you are becoming more comfortable with the material." Opportunities to participate allowed the prospective teachers to affirm their own understanding for themselves.

3.1.2 Instructor's role in supporting participation

The prospective teachers with a positive utility value for participating also mentioned the role of their instructors in creating an environment that supports participation. They said that their instructors made their classes "very inviting to participate." One prospective teacher wrote, "The professor is very open and excited about hearing our ways of thinking," while another wrote, "The teacher takes time to understand your questions and answer them with care." These students wrote about different participation practices that were encouraged by instructors—sharing "ways of thinking" or asking questions. Another prospective teacher wrote, "My math class is run as a discussion. If someone has something to say, they will not be ignored or made fun of if they are wrong." They recognized that the amount of participation from students depended on the structure of the class and how their instructor related to their students.

3.1.3 Participating to prepare for future teaching career

A small subset of the prospective teachers (6%) reported that participating aloud during whole-class discussions about mathematics helped prepare them for their future careers as teachers, which indicated a positive utility value for participating to achieve a longer-term goal. For example, a prospective teacher wrote, "By participating, I can be better prepared to teach students." Another wrote, "Participating helps me learn how to put my methods into words, so when I have to teach, I will have an easier time explaining things to my class." Prospective teachers thought participating helped them become more effective teachers by engaging in mathematical communication and seeing firsthand how participating helped them understand mathematics. A prospective teacher wrote, "This understanding of the importance of participating will help me to teach my own class the benefits of participating so they receive a deeper, more meaningful understanding of the material." Participating aloud not only helped these prospective teachers achieve a goal of learning mathematics in the short term but supported their longer-term goal of learning to communicate mathematically and learning about mathematical communication for becoming a mathematics teacher.

For these prospective teachers, participating in discussions supported their short-term goal of learning of mathematics, and to a lesser degree, their longer-term goal of becoming a mathematics teacher. Their descriptions of *how* they participated indicated a range of participation approaches and different points of view on the role of the instructor as an authority in the learning process. They also expressed awareness of their instructors' efforts to foster participation.

3.2 Negative utility value: prefer to observe or work alone

In contrast to the prospective teachers who expressed positive utility values for participating, the next most frequent response in this sample (from 49.3% of participants) was a negative utility value for participating. These prospective teachers did not express that participation helped them achieve a goal of learning mathematics or becoming a future teacher. Also, these participants were likely to report having a shy personality.

3.2.1 Learn through observing others' solutions

Prospective teachers with a negative utility value for participating preferred to learn through listening or observing classroom activity. One prospective teacher wrote,

> I find that I learn the material well when I am able to just sit back and watch the problems be worked out before me. This way, I see many different approaches, and I am able to choose the one that works best for me. I do not find that my lack of participation hurts me. I learn the material by watching and listening to others and by working on my own.

She attended to others' solutions to problems, suggesting that learning mathematics involves understanding solution methods and being able to select among them. Another prospective teacher wrote, "By listening carefully to other students and the teacher's response, I am still able to receive the same information and understand the material." Attending to the discussion involved thinking about the knowledge (usually of solutions to problems) communicated by others.

Descriptions of attending to solutions and answers were prevalent among the responses from these prospective teachers with negative utility values for participating. One prospective teacher wrote, "I'll raise my hand if I know the answer, but it doesn't really help me understand the material that much more. As long as I know how to do the problems, I don't think it really matters if I participate or not." Another wrote, "Sometimes it's better and easier to learn by watching the teacher and others who know what they are doing so that you can get a sense of how to do the problems correctly and you can imitate." The goal of attending to the whole-class discussions for many of these prospective teachers appeared to be learning how to execute procedures or getting a correct answer. Participating aloud was not viewed by these prospective teachers as a way to explore ideas or work on mathematics informally with others, as exemplified by this response,

> I can usually figure things out by merely listening during a discussion or working independently on a problem to solve it. Participating for me only helps to push my point or the correct answer to the rest of the class.

Instead, participating aloud was viewed as an opportunity to share solutions or answers once they thought they were correct, observing was an opportunity to see correct solutions, and they preferred to listen to the contributions of others in the discussion. The object of knowledge they reported that they acquired was described usually as a solution strategy and the process for gaining that knowledge was either working on their own or observing solutions of others.

3.2.2 Shyness

Those with negative utility values for participating were likely to self-identify as shy. For example, one prospective teacher wrote,

> I am very shy in class and do not like to participate. It has nothing to do with this particular class. I am like this everywhere. I always pay attention. I just don't like to speak out loud in front of everyone. I just have a fear of speaking in front of a group of people.

These prospective teachers did not want to talk aloud in class, as exemplified by this response, "I've always been quiet in all of my classes. I'm not comfortable talking in front of a class. It's not the math class itself that's intimidating." Other prospective teachers wrote, "Public speaking of any sort is a challenge for me," and "I have always been shy in class." These prospective teachers did not mention their future careers as teachers as providing a reason to attempt to talk about mathematics publicly but instead mentioned their shyness as an explanation for why they did not participate aloud.

3.3 Combination of utility values: participate to seek help when struggling to learn

Of the prospective teachers in this sample, 22.4% reported evidence of both positive and negative utility values for participating. When they talked about their own participation practices and those that they observed, learning was described as an interactive process among members of the class, and there was value placed upon both participating and listening.

> Thinking out loud helps me figure out what I am having a problem learning. I also think it is important to hear people other than the teacher explain things. Hearing how others figure things out helps me learn.

This prospective teacher wanted to hear from classmates, so authority for understanding mathematics was distributed among members of the class in her view. Also, she made sense of her own thinking by participating aloud.

Some prospective teachers participated aloud only when they did not understand or when they had questions, as exemplified by this response, "It's [participating] important to me if I have questions on the subject being taught. If I understand what's being taught, I have no interest in participating during math class." These prospective teachers talked about participation as one way to learn, among others.

> I feel it's important to participate in math class because then I can get my questions answered and can understand the material better. However, many other students in my class tend to have the same questions that I do, and if I listen to other students' questions and ideas, I tend to learn the material better than just listening to the teacher explain concepts back to me.

Those who expressed positive and negative utility values usually mentioned the importance of hearing the thinking of peers, not only the teacher. They also usually described their participation as asking questions in contrast to practices such as presenting solutions or answers.

3.4 Save face when participating

Another frequently reported motivation to participate (among 39.9% of the sample) was for the purpose of demonstrating their competence in mathematics to others or to achieve performance-approach goals. Prospective teachers who participated for this reason were likely to report having lower self-efficacy in mathematics and wanting to avoid participating when they were incorrect, concurrently holding performance-avoidance goals. A response that was typical of these prospective teachers was as follows:

> I only like to participate in math class if I am confident that I am correct. It is embarrassing to me to be wrong and have the teacher correct me in front of the entire class. If I am confident of my answers, then I am very likely to participate. If I am not confident of my answers, then I am unlikely to participate. I am not confident about my answers a majority of the time.

Those who expressed this sense of self-protection also described their participation practices as sharing answers rather than interacting about solutions or ideas or asking questions.

> On occasion, if I'm really confident in my response, I'll share my answer, but I'm usually reluctant... I don't usually feel that I'm 100% clear on what's going on, and if

> I'm not sure, I don't really feel inclined to share my answers that are quite possibly wrong.

Prospective teachers who did not consider themselves to be good at mathematics wanted to save face by participating when they were certain about their thinking and avoided participating when they might have been incorrect.

3.5 Participate to help others learn

Of the prospective teachers in this sample, 24.3% reported wanting to participate to help their classmates. Those who participated to help others were likely to report having high self-efficacy in mathematics as well. For example, one prospective teacher wrote,

> I'm somewhat likely to participate in math class because I feel confident with my answers and responses. Also, I think that if I participate maybe it will help other students understand it better.

These prospective teachers spoke about their participation practices as opportunities to display their knowledge (answers or reasoning) to help their classmates.

> Often I find myself speaking up a lot, because I usually know the answer and am able to explain my thinking and reasoning clearly so that others can understand it... Personally, I enjoy participating when I know it will help someone else better grasp the idea.

It may not be completely surprising that some prospective teachers would be willing to participate to help others, as they may be attracted to the teaching profession partially out of a desire to be helpful. However, when prospective teachers talked about wanting to help others learn, this social goal was usually connected with their self-efficacy such that they also expressed confidence about their own mathematical knowledge. These participants said that they helped others after they understood, in contrast to describing a process of constructing an understanding together with others.

4 Discussion

The primary contribution of this study is the description of the complex interactions between prospective teachers' motivational values, beliefs, and goals in relation to their reported participation practices, presented as motivational profiles. Prospective teachers' motivational profiles indicated variations among participants in their views of their roles during whole-class discussions and their thinking about the purposes of classroom discussions. Understanding how prospective teachers view their roles during discussions and how they view the purposes of whole-class discussions can provide teacher educators, including instructors of mathematics content courses for teachers, with insights to support prospective teachers' learning of mathematics as students and for their future careers as teachers.

4.1 Learning mathematics during discussions: the role of listening to others

A prevalent theme in these data was that some prospective teachers said that participating aloud supported their learning of mathematics, and others did not think participating was

essential for their learning. During whole-class discussions, many participants are listening, while some are explaining and interacting; not everyone can talk aloud during every discussion, and learning can occur when attending and listening during classroom discussions. Indeed, listening to others can be an active learning process in that students can induce their own acquisition of mathematics concepts by actively selecting information that allows them to fill in gaps in their own understanding to make sense of mathematics (Nunokawa & Ohzeki 2004). By not participating aloud, prospective teachers are not necessarily missing opportunities to acquire understandings of mathematics concepts or develop procedural skills, but they are missing opportunities to engage in mathematical communication, which is a skill that would be useful for future teachers to develop, since teachers talk with their students about mathematics and negotiate meanings about mathematics publicly.

4.2 Exploratory talk versus final draft talk: reported participation practices in relation to motivational profiles

Prospective teachers' characterizations of their participation practices varied with respect to whether they described participation as an exploratory process of making sense of mathematics with others or as presenting their thinking after they were certain about their solutions or answers. Practices described as sharing solution strategies or ideas for the purpose of seeking feedback or asking questions were more exploratory. In contrast, participation practices were less exploratory when they were described as presenting finished thinking, such as when prospective teachers wrote about participating to share correct answers or correct solution strategies. Barnes (1992) described these different approaches to participating as "exploratory talk" and "final draft talk." Exploratory talk occurs when speakers are rearranging their thoughts during improvised talk," and final draft talk "amounts to a formal completed presentation for a teacher's approval" (p. 108). A benefit of exploratory talk is that learning occurs through engaging critically and constructively with others' ideas (Mercer 2000).

Descriptions of participation practices varied by prospective teachers' motivational profiles, which suggests that prospective teachers' motivation to participate can relate to *how* they participate. Those who expressed positive utility values were more likely to report engaging in exploratory talk and to report perceiving that their teacher provided support for doing so. Prospective teachers who said that they participated to demonstrate their competence or help others were more likely to report engaging in final draft talk. If teacher educators would like to promote a positive value for participating among prospective teachers, either in support of learning mathematics concepts and procedures or developing skills to reason about mathematics verbally, explicitly discussing purposes of different participation practices while providing support for engaging in exploratory talk may help prospective teachers see its value.

Using prospective teachers' social goal of wanting to participate to help others as a hook to encourage their participation in discussions becomes complicated when considered in relation to self-efficacy. Prospective teachers who participated to help others reported having high self-efficacy and engaging in final draft talk. For these teachers, helping meant showing others what they knew once they were certain that they knew it. Although helping others could provide an opportunity to engage in communicating mathematically, for these prospective teachers, helping others did not appear to serve as a process for acquiring mathematics knowledge.

Views of participation are situated within opportunities to participate in current classrooms and informed by students' histories as learners in previous classrooms. An opportunity for future research would be to observe how and when prospective teachers enact their participation

practices, as situated in particular classrooms' norms, for a more nuanced examination of the relations between motivational profiles and participation practices.

4.3 Transition from student of mathematics to teacher of mathematics: coping with shyness and face saving

Prospective teachers who reported that participating in discussions was not essential for their learning of mathematics were also more likely to self-identify as shy. A shy personality would not necessarily interfere with learning of mathematical concepts and skills in mathematics content courses for teachers, if learning is conceived as acquiring understandings of mathematical concepts and procedures. However, those who identify as shy may be less likely to engage in opportunities to learn to communicate mathematically in a public setting.

Some prospective teachers attempted to save face during classroom discussions, as they were hesitant to participate if they were not certain that they were correct, and they were more willing to participate when they were certain about their responses. These results support findings from previous research in motivation indicating that performance-avoidance goals were negatively related to self-efficacy (e.g., Meyer et al. 1997; Turner et al. 1998) and confirm this relationship among undergraduate prospective elementary teachers. This is not an ideally productive motivational profile, as taking risks to participate when unsure can be helpful for acquiring knowledge of mathematics and learning to communicate mathematically.

For these prospective teachers, part of their transition from viewing themselves as a student of mathematics to a future mathematics teacher will involve becoming more comfortable with communicating their mathematical reasoning verbally and publicly about mathematics as well as taking intellectual risks to negotiate mathematical meaning with others. It is worth investigating whether explicitly encouraging these prospective teachers to think about their mathematics content courses for teachers as a site to develop skills for teaching mathematics as well as acquiring mathematical knowledge for teaching, accompanied with appropriate scaffolding and support, could help them cope with their shyness or self-efficacy enough to practice discussing mathematics with one another in the context of mathematics content courses for teachers.

4.4 Limitations

The self-report nature of these data limits what can be generalized from this study. If a prospective teacher did not mention a motivational value, belief, or goal, this does not mean that the prospective teacher would not be motivated to participate for those reasons. The instrument may not have activated the response. However, if the participant did not mention a motivational value, belief, or goal when asked in an open-ended manner, it may not be a strong motivational factor for them, even if they would have reported it on a closed-choice survey instrument.

5 Conclusions

Results from this study provided insights for studying motivation to participate in mathematics classrooms discussions and supporting prospective teachers' learning of mathematics content and skills for teaching mathematics. When studying motivation, including an assessment of practices in which participants engage provides insight for

interpreting participants' motivation. The open-ended methodology used in this study revealed that prospective teachers' motivational profiles varied in relation to their descriptions of their participation practices. This result would have been missed if prospective teachers' motivation had been assessed through Likert-scale closed-choice instruments.

Although these mathematics content courses for teachers were designed to provide prospective teachers with opportunities to communicate mathematically, some of these prospective teachers did not consistently recognize or take advantage of these opportunities, as indicated by the prevalence of negative utility values for participating in this sample and self-reported participation practices that were more aligned with final draft talk rather than exploratory talk. To support the acquisition of knowledge for teaching mathematics and learning to participate as a mathematics teacher, teacher educators should develop strategies to broaden prospective teachers' views of what it means to learn mathematics in content courses for teaching.

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