The impact of participation in an online professional community on the development of elementary pre-service teachers’ knowledge of teaching mathematics

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January 2010

A thesis submitted to McGill University in partial fulfilment of the requirements of the degree of Masters of Arts, Educational Leadership

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This is for Sandra 
For giving me the courage to take this leap 

And to the memory of my mother
Abstract

This inquiry sought to examine the effects of participating in an online discussion forum on the development of knowledge for teaching mathematics. The participants of this study were among the pre-service teachers from a large urban university, chosen as they were completing their mathematics pedagogy course in their teacher-education program and entering a field experience for that academic year. A qualitative analysis of the online discussions of my participants was done under the framework of communities of practice (Wenger, 1998) and Ball et.al’s (2008) understanding of the knowledge for teaching mathematics. These theories allowed for themes to emerge that shed light on the development of pre-service teachers as they moved from student to teacher. Pre-service teachers struggle to shed their student-perspective as they move from theory to practice, which ultimately affects their development of knowledge for teaching mathematics.
Résumé

Acknowledgements

The completion of this thesis would not have been possible without the support and generosity of many individuals.

I would first like to thank the Social Sciences and Humanities Research Council, and the Provost Fellowship for their generous funding that allowed me to devote my time to complete my studies and research.

I am extremely grateful for the guidance, support and mentorship of my supervisor, Dr. Annie Savard. This inquiry developed as it did because of the critical questions she asked of me, her willingness to dialogue with me about my research and for her unwavering faith in my abilities.

I am indebted to the EDEE320 class and those pre-service teachers who both responded to the online surveys and participated in the online discussions that were the focus of this inquiry.

I would like to acknowledge Grant Hartwick, who was the central piece in the organization of my participants and of ensuring their anonymity throughout the study; and Mariette Xenopolous and the ICS team at McGill University, who were very professional, accommodating, and efficient in helping me design the appropriate online space for use in this inquiry.

I wish to thank all my professors whom I had the honour of taking their class. In particular, I would like to thank: Dr. Kate Le Maistre for allowing me to form my research ideas and design, and for providing such individualized and expert advice; and Dr. David Dillon and the EDEM677 class (2008-2009) for creating an exciting, collegial and inspiring place to allow my ideas to bloom.

I would like to acknowledge my family: My dad for the strength and courage he has shown throughout his life that serves as constant inspiration to me in living a full life regardless of the challenges that present themselves; My sister for being such a positive role model in my life; My step-mother for her serendipitous source of friendship. You have all made me the person I am today.

Finally, I wish to thank Stephane Dubé, whose unfailing love, understanding, and unconditional support saw me through the completion of this study.
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1 Introduction

1.1 Reflecting upon my own mathematical journey

How mathematics is taught in schools has changed dramatically over recent years. Like many of my colleagues, my own transition from knowledge acquirer (student) to knowledge disseminator (teacher) is straddled between the more traditional view of mathematics and the recent educational reforms. This moment of transition is such that to refer to a teacher as a “knowledge disseminator” is highly inappropriate, and is reminiscent of “how it used to be”.

Mathematics has traditionally been handled such that the teaching strategies and what students do are “subordinate” to the mathematical concepts themselves (Brown, 2007, p. 764). My own experience as a mathematics student fits this description well. Mathematical facts and knowledge were presented just so – as fact that lived in a state of absolute truth. As I shifted roles from student to teacher, so did my view of the nature of mathematical knowledge. This shift is seen as a result of two factors: 1) As mentioned, my mathematics education and my teacher-education took place in two different eras, the latter having an emphasis on the learner and the former having an emphasis on what is being learned; 2) That as a teacher, I began to think about mathematics and mathematical knowledge differently as I sought to make the knowledge available to my students. The effective result was mathematics was no longer seen as facts to be learned but as ideas and concepts to be navigated through and understood by each learner.

Consequently, mathematical knowledge was no longer an impenetrable entity to me that existed in a state of absolute truth. In light of student-centred learning, I began to understand mathematics to be a network of knowledge constructed by each individual. Although I had acquired an in-depth understanding of mathematical concepts, when examining these concepts in a student-centred way of thinking, I quickly realized that this was not enough if I was to teach mathematics effectively. That is, the focus in mathematics education is not just to assess what mathematical knowledge a teacher knows but what teaching knowledge of mathematics a teacher needs to know. In my own teaching experience and working with my colleagues, it was clear that the mathematical knowledge a teacher knows and the teaching knowledge of mathematics a teacher knows
is often considered two different identities. We all came with varying levels of
mathematical training, yet this knowledge rarely reflected in our teaching of the subject.
However, I noticed our varying knowledge of mathematics meant we each understood the
work of a mathematics teacher differently. As I navigated through my own developing
teaching practice, what I know about mathematics and what I know about teaching
mathematics became inextricably tied. In addition, I quickly realized that the knowledge
base of a teacher is somewhat elusive. Or rather, it is so implicit in nature that it is
difficult to describe.

When I began my graduate work I found myself in the role in the role of teaching
assistant for a “Teaching Elementary Mathematics” course, a requirement for the
Kindergarten and Primary teacher education program at this university. I found myself for
the first time immersed in dialogue about teaching mathematics. In my seven years of
teaching experience I routinely discussed with my colleagues the more practical aspects
of lessons but rarely delved into discussions on teaching mathematics. It was not until I
was immersed in an environment where discussions about teaching mathematics were a
part of daily practice did I realize its absence in my own teaching practice. Further to this,
I also noticed how much I was able to verbalize about teaching mathematics. That is, my
knowledge base for teaching was in fact so implicit that I did not know I was in
possession of it until presented with the opportunity to talk about it. Shifting my focus to
the pre-service teachers with whom I worked, I was also able to observe their respective
development as teachers in this privileged environment of continuous discussion about
teaching and learning. What struck me was how our different experiences affected our
respective experiences within this particular context. I observed two factors that
influenced this: our differences in how we perceived mathematics and the varying
degrees of our practical experience.

Many of the students in this class came with an understanding of mathematics that
was reflective of the “subordinate” view of mathematics, plastered with the idea that
mathematics consists of procedures to be completed rather than concepts to be
understood. Similar to my own experience working with other mathematics teachers, the
understanding of the nature of mathematics shaped the dialogue about teaching
mathematics. I noticed that the pre-service teachers I worked with were able to discuss
with passion how to teach students mathematics yet, at the same time, did not exude the same passion for mathematics itself. For example, many relayed feelings of discontent or hatred for mathematics itself, or focused on the procedural aspect of mathematics. In my own experience, I always found that my understanding of the mathematical concepts and my interest in mathematics helped me to break down this knowledge to make it accessible to students. That these pre-service elementary school teachers understood mathematics in a contrary way led me to question what mathematical knowledge is necessary in order to teach mathematics.

I also noticed that pre-service teachers were often unable to move their in-class dialogues into practical knowledge. With the ability to think back and relate discussions to my own experiences, engaging in dialogue about mathematics and teaching mathematics has allowed me to share and develop my own ideas of teaching mathematics. However, without past experiences to link these discussions the pre-service teachers did not seem to be able to consolidate their knowledge as fully as one may expect. Although it seemed learning together through dialogue and discussion was effective, there was an element missing that related to being able to put ideas into immediate practice. As teachers are continuously learning, teaching and learning should be inextricably intertwined. This missing element helped to focus the nature of my inquiry.

1.2 Focusing the Inquiry

Reflecting upon my own experiences, both as a professional and as a graduate student, has focused this inquiry on two main themes: Understanding the knowledge to teach mathematics; and understanding how this knowledge development is integrated in one’s practice.

As the inquiry developed, delineating what is the knowledge base required for teaching proved to be too large of an endeavor. As any teacher or educator may realize, what we employ on a daily basis in our work is often second nature and deeply embedded with our own students in mind and how to best meet their needs. How and why we know what activities may work best and what activities will not work is tied directly to the context of our practice; what is true for me may not be true for you. This idea brings forth
the very subjective nature of knowledge for teaching, which ultimately becomes an important aspect of this inquiry. However, although the knowledge for teaching is tied to each individual context and practice, it is still possible to talk about and share these experiences with others. This is a result of the fact that there are shared types of knowledge that each teacher understands and knows. For example, although two teachers may work in different contexts and have different experiences, they may still share lesson plan ideas that are understandable to each other. Given the opportunity to talk about and possibly make explicit what we do know about teaching in our context is a powerful tool in order to develop our individual practices. Further by making explicit what we know about teaching, we gain an understanding of the elements of knowledge for teaching and more importantly, how teachers are using their knowledge in practice.

How pre-service teachers apply their knowledge in practice is of paramount importance. As there is often cited disjoint between theory and practice in teacher-education (Laferriere, Breuleux, & Bracewell, 2000) helping pre-service teachers integrate these two forms of learning experiences will help unify their teacher education into a more holistic experience. This inquiry bridges the dichotomy by providing a means for pre-service teachers to maintain their discussions about teaching while in their respective field experiences. Although this lack of cohesion between theory and practice is seen throughout the teaching profession, the focus on pre-service elementary teachers was chosen as it is in teacher-education programs where most teachers begin to formulate their knowledge of teaching and reformulate their knowledge of mathematics (Brown, McNamara, Hanley, & Jones, 1999). As I experienced in my own development from student to teacher, the pre-service years are critical in providing teachers with the base to generate the means in which to develop the knowledge to teach mathematics well. In addition, the focus on elementary pre-service teachers allowed me to examine the mathematical knowledge of teachers and the impact this has on the development of knowledge to teach mathematics.

1.3 Research Question

The focus of this inquiry centres on the following question:
In what ways does participation in an online professional community contribute to the development of elementary pre-service teachers’ knowledge for teaching mathematics?

Understanding how a teacher’s knowledge base develops within a collaborative environment is thus the focus of this inquiry. That is, I seek to examine how individuals interact with each other in order to develop their own knowledge that in turn is used to teach mathematics. The use of an online discussion forum in conjunction with their field experience will provide a look at how pre-service teachers begin to connect their work as students (in a teacher-education program) with their work as teachers. By providing pre-service teachers with the opportunity to continue in-class dialogue, a means to make explicit the knowledge they are utilizing in their teaching is created.

With the possibility of encouraging such solidarity in an online community, educational research has started to focus on the possibilities that online venues have on the teaching profession. Prior research in the field has utilized online communities to bring teachers together. These online communities have been examined to assess the effects when: teachers use these communities for moral support (Paulus & Scherff, 2008); or when teachers use these communities to share teaching resources (Dalgarno & Colgan, 2007; Goos & Bennison, 2008). With the immediate attention that needs to be paid to providing a teacher with sufficient knowledge for teaching mathematics, it is fitting to use an online community’s collaborative nature to develop this knowledge. As such, further research should focus on establishing such communities and examining what development of knowledge for teaching mathematics occurs. This research direction also presents the opportunity to advance what we know about knowledge for teaching mathematics.

In order to address my research question, I asked participants to use a purpose-created online discussion forum to connect with each other in their respective field experiences. Participants were asked to use the forum to pose questions to each other and to share daily experiences with each other. Through these contributions I sought to

- Identify the focus of discussion topics amongst pre-service elementary teachers.
- Examine the shift in focus of discussion as pre-service elementary teachers gain
The reflection upon my own journey from mathematics student to mathematics teacher informed the lens I chose to examine the online discussion forum. Interested in both the knowledge required to teach mathematics and how this knowledge develops, I chose to examine the different forms of knowledge for teaching mathematics and the related elements of community formation that assisted in the development of that knowledge.

1.3.1 Different forms of knowledge for teaching mathematics.

Recognizing that what I know about mathematics has impacted my teaching practice drew me to the work of Deborah Loewenберg Ball and her colleagues (Ball, Thames, & Phelps, 2008), whose work has influenced the re-formulation of a mathematics teacher’s work. Not only does this work make explicit the knowledge required to teach mathematics, it also differentiates the forms of knowledge to teach mathematics. That is, although there is a distinction between knowledge of mathematics and knowledge for teaching mathematics, Ball (2000) has emphasized that the development of both forms of this knowledge is necessary in order to teach effectively.

1.3.2 Community formation.

Wenger’s (1998) notion of a community of practice allowed me to understand the learning that occurred while in practice. His idea that individuals who work together implicitly make meaning of their setting and develop a way of working within that setting seemed so innate to my own teaching experiences. However, just as my knowledge for teaching was never made explicit, this notion of community formation illuminated another factor of teaching that had been overlooked. The community that is developed when individuals work together within a practice was seen to me as pivotal in what knowledge was developed and how it developed. This became a means in which to examine the unique development of pre-service teachers from student to teacher. In addition, the community of practice model provided a means to connect both theory and practice that can often be separated in teacher education programs.
1.4 Rationale for the study

This inquiry contributes to research in mathematics education by examining both the knowledge required to teach mathematics and how to aid in the development of this knowledge.

The current approach in mathematics teaching requires students to make discoveries and thus their own knowledge of mathematics (National Council of Teachers of Mathematics (NCTM), 1997). This in turn has changed the knowledge teachers need to know in order to teach mathematics well. Research has indicated that the mathematical knowledge of elementary school teachers may be shallow and does not include an understanding of why and how mathematics is applied (Ball, 2000; Skemp as cited in Philipp, et al., 2007). That is, the knowledge base of elementary school teachers may be such that a teacher cannot help their students learn mathematics (Ball, 2000). The development of a teachers’ knowledge base, then, is clearly an important aspect of one’s teaching practice and teacher education.

The existing research further displays the need for a practical and continual means to develop a teacher’s knowledge base. For example, in-service workshops and pre-service education programs provide discrete, finite opportunities in which to renew a teachers’ knowledge (e.g. Arcavi & Isoda, 2007; Kotsopoulos & Lavigne, 2008; Margolinas, Coulange, & Bessot, 2005); The process of videotaping classroom interactions and then finding the time in which to review and reflect upon one’s practice (see Nilsson, 2008; Ticha & Hospesova, 2006) is time consuming and perhaps feasible in only a research setting. As well, these means all lack the endurance that is desired to create the life-long learning that teaching professionals need (Shields as cited in Lee, 2004; Nipper & Sztajn, 2008). What is required is a viable, convenient way in which to engage teachers to develop their knowledge for teaching.

Although this inquiry is focused on pre-service teachers as the participant-base, the nature of this inquiry is seen to parallel the practical realities of a teacher’s work. Motivating teachers to join or participate within a teacher network needs to account for the barriers that may be encountered in practice. In a demanding profession, a teacher is often bound by time and energy constraints that affects their participation in any type of teacher development (Hiebert, Gallimore, & Stigler, 2002), let alone one that is
continuous and ongoing. My own teaching experience is indicative of the lack of time for teachers to develop professionally. Although local (school) contexts may provide a means to enable meaningful collaboration and dialogue, this does not address teachers who work in isolation. What is required is a venue in which people can gather regardless of geographical location. With advancing technology, finding innovative uses of the internet in teaching practices is of paramount importance if teachers are to prepare students for the future. An online community can serve this need, as it not only facilitates collaboration between members (McFarland as cited by Schlager, Fusco, & Schank, 1998) but also allows for a many-to-many communication (Rheingold, 1993). As such, an online venue is seen as the suitable location for a teacher network that supports the development of knowledge for teaching mathematics because: it provides a means to gather teachers; it enables the creation of a support structure between these teachers; ideas and resources can be easily shared with everyone; and individuals can reflect upon their practices by virtue of their being a part of the online community.

This inquiry thus distinguishes itself by initiating a drive of life-long learning by introducing pre-service teachers to the possibilities of continued learning as they develop in practice. In doing so, this inquiry examines the impact of an online discussion forum on the development of knowledge for teaching mathematics in pre-service teacher education. Although the research to date has included the utilization of online communities in teacher education (e.g. Dalgarno & Colgan, 2007), it has not addressed whether an online community can aid in the development of knowledge for teaching mathematics. In addition, prior research has not addressed whether an online community can be used to help researchers better understand what the knowledge for teaching mathematics is comprised of. This inquiry hopes to contribute to the body of literature that examines the knowledge for teaching mathematics by bridging the theoretical and practical experience within a teacher-education program.

1.5 Significance of the study

This study will provide insights into the needs of pre-service teachers as they develop their knowledge of teaching mathematics. By examining pre-service teachers as they develop their respective teaching practices, elements of their knowledge of teaching
mathematics and how they use this knowledge will emerge. Teacher educators and teacher education programs will be able to improve their programs to better meet the needs of their students with such information.

This study will also provide a glance at if and how an online community for teachers to develop their knowledge of teaching mathematics can be sustained. The results will help establish whether an online community can be used as a cost-effective professional development model for teachers.

1.6 Delimitations, Limitations

This research study will examine types of teaching knowledge for mathematics. This will include the knowledge that teachers use while teaching mathematics. It is recognized that through this examination, elements of general teaching knowledge that are common to all teachers and independent of the subject matter may emerge. However, the focus of this study is to identify and examine the teaching knowledge for mathematics.

1.7 Summary

This chapter outlined the notion of a knowledge base for teaching mathematics and the growing interest to understand what this knowledge comprises and how it may be developed. The focus of the study introduced seeks to understand how an online discussion forum may bring forth aspects of what the knowledge for teaching mathematics comprises and what the effects of participating in an online discussion forum will have on the development of this knowledge to teach mathematics. The next section will review the literature related to this study and elaborate on the theories that frame my data analysis.
2 Literature Review and Theoretical Framework

The study proposed will examine how the interactions in a closed online community can aid in the ongoing development of a pre-service teacher’s knowledge for teaching mathematics while also identifying aspects that define a teacher’s knowledge base for teaching mathematics. The review of the literature seeks to address the following questions: What is considered to be the necessary knowledge for teaching mathematics? How has mathematical knowledge for teaching been studied? What have studies on teacher development revealed about how a teacher’s knowledge base develops? How have online communities been used in teacher training programs and in particular, how have online communities served as a tool in which to develop teachers? In navigating these questions, the review of the literature supports the current need to provide rich opportunities for teachers to develop the necessary knowledge base to teach mathematics well.

2.1 Mathematical knowledge for teaching

A teacher needs a special kind of knowledge of the subject she teaches. Begle (1979) determined that there was no relationship between the number of mathematics courses a teacher had completed at the post-secondary level and the performance of their students on standardized mathematics tests. That is, knowing more about mathematics does not make someone a better mathematics teacher. It is not enough for a teacher to understand the subject themselves; a teacher needs to be able to use their subject knowledge to initiate and engage student learning (Ball, 2000; Sanders & Morris, 2000; Stacey, et al., 2001).

Lee Shulman (1986) was the first one to distinguish that teachers need and utilize knowledge that goes beyond just knowing the subject area. He proposed that teaching knowledge consists of three main entities: knowledge of the subject matter (subject content knowledge or SCK), knowledge of the program and materials to teach a subject (curricular knowledge) and knowledge of how to make the subject understandable to students (pedagogical content knowledge or PCK.) Thus, Shulman identified that a teacher must know the subject matter they teach in such a way that they understand how a
student should approach learning particular topics, in what sequence the topics should be introduced, and how to help a student connect this new knowledge to his/her existing knowledge.

The multi-faceted aspect of knowledge for teaching has resulted in research studies that seek to understand and assess a teacher’s knowledge base. This assessment has often utilized multiple choice questions to engage both pre-service teachers and practicing teachers in revealing their proficiency with specific types of teaching knowledge (e.g. H. C. Hill, Ball, & Schilling, 2008; Stacey, et al., 2001). This work has been significant in identifying the gaps in a teacher’s knowledge base for teaching mathematics and has also lead to reexamining how teacher education programs handle the preparation of prospective mathematics teachers (Tirosh, 2000). The approach, however, of using multiple choice questions limits the scope of the research findings to content specific areas of mathematics (e.g. division of fractions (Tirosh, 2000) or decimals (Stacey, et al., 2001)).

Alternatively, others have focused on more qualitative methods in which to assess a teacher’s knowledge base. These qualitative methods focus more on the pedagogical knowledge that teachers employ in their practice. While research has traditionally quantified a teacher’s subject knowledge by enumerating the number of mathematics courses studied or using scores on mathematics questionnaires, it is not easy to quantify how a teacher, for instance, knows how to help a student who is struggling with a particular mathematical topic. Thus, examining pedagogical content knowledge requires involved methods of study. Having said that, research has successfully used multiple choice questions to draw out how a teacher perceives the learning process involved with particular mathematical concepts (H. C. Hill, Schilling, & Ball, 2004).

Despite the methods chosen, the common focus when examining mathematical pedagogical content knowledge is a teacher’s knowledge of how a child thinks about mathematics (e.g. Cobb & et al., 1991; Fennema & et al., 1996). A longitudinal study conducted by Fennema et.al (1996) focused specifically on relating knowledge of how children think to the teacher’s instructional strategies. By helping a teacher link their instructional strategies with how children think about mathematics, a teacher is able to develop instructional strategies attuned to their students’ needs (Fennema & et al., 1996).
Furthermore, a teacher then begins to take ownership of this knowledge, embedding it in their practice and in essence create their own bank of knowledge for teaching (Fennema & et al., 1996).

Aligning with this model of knowledge development, Seymour and Lehrer (2006) examined how pedagogical content knowledge (PCK) develops by helping a teacher listen to a student as a way to understand their thinking processes. This work identified another aspect of a teacher’s knowledge base, that being the ability to facilitate and promote student discourse in the classroom. Seen as a crucial skill in order to design effective instructional strategies, a teacher who listens to students engage in useful and informative mathematical discussions will be able to anticipate student difficulties (Seymour & Lehrer, 2006). In turn, the teacher may better be able to assist students in overcoming these difficulties by drawing upon and linking to the student’s existing web of (mathematical) knowledge.

This social constructivist development of knowledge for teaching is consistently revealed in the research, acknowledging that teaching knowledge for mathematics is best developed when teachers work together (e.g. Adajian, 1996; Davis & Simmt, 2006; Nilsson, 2008). Furthermore, in order for a teacher to acquire this knowledge for teaching, s/he must be provided with the same opportunities given to students; that is, teachers should be engaged in the same social interactions that help students develop their knowledge of mathematics (Cobb & et al., 1991). This call has also informed a branch of research inquiries where researchers and teachers are interacting meaningfully in order to develop shared understandings (e.g. Carpenter & et al., 1989).

As researchers and teachers have collaborated in research inquiries, there is an inevitable sharing of the theoretical and practical knowledge that each party brings. As a result, a teacher’s knowledge base (a theoretical entity) and how that knowledge base develops (a practical entity) have become interlocked. However, outside of these researcher-teacher partnerships, each type of knowledge is often considered a separate entity, particularly in teacher training programs (Ball, 2000; Davis & Simmt, 2006; Stacey, et al., 2001). For example, it is common to see pre-service teachers enroll in both courses that develop their knowledge of a particular subject and courses that develop pedagogical theories of teaching a particular subject. However, separating the
development of each type of knowledge does not provide sufficient opportunities for a pre-service teacher to be able to use their knowledge of the subject in the work they will do as a teacher. In order to develop the appropriate level of knowledge for teaching mathematics, it is imperative that the types of knowledge described by Shulman (1986) interact with one another. Aligning with John Dewey’s concept of duality, teaching and learning to teach depends on both the development of subject knowledge and pedagogical methods (Ball, 2000; Philipp, et al., 2007) and the two should be seen as linked bodies of knowledge (Walker, 2007).

In summary, the knowledge a teacher needs to teach effectively is seen to be so complex and intricate that it is unreasonable to expect a teacher to perform their work in isolation. The implication here is that in order for a teacher to develop the knowledge they need to teach, they need to work with other teachers as a means to pool ideas and resources. Further, this collaboration must be linked closely to the work that utilizes this knowledge (i.e. teaching). As such, it is important to understand what kind of learning and development happens in a teacher’s practice.

2.2 Professional Learning and Development

A common term heard in any educational setting is “professional development”. Professional learning and development have come to mean many different things for different people. For the teaching profession, the goal of professional development is to bring about change in the classroom practices of teachers, in their attitudes and beliefs, and in the learning outcomes of students (Guskey, 2002). Guskey (2002) explains this teacher change to be a cyclical process that begins when a teacher, through professional development, acquires new knowledge or strategies that can be implemented in their practice. It is when a teacher changes how they approach their classroom that changes to student learning outcomes may be initiated. When these changes to student learning outcomes become evident to a teacher, their own beliefs and attitudes will change (Guskey, 2002). It is this chain of events that indicates to the teacher that the professional development was effective; this will motivate the teacher to maintain their involvement in the professional development and thus the cycle continues (Guskey, 2002).
However, this implied ongoing professional development is not often seen in practice. Although prior research has shown the positive changes to a teacher’s beliefs about teaching mathematics as a result of professional development (e.g. Corwin, 1993; Lee, 2004), the professional development available to a teacher is often short term and not applicable to their daily practices (Lieberman, 1995; Schlager, et al., 1998). As per Schalger et al. (1998), “professional development for teachers is heavily skewed toward pockets of formal, highly structured activities outside the context of their actual work” (p. 17). This “acquisition metaphor” for learning is being replaced by a “participatory metaphor” for learning (Matos, Powell, Sztajn, & Hovermill, 2009). That is, learning is no longer seen as acquiring knowledge for a specified period of time but as a participatory, ongoing act that links directly the context in which the learning takes places (Matos, et al., 2009).

A growing number of research inquiries now point to the idea of community based learning or professional learning communities, which sees teachers working together in order to develop and to make meaning of their work (e.g. Corwin, 1993; Lieberman, 2000). Although it is believed that a (mathematics) teacher must do his/her own subject thinking in order to develop both content and pedagogical knowledge, this teacher must also interact with other teachers, forming a community of teachers; individual reflection is not enough to change a teacher’s thinking and positively affect their practice (Corwin, 1993). When teachers are “teaching together, listening to one another, questioning, reviewing and learning together, their reframing of practice suggests that the knowledge of teaching somehow takes on a new and different significance across the group as opposed to being at an individual level alone” (Nilsson, 2008, p. 1294). This idea of teachers networking with each other has been given an increased position in education as a means of professional development and has shown to develop a teacher’s knowledge for teaching mathematics more meaningfully than otherwise.

By observing mathematics teacher interactions Davis and Simmt (2006) believe that the knowledge for teaching mathematics is the result of the interactions of the following knowledge types: subjective understanding, classroom activity, curriculum structures and mathematical objects. The interactions of these knowledge sets can be understood as a fluid process where a teacher’s knowledge of mathematics can produce
new pedagogical knowledge and develop insight into the larger curriculum structures. As described by Davis and Simmt (2006), this interaction is best observed when teachers collaborate with one another to strengthen their conception of mathematical ideas. They believe that providing a teacher with opportunities to discuss mathematical concepts allows this teacher to build upon their own mathematical knowledge (or Shulman’s (1986) subject content knowledge). In turn, these new acquisitions of knowledge may then provide insights into a student’s mathematical understanding (or pedagogical content knowledge (Shulman, 1986). That is, when a teacher discusses mathematics with other teachers, they will gain a different representation of how to examine mathematical concepts which may shed light on how a student thinks about mathematics (Davis & Simmt, 2006). Finally, Davis and Simmt (2006) illustrate that this development of subject knowledge also helps a teacher to see the progression of mathematical concepts throughout the curriculum (i.e. Shulman’s (1986) curriculum content knowledge). They refer to the entire phenomenon described as “classroom collectivity”, in which various pieces of a teacher’s knowledge interact with another teacher’s knowledge.

The development of knowledge for teaching hinges on a teacher having meaningful dialogue with colleagues. A teacher can develop a deep insight into teaching and their teaching practice with ongoing professional conversations with their colleagues (Routman, 2002). In order to develop their teaching practice, a teacher needs to reflect upon their practice as a means to bring forth their knowledge of teaching in these professional dialogues. For example, how students think about mathematics or how students interact with each other. Focusing collaborative dialogue on students will move a teacher away from what they consider is important to appreciating and understanding what a student understands (Ticha & Hospesova, 2006). Consistent with the current movement in mathematics education, appreciating how a student understands mathematics will allow a teacher to help this student create their own understanding. With the necessity to appreciate how a student approaches mathematics, a teacher must draw upon their classroom experience in their development of knowledge for teaching. That is, the development of knowledge for teaching must not be treated as a separate entity from a teacher’s teaching practice.

This development scheme is consistent with the complex nature of knowledge for
teaching. Knowledge for teaching is not just an organized set of knowledge types but it is these knowledge types intertwined with a teacher’s practice and the context of that practice (Hiebert, et al., 2002; Wenger, McDermott, & Snyder, 2002). The complexity of a teacher’s work has lead to how professional learning should be delivered. Meaningful professional development should respect and address teacher’s beliefs and address the link between subject knowledge and pedagogical knowledge (Walker, 2007). How this is accomplished now emphasizes the idea that teachers need to engage in professional learning that models what we want to see in our classrooms (Cobb & et al., 1991; Walker, 2007): through collaboration.

A teacher working collaboratively with other teachers brings forth the idea of teacher networks. Using the definition used by Tricia Niesz (2007), a teacher network is a group of teachers that come together for purposes related to teacher learning, inquiry, support or school improvement. By their very nature, teacher networks enable a social constructivist learning model, where teachers come together to discuss issues of relevance, thereby expanding their own knowledge base for teaching. With this learning, teacher networks also provide a means for professional development that unlike other forms of professional development is ongoing and meaningful to the teacher.

Motivating a teacher to participate in such continuous professional development is dependent on the teacher’s time and energy (Hiebert, et al., 2002). An online venue, that facilitates collaboration between members (McFarland as cited by Schlager, et al., 1998) and allows for a many-to-many communication (Rheingold, 1993) can serve to address both the time and energy constraints that often deter a teacher’s ongoing professional development. The literature has revealed the need for such continued professional development. As we move further into the twenty-first century, the creative use of computer technology is becoming more prominent. As such, the next section seeks to examine how online communities have been used in teacher training programs and how this tool may be applicable in teacher development.

2.3 Online Communities in Education

There is no agreed upon definition of an online community (De Souza & Preece, 2004). The term “online community” was first used by Howard Rheingold and Roxanne
Hiltz to describe a strong connection between people in an online space (Preece & Maloney-Krichmar, 2003). Others have considered an online community as “a group of people, who come together for a purpose online, and who are governed by norms and policies” (De Souza & Preece, 2004, p. 1). In education, such online communities have been used in pre-service teacher education and have been used by practicing teachers who seek to form a network.

In pre-service education, online spaces have often been set up in order to supplement the face-to-face classes (e.g. Hough, Smithey, & Evertson, 2004; Paulus & Scherff, 2008; Slavit, 2002). These spaces have also been used to maintain a connection between pre-service teachers as they transition into their roles as practicing teachers (e.g. Dalgarno & Colgan, 2007). Exposing teachers and pre-service teachers to innovative uses of technology is seen as paramount in order for teachers to prepare their students to innovatively use the technology in today’s world (Li, 2005). As a result, much of the relevant literature on online communities focuses on aspects of their sustainability.

Sustaining an online community is dependent on two factors: participation levels and the “usability” of the technology that drives the online community (De Souza & Preece, 2004; Schlager, et al., 1998). Thus, sustainability refers to the notion that the online community is used by its members; an online community can simply exist in cyberspace but if it is not being used, this is not considered to be sustained. As related, the ability to participate in the online community is dependent on the technology that drives the online community; if its use is not intuitive or easily handled, members will be unable to participate. As such, participation and the ability to participate (as affected by the technology) are interconnected, and vital to the sustainability of an online community.

How and why one chooses to participate in an online community is a complex entity that encompasses issues of negotiated discourse, trust and boundaries. Unlike face-to-face communication, online discourse often offers a plethora of topics in which to choose from and engage in conversation. This idea of choice may hinder the participation of a given member if they are unable to decide which issues to discuss; Alternatively, they may choose to not participate at all, being unmotivated by the existing topics of discussion (Teo & Webster, 2008). In an online community, when the members of the community are able to together negotiate how the space will be used, and thereby how
they will communicate, the sense of ownership increases the participation level, and thus the collaborative behaviour of the community (Goos & Bennison, 2008; Gray, 2004; Wenger, et al., 2002). Thus, eliciting participation in any community is inextricably intertwined with a strong sense of shared purpose within the community (Adajian, 1996; Hough, et al., 2004; Lieberman, 2000).

Participation is also linked to establishing trust amongst the members (Hough, et al., 2004). Building trust in an educational community requires four elements that are linked to collaborative actions: “respectful exchanges and genuine listening amongst the community members; personal regard and willingness to go beyond the expectations of one’s role; competence in one’s assigned role; and an ethical commitment to the education and welfare of children” (Bryk and Schneider as cited in Sztajn, Hackenberg, White, & Allexsaht-Snider, 2007, p. 972). Thus, with a shared commitment to students and through participation, trust relationships are allowed to flourish and in a reiterative process increases both participation levels and the quality of participation. As a community grows and relationships are created between individuals, 3 stages of increasing trust can be observed: where individuals are committed to maintain their participation (provisional stage); where individuals get to know each other such that they are able to predict each other’s behaviour (knowledge-based stage); where individuals are able to empathize with each other (identity-based stage) (Lewicki and Bunker as cited in Sztajn, et al., 2007). In an online community, higher levels of trust may be difficult to attain if there is a lack of face-to-face relationships (Dalgarno & Colgan, 2007; Goos & Bennison, 2008; Hough, et al., 2004). As such, trust relationships are closely linked to the boundaries of the online community.

Whether face-to-face relationships exist or not determines the boundaries of an online community and accordingly, the boundaries of an online community affect the functioning of that online community. When the members of the community are connected only through an online realm, the boundary of the community is clearly defined. In these cases, trust is difficult to ascertain as the participants know only each other’s online identities, and consequently they may not readily want to share thoughts, ideas or experiences (Hough, et al., 2004). On the other hand, many online communities exist offline as well (Preece & Maloney-Krichmar, 2003), rendering the boundaries of the
community as unclear and indistinct. In these cases, established face-to-face relationships increases the trust relationships in the online community and thus increases the level of participation in an online community, since members may feel more open and willing to share (Hough et. al. 2004).

However, the motivation to participate in an online community is at times solely to overcome geographical isolation (Gray, 2004), implying that without a face-to-face relationship, individuals will still seek out online communities in which to actively participate. An individual drawn to a community in this manner returns to the notion that participation fundamentally begins with a shared purpose. Successful (sustained) communities, whether online or not, are formed when there is a clear sense of purpose, as per de Souza and Preece’s (2004) definition. This idea further suggests that when this shared purpose is developed in conjunction with the participants themselves, the community is more likely to sustain itself as the goals and values were created by these participants (Adajian, 1996; Goos & Bennison, 2008; Hough, et al., 2004; Lee, 2004). This creates a sense of camaraderie amongst the participants, which is conducive to facilitating a high level of collaboration and reflection.

Intertwined in all these issues related to sustaining online communities is the role of the facilitator or moderator of the online community. Seen as the key to building an “atmosphere” conducive for collaboration (Gray, 2004), the facilitator of an online community is a contributing participant of an online community. Further, the facilitator has often coincided with the “expert” role in the community. For example, when used in pre-service teacher education, the online community’s facilitator is often the course instructor (e.g. Dalgarno & Colgan, 2007; Li, 2005; Slavit, 2002); when used by practicing professionals, the facilitator may be someone who has accumulated a lot of experience in the particular field (e.g. Gray, 2004). The consensus in all examined online communities is the desire for participants to connect with an expert (Dalgarno & Colgan, 2007) and to have a person who generates “input” and “thought” (Gray, 2004, p. 30). Although seen to hold a wealth of knowledge, the facilitator has first and foremost served to encourage participation by the members of the community.

How a facilitator encourages participation is dependent on their own level of participation. Levels of participation on the part of the facilitator can be described in 5
levels: *Resolving* issues that the participants were unable to resolve themselves; *validating* points previously made by other members of the community; *redirecting* questions posed to them back to the participants; *expanding* on already presented ideas and finally *withholding* their participation and encouraging the members to lead and become active participants in the discussions (Simonsen & Banfield, 2006). Where discourse is most desirable between the members, the facilitator’s role is seen as the inverse to that of the members. That is, withholding participation is the desirable action of the facilitator (Simonsen & Banfield, 2006). Encouraging members to take ownership of the online space reiterates what the literature reveals as the need for members of a community to develop their own means in which to communicate. This addresses the previously discussed issues pertaining to sustainability: negotiating what and how discourse will occur, trust, and boundaries. Effective facilitation of an online community should also include a technical competence (Gray, 2004), linking to the other issues of sustainability as related to the ease of use of the online technology.

That collaboration and reflection can be elicited from participation in an online community has significance for its use by teachers. With the established notion that the knowledge for teaching is a complex web, teachers need to collaborate with each other in order to develop the knowledge they need to be effective. Although one may develop knowledge on their own, drawing a parallel to Gardner’s (2007) point on leadership, the skills and knowledge a teacher needs are too vast for a single teacher to develop on their own. When an online venue can widen the net of collaboration, the learning that will occur as a result of these many interactions will engage teachers in a continuous learning cycle to develop the knowledge they need to teach effectively.

### 2.4 Theoretical Framework

The literature indicates that there is a need to further examine what types of knowledge comprises a teacher’s knowledge base. The literature has also indicated that the means in which to develop the knowledge for teaching effectively is best done in a collaborative manner that intertwines the knowledge with practice. Thus, in order to examine the development of teaching knowledge of mathematics, this study draws upon
two different theories that informs both the methodology and methods of the study: theory of mathematical knowledge for teaching (Ball, et al., 2008; H. C. Hill, et al., 2008) and communities of practice (Wenger, 1998). This section intends to elaborate on the theories that will be used in the analysis of the data collected in a closed online discussion.

2.4.1 Mathematical knowledge for teaching.

First introduced by Lee Shulman (1986), the common framework for teaching knowledge consists of three main entities: knowledge of the subject matter (subject content knowledge or SCK), knowledge of the program and materials to teach a subject (curricular knowledge) and knowledge of how to make the subject understandable to students (pedagogical content knowledge or PCK.) Building upon this framework, Ball et.al (2008) provide a more appropriate framework for the mathematical knowledge for teaching. With this specificity to teaching mathematics, this framework nestles this inquiry well in that it provides both a way to understand the necessary knowledge to teach mathematics well and it provides a means to examine and identify different forms of knowledge for teaching mathematics. In identifying these different forms of knowledge for teaching mathematics, Ball et.al (2008) have further developed Shulman’s framework to distinguish between the knowledge that a teacher utilizes in a context involving students and the knowledge that a teacher utilizes in a context that does not involve students. This partition is of interest to this inquiry’s context. Drawing participants from a teacher-education program implies a similar partition in knowledge as this group of individuals is immersed in theoretical development and engaged in practical learning in two disjointed contexts.

The knowledge Ball et.al (2008) identify as the knowledge a teacher utilizes in the context of students and teaching refines Shulman’s pedagogical content knowledge and identifies three aspects of PCK: knowledge of content and students (KCS), knowledge of content and teaching (KCT) and knowledge of curriculum (2005). The knowledge of content and students is defined as the knowledge of mathematics as it links with knowledge of how students “think about, know and learn” this mathematical knowledge (H. C. Hill, et al., 2008, p. 375). Similarly, the knowledge of content and teaching is
knowledge of mathematics as it links to teaching this mathematical knowledge; the knowledge of curriculum is similar to Shulman’s curricular knowledge or the knowledge of mathematical programs and materials used to teach mathematics (H. C. Hill, et al., 2008).

The knowledge Ball et.al (2008) classify as knowledge a teacher utilizes in contexts that do not involve students refines Shulman’s subject content knowledge specific to mathematics, identifying three aspects of subject matter knowledge (SMK) of mathematics: specialized content knowledge, common content knowledge and knowledge at the mathematical horizon (2008). Specialized content knowledge (SCK) is the mathematical knowledge that is specifically utilized by a teacher to engage in particular teaching tasks; Common content knowledge (CCK), on the other hand, is the mathematical knowledge used in teaching but is shared with other professions that also use mathematics; knowledge at the mathematical horizon can be considered knowledge of how mathematical ideas and concepts link to other mathematical ideas in the past and future of a student’s learning trajectory (Ball, et al., 2008; H. C. Hill, et al., 2008).

To clarify how these different types of knowledge may be distinguished, consider the concept of fractions. Knowing what fractions are, how to operate with them and use them in everyday situations is a form of common content knowledge, as this knowledge of fractions is knowledge that any individual may possess. However, knowing that a student in grade 2 should first have a strong grasp of fractional values and how to represent fractions before they can operate with fractions is a form of knowledge at the mathematical horizon as it relates to knowledge of fractions within a vertical examination of the curriculum. Another form of knowledge specific to a teacher is employed when devising assessments for their students. Suppose a teacher would like to evaluate whether her students have grasped a basic facility with fractions. She knows in order to do this, she could ask her students to order a set of fractions; a set of fractions carefully generated so that it requires her students to employ a variety of fraction-related concepts to order the values appropriately, and not a set of fractions where even by committing common errors the student will still yield the correct order. This is considered to be specialized content knowledge as it is knowledge of fractions that a teacher would (need to) employ. In addition to this specialized content knowledge, a teacher should be aware of a
student’s need to know how to order fractions (knowledge of curriculum as related to fractions) as well as common student misconceptions about fractions. For example, she may know that a student may find it difficult to understand that fractions with different denominators are not easily comparable without first finding a common denominator (knowledge of fractions and students). As a consequence, a teacher has developed strategies that will help this student understand how to order a set of fractional values (knowledge of fractions and teaching).

It is prudent to note that common content knowledge in itself (as with the other aspects of knowledge for teaching mathematics) is not intended to be a trivial form of knowledge. There is a distinction between the knowledge of how to perform an algorithm to add two fractions and the knowledge of why that algorithm in fact, adds two fractions. This distinction is often referred to as the difference between instrumental knowledge (applying algorithms or rules without understanding of reasons) and relational knowledge (knowing what the algorithm is and why it works) (Skemp as cited in L. Hill, 1997); or more often referenced as procedural knowledge versus conceptual knowledge, respectively (e.g. Baroody, Feil, & Johnson, 2007; Star, 2005). Although research has focused more on a teacher’s conceptual knowledge, more recent calls propose that the development of procedural knowledge not be ignored but rather should be seen as a complement to conceptual knowledge (e.g. Star, 2005). That is, a teacher should be able to adeptly handle mathematical procedures while also understanding the structure and meaning behind these procedures.

Unfortunately, pre-service teachers often have only a procedural understanding of the mathematics they will teach (L. Hill, 1997). This view of mathematics can often be attributed to the pre-service teacher’s own experiences as a student in elementary school and points to deeply ingrained conceptions pre-service teachers have about teaching and teaching mathematics (Brown, et al., 1999; DeBlois & Squalli, 2002). In fact, a teacher’s own practice is often affected by this perspective that they gained in their own student experiences (Ball & McDiarmid, 1989; Philipp, et al., 2007). Thus, in their teacher-education programs, where pre-service teachers are developing their practice and their knowledge for teaching, it becomes crucial to understand where they are coming from. However, what is also seen is the emergence of another perspective of learning: that of a
university student where pre-service teachers re-visit and re-confront the mathematics they learned as elementary school students. In this university perspective, pre-service teachers begin to redevelop some of the conceptions they had of mathematics and then bridge over to the learning perspective of a teacher, where they begin to consider student learning (Brown, et al., 1999; DeBlois & Squalli, 2002).

Thus, the distinction that Ball and her colleagues (2008) make between a teacher’s knowledge that involves teaching and students and the knowledge that does not involve teaching or students is important. This distinction emphasizes that a teacher develops knowledge both within their teaching practice (PCK) and outside of their teaching practice (SMK). This is paralleled in the different learning perspectives that pre-service teachers engage in, where the university-student perspective sees a reconfiguration of the knowledge of mathematics and the teacher perspective begins situating this knowledge in the classroom with elementary school students. This study, although focused on the knowledge that is developed within practice, understands that PCK is intertwined with knowledge of mathematical content (SMK). Thus, understanding all aspects of the knowledge base to teach mathematics is important in understanding the development of a pre-service teacher’s knowledge for teaching mathematics.

It is believed that developing the adequate knowledge for teaching mathematics requires that the teacher remain close to their practice (Hiebert, et al., 2002). The complex nature of mathematical knowledge for teaching and the need to make a rich link to practice complicates the analysis of knowledge development. As the inquiry focuses on development in a collaborative setting, what is required is a model that examines modes of participation. By examining how individuals interact with one another, the vehicle in which the knowledge for teaching mathematics is developed can be better understood. Wenger’s (1998) community of practice offers an appropriate lens to examine the elements that enable the acquisition and development of mathematics knowledge of teaching.

2.4.2 Community of Practice.

A community of practice can be considered a setting in which learning takes place. Individuals come together with a shared interest or goal that then becomes the
focus of learning. What is learned by the individuals in the community is the practice itself, an emerging structure that involves the evolution of three interconnected pieces. First, the members of the community are defined by not only a shared interest but also an implied competency within that interest (Wenger, 1998). This competency provides a means in which members can engage in the community both thoughtfully and meaningfully. Together, the members find a way in which to engage and interact with each other. Second, as they navigate their way through the functionality of their collaborations, members of the community are also making sense and meaning of their situation and their collective existence within their practice. Thus, as a community evolves, so is the way in which the members of the community understand their practice and work, and develop a means to respond to the context they find themselves in. So, the means of participation within the community, the sharing of information or engagement in activities, is determined by the members themselves and allows individual members of the community to not only learn from one another but also to understand their collective being (Wenger, 1998). Third, as this process evolves, so does the natural development of a repertoire of tools, artifacts and/or routines that provide a way to share the knowledge and learning within their practice (Wenger, 1998). The community develops a means to preserve their practice and what is learned in order to allow both existing members and new members to understand the idiosyncrasies of the community.

The community described by Wenger is not unlike a community that one may observe in a school. In my own experience as a mathematics teacher I found myself working with colleagues of varied mathematical backgrounds. Despite the continuum in which our comfort level with mathematics lay, as a group we were motivated to understand and practice effective teaching practices in our mathematics classes. This shared interest was implied by our role as mathematics teachers and confirmed our ability to dialogue meaningfully with each other about teaching mathematics. As we had to respond to our local context (our school), we developed a way to work as mathematics teachers within this context and in doing so, defined our perception of a “mathematics teacher”. We were able to learn from each other as we shared teaching ideas that enabled the collaborative development of new resources (based on new knowledge). These resources allowed for the preservation of what we learned and served to inform future
teachers that entered the school.

The integration of new members in a community of practice brings forth two important aspects of a community of practice. One is that of peripheral participation (Lave & Wenger, 1991), that accounts for the participation in an almost observatory way. This allows any member to understand the community before themselves making active contributions and fully engaging in the practice of the community (Lave & Wenger, 1991). In this sense, a community of practice will grow and develop as a whole; but at the micro-level also allows individual members the ability to define their own learning trajectory (Wenger, 1998), the second unique characteristic of a community of practice. That is, individuals enter and engage in a community of practice because their current path of learning aligns with the practice of a particular community. As a member of this community, that individual participates in the community but also within their own path of learning. In this sense, the duration of an individual’s “stay” in a community of practice may vary depending on the collective knowledge generated in the community and its fit with the individual’s own trajectory.

This collective knowledge making within a community of practice to produce (new) shared knowledge (Wenger, 1998) poses a significant implication. Although there has been significant work done that provides a means in which to distinguish types of teaching knowledge (e.g. H. C. Hill, et al., 2008), much of the knowledge that teachers employ in their practice is not easily qualified. Like any practitioner, a teacher’s knowledge is linked to their practice; and it is intertwined and organized around and within problems that that knowledge addresses (Hiebert, et al., 2002). This embedded nature of the knowledge base of teachers in practice makes the specific elements of this knowledge difficult to classify. The interactions in which knowledge is shared and created in a community of practice provides a means in which to integrate both the practical and theoretical knowledge for teaching (Wenger, et al., 2002), thereby integrating practice and theory. Wenger’s (1998) “duality of meaning” (pp. 55 - 71), a symbiotic relationship between participation and reification, portrays the necessity of a free flow between classifying knowledge for teaching and sharing this knowledge as a means to ensure the knowledge is understood collectively while also ensuring the knowledge is true or valid.
For example, teachers have the opportunity to collaborate with each other in their daily work to share ideas. Their interactions not only enable collaborative participation of each individual teacher but together they build ideas of teaching that become a part of their knowledge bank for teaching. As these pieces of knowledge emerge in some context, this knowledge is inextricably connected with that context (for example, a particular problem). If there is no such context, pieces of knowledge will not be able to surface on their own. Similarly, if elements of knowledge do emerge, there must be a context in which that knowledge can be applied. In essence, Wenger’s argument implies that establishing the knowledge for teaching mathematics outside of practice, or vice versa, makes little sense when one needs the other in order to exist. As such, a community of practice is a unique venue in which to hold the knitted structure of teaching knowledge as it may reveal the knowledge base of teachers while it also allows teachers to develop this knowledge.

2.5 Research Question

The literature indicates that (mathematics) education needs to focus on two areas: to understand what is the adequate knowledge that teachers need to teach mathematics and how to ensure all our teachers are continually able to develop this knowledge. Research to date has focused on classifying the knowledge teachers need, as well developing models of learning and development in practice. This inquiry contributes to this body of research by merging the gap in two areas of research. That is, how can teachers work together to develop the knowledge they need to teach mathematics well?

In what ways does participation in an online professional community contribute to the development of elementary pre-service teachers’ knowledge of teaching mathematics?

The framework of knowledge for teaching mathematics provides a means in which to distinguish the various elements of knowledge required to teach mathematics. A community of practice offers an understanding of how to navigate through webs of participation and the outcomes of such collaboration. Together, these two models provide
a basis in which to examine how the knowledge for teaching is developed in a collaborative environment.

2.6 Summary

When conducting any qualitative study, there should be a coherence between theories, questions and methods (Yanchar & Williams, 2006). This chapter has presented the theories that ground this inquiry and the question that emerges from these theories. The presented theoretical framework of knowledge for teaching mathematics illustrates the complex nature of this knowledge. Further, the literature indicates that there is a need to find a viable way for teachers to collaborate and learn from each other in order to filter through the various types of teaching knowledge. This social-constructivist perspective of how teachers develop the knowledge for teaching mathematics weaves together this knowledge and communities of practice for teachers.

The examination of relevant studies and theories has supported the design of this inquiry, which will be elaborated on in the next chapter. The following chapter expands on the methodology and methods employed in this inquiry. A part of this discussion will utilize the principles of a naturalistic inquiry to bring together this study’s central question.
3 Methodology and Methods

Understanding how a teacher’s knowledge base develops within an online collaborative environment is the focus of this inquiry. I seek to examine how individuals interact with each other in order to develop their own mathematics knowledge for teaching.

The literature on knowledge for teaching not only points to the intricate pieces that comprise this knowledge but focuses also on how this knowledge is developed. What emerges is that the development of mathematics knowledge for teaching requires reflection and collaboration with other teachers (Corwin, 1993; Davis & Simmt, 2006; Kotsopoulos & Lavigne, 2008; Nilsson, 2008; Peterson & Williams, 2008; Ticha & Hospesova, 2006). When teachers are “teaching together, listening to one another, questioning, reviewing and learning together, their reframing of practice suggests that the knowledge of teaching somehow takes on a new and different significance across the group as opposed to being at an individual level alone” (Nilsson, 2008, p. 1294). This idea of teachers networking with each other has been given an increased position in education as a means of professional development for teachers; in particular, it drives the notion of professional learning communities and the design of this inquiry.

This chapter develops the methodological theories that ground this inquiry and explains the methods used to examine the development of knowledge for teaching mathematics in pre-service elementary teachers. I begin by explaining my understanding of the nature of knowledge to teach mathematics and how a teacher develops this knowledge in his/her practice. With this ontological and epistemological basis, I explain how these assumptions informed the design of this inquiry, bringing in elements of a naturalistic inquiry (Lincoln & Guba, 1985) to ground my choices. After introducing my participants I move back and forth between my own role in the research, how the data was collected, and how I approached the analysis of the data. This presentation will highlight the care taken to ensure my own positioning is understood and will demonstrate how that positioning affected the inquiry.
3.1 Methodology

A naturalistic inquirer understands and works under the axioms of the naturalistic paradigm (Lincoln & Guba, 1985). She understands realities and knowledge to be subjective and understands that the phenomena observed is strictly tied to the time and context of the inquiry (Lincoln & Guba, 1985), in a tightly wound relationship. These guiding principles of a naturalistic inquiry were employed within this inquiry. This section of the chapter will highlight these values as the nature, context and design of the inquiry are presented.

This inquiry seeks to understand the knowledge development of elementary pre-service teachers in a collaborative environment. In this sense, a social constructivist perspective is adopted in this inquiry, that knowledge may be constructed through social interactions, which gradually alter and shape what we know (Vygotsky, 1978). I also have adopted a socio-cultural perspective of knowledge, understanding that in a collaborative environment, each individual brings with them an array of different experiences. Within this inquiry alone, my participants were engaged in different classrooms, with different teachers, while also teaching different grade levels and a combination of different subjects.

“I am teaching a Split cycle three, focusing on Math right now due to the fact that they are preparing for their Ministry math exam after I finish stage. The students are currently doing their ELA Ministry exams”

“I will be teaching Language Arts grades 1 & 2 and Mathematics for grade 2!”

“At first I was upset that I would be in a media class and a grade 5 English, Math class but my teacher is amazing and I am paired with a great student. I am learning a lot about media which is great because I really need it! The smartboards in the school is also amazing! The media class I have two and half days a week grades 2-6 and the rest of the days I am in a grade 5 English, Math class.”

It is conceivable, then that the knowledge for teaching is and should be directly linked to the individual teacher, his/her experiences and his/her own teaching practice. Knowledge of any kind is unavoidably tied to the culture in which it relates to and the culture in
which an individual interacts with such knowledge (Lerman, 2001; Radford, 1997). In the context of this inquiry, the nature of knowledge for teaching is seen as a subjective entity for this reason, as it is tied to the practice of each individual teacher. A teacher’s practice includes an interactive process of various entities including their classroom, their students and their colleagues. I thus understand realities to be whole entities that cannot be separated from their contexts (Lincoln & Guba, 1985). Based on our individual experiences and our current contexts, we each construct our knowledge and a reality that conforms with our existing surroundings.

For example, any second grade teacher has an understanding of the curriculum for a grade two student. But with different classrooms consisting of different students, contained in a different school and/or in a different city, how each second grade teacher applies this knowledge differs. In addition, how one comes to know such knowledge of the curriculum will vary depending on each individual’s personal history which then informs his/her current learning trajectory (Wenger, 1998). As a result, each individual creates their own knowledge of the curriculum and how that knowledge is used in the classroom. In addition to these variations, further variations in knowledge are embedded in the fact that each individual brings to their practice different learning experiences, both as students themselves and in their professional training. Put together, what each individual teacher knows about teaching is not only individualized but tied closely to one’s own changing contexts.

The intricate web that forms an individual’s knowledge for teaching was reshaped within the collaborative environment of this inquiry. Interacting with others who have similar interests or competencies in the same field can shape what we know (Wenger, 1998). In order to make meaning of the experiences and development of my participants, I employed the guidelines of a content analysis, understood to be an examination of human communication in order to identify patterns or themes (Leedy & Ormond, 2005). Using the contributions from within a collaborative environment, a content analysis allowed me to not only make meaning of the participants’ experiences but to examine how each approached the learning to be a teacher and thus how their knowledge for teaching developed. The following is an example of the varied experiences and attitudes that came together in the collaborative environment.
“Some courses are helpful but I believe you only really learn what it is to be a teacher when you are actually in the classroom learning from the students and the cooperative teacher.”

“All semester long, we learn theory, and finally, we are given the chance to put theory into practice :) It's almost as if everything is coming to life.”

The operational aspects of the content analysis, to make sense of the data and to allow themes and patterns to emerge, will be elaborated upon in a subsequent section of this chapter.

3.2 Research Question

This inquiry focuses on how interactions with other teachers form and reform our knowledge to teach. The methodology and methods described in this chapter seek to address the following question:

In what ways does participation in an online professional community contribute to the development of elementary pre-service teachers’ knowledge of teaching mathematics?

With the understanding that knowledge is subjective, I understand that the meaning extracted and interpreted in the data are tied to both the time and context of this inquiry (Lincoln & Guba, 1985). In this sense my background and that of my participants are crucial entities that need to be explored in order to understand the context of this inquiry.

3.3 Background of the Researcher

My own development as a mathematics teacher and the development of my own knowledge to teach is an intricate, interwoven aspect of this study. That is, how the study came to be and how it has developed is linked tightly to my own perspective on how knowledge for teaching is developed and how it is used.

My own journey as a mathematics teacher began, formally, with an undergraduate degree in mathematics and computer science. In stating this I recognize that my initial training influenced my view of the nature of mathematical knowledge to be other than my
current position. That is, I saw knowledge (of mathematics) as a body of knowledge that was absolute and impenetrable by my surroundings and my own experiences. As the focus of my training moved towards mathematics education the mathematical knowledge I had developed was inevitably affected. In order to think about and learn about teaching mathematics, it was necessary to take this mathematical knowledge and examine it in terms of my students and how they might best come to understand this knowledge. As I began to look at mathematics through the perspective of my students, the knowledge base that I was applying was changing as well. This was the result of two related factors: 1) with a specific context of a particular cohort of students, my own understanding of teaching certain mathematical concepts may differ from that of another mathematics teacher due to the inevitability that 2) my understanding of the mathematical concepts themselves have changed in such a way that may not be identical to that of another mathematics teacher. Appreciating these different perspectives became a pivotal aspect of my continued development as a teacher and my development of knowledge to teach mathematics.

I believe this appreciation for the varying contexts of each teacher has contributed to the realization of this study. I understand becoming aware and appreciative of what someone else knows about teaching involves collaborative, dialogic methods. Knowledge of how to teach is formed from past and current contexts, and to truly recognize the richness of these experiences, I sought to engage my participants in a personal yet risk-free environment. My interactions with my participants began as a teaching assistant in their Mathematics pedagogy course. This alternate role to researcher further shaped the design elements of this study. These sometimes competing roles presented obstacles as the inquiry emerged. I was wary of these obstacles in terms of their affect on the results of the study. Guided by the notion of “good enough” methods (Luttrell, 2000), each decision made throughout the design process had me examining what would be gained and what would be lost as it related to this study. In turn these decisions affected how I handled any potential privacy and ethical concerns in order to protect my participants. These concerns, which will be subsequently addressed, were openly discussed with my participants, to ensure transparency and to build a sense of partnership within this inquiry.
3.4 The Participants

As a teacher, I sought to provide the opportunity of dialogue and collaboration for other teachers while in practice. Thus, the notion of learning as doing (Wenger, 1998) motivated the choice of the participant pool for this inquiry. The participants for this study were, at the time of the study, second year pre-service elementary school teachers at a large urban university. This cohort of individuals was selected as the second year of this particular degree program is when students take the only two mathematics courses in their education degree. Throughout the academic year, the participants engaged in discourse about mathematics and teaching mathematics. As pre-service teachers, these dialogues took place out of the context of practice and with minimal experience to draw upon. The exception to this was a course assignment that centered on two three-hour volunteer sessions at a local community centre. The nature of each visit was to enable each pre-service teacher the opportunity to assist students with their mathematics homework. Although it was not always possible to work with students who had mathematics homework, the experience at the very least provided an opportunity for pre-service teachers to work with children in a classroom-based setting. This course assignment, with the permission of the students, helped me to understand the participant pool’s current position within their individual learning trajectories of teacher development. I elaborate on this matter when I describe my process of data collection.

As a teaching assistant to the participant-pool, I was able to introduce the study in a brief, ten minute presentation during their weekly mathematics lab\(^1\). To ensure a clear distinction between my role as a teaching assistant and my role in this research project, consent forms were handed out and collected by a third party. These consent forms\(^2\) remained in the possession of this third party throughout the study and during the reporting of this study. This ensured that I was not aware of which students had agreed to participate in the study. In addition, although the study centered on their field experience and utilized a course assignment as a source of information, the anonymity of the participants ensured that their participation in the study would not and could not affect their grade in either the course or their field experience.

\(^1\) See Appendix A for a copy of the script used to introduce this study to my participant pool.
\(^2\) See Appendix B for a copy of the consent form and accompanying information letter given to each individual in my participant pool.
3.4.1 The field experience.

In any teacher-education program, students are provided with practical experience in the field. This relies on teacher-volunteers (cooperating teacher) in schools to work with one pre-service teacher in his/her classroom. The pre-service teacher works within a cooperating teacher’s classroom, gradually taking on more responsibilities in the classroom under the guidance and support of their cooperating teacher. Eventually, the pre-service teacher may take over instructional responsibilities and be given the opportunity to oversee the entire classroom. The cooperating teacher provides feedback and guidance to the pre-service teacher, and upon completion of the field experience, will complete an evaluation of the pre-service teacher, commenting on the pre-service teacher’s preparation and implementation of lessons, management skills and professional qualities. This evaluation will determine whether the pre-service teacher may advance to the next field experience. At this university, pre-service teachers are further supervised by a retired teacher, seen to be the liaison between the field experience and the university⁴. Supervisors tend to supervise approximately 10 pre-service teachers during any given field experience. They will also evaluate the pre-service teachers by sitting in on and observing a lesson the pre-service teacher plans and implements.

The field experience for this cohort of students took place at the end of their academic year. As the cohort of individuals was completing their second year, this was their second field experience. The first field experience focused on observation tasks over a 12-day period (Monday to Thursday for three weeks) near the beginning of the previous academic year (i.e. in the first year of the program). If a pre-service teacher was provided with instructional opportunities, this would have been with one student or a small group of students. On the other hand, the second year field experience is more involved. The timing of the second year field experience allows pre-service teachers to complete both theoretical and pedagogical courses in elementary education. Thus, in this 3-week field experience, pre-service teachers may engage in instructional tasks involving the entire class and that could lead to taking over up to 50% of the cooperating teacher’s course load.

⁴ Universities differ on the role of the supervisor. At this university, the supervision is done by individuals not associated with the Faculty. At other universities, pre-service teachers may be supervised by faculty members.
During this second year field experience, pre-service teachers also enroll in a seminar course. Beginning one week prior to the start of the field experience, there are four 3-hour sessions to this seminar course. The seminar course intends to prepare pre-service teachers for their field experience by developing their planning and teaching practices. This includes deepening their understanding of the subject-specific competencies in the province’s curriculum. The seminar course also serves to deepen pre-service teachers’ understanding of professionalism and learning in a professional community. Successful completion of the seminar course requires the pre-service teachers to complete five assignments that all work towards a professional portfolio that each pre-service teacher builds upon throughout their teacher-education program. These assignments are: 1) To develop or modify a lesson plan that demonstrates an understanding between learning and evaluation for all students, across a range of abilities; 2) To describe a situation that exercises professional qualities and behaviours, and to reflect on how they upheld or demonstrated a high level of professionalism; 3) To critically review of a journal article that relates to an aspect of cultural diversity in schools; 4) To revisit and revise their educational philosophy (first developed in the first field experience); 5) To use and apply the province’s professional competencies in a self-evaluation and reflection of their own growth throughout the last year.

Along with this seminar course, this study provided the participants with one of their first opportunities to dialogue with one another while they applied their own knowledge of teaching (during their field experience). However, this study modeled a form of ongoing professional development program as participation was voluntary and sought to support participants in their field experience. The online forum allowed pre-service teachers to connect with each other in order to share, to discuss and to reflect upon their experiences. The common enterprise (Wenger, 1998) that allowed the participants to interact meaningfully with each other was grounded in their established connection of being students in the same teacher education program. The culture of their teacher-education experience provided a point of common departure in terms of what it is to be a student in this teacher-education program and a means of interacting in the culture of this teacher-education program (Lerman, 2001; Radford, 1997). However, their varying contexts of field experience and their own set of experiences and knowledge that
brought them to this teacher education program created a need to find a new means in which to work with one another. In addition, my inclusion in the community inevitably changed the dynamics and the nature of their interactions.

3.5 Data Collection Tools

The data in this inquiry was collected using two tools: an online discussion forum and two related surveys that were designed to be delivered before and after participation in the online discussion forum. That the participants and I had established a connection with each other through a teaching assistant-student relationship informed the manner in which privacy and ethical concerns were addressed. The measures taken to ensure the privacy of the participants and to maintain high ethical standards are presented along with each data collection instrument. Of particular importance is that the inquiry began only after the course had come to an end. This drew a clear distinction between the course and the research project and more importantly, marked the end of the official teaching assistant-student relationship. Ethical approval was granted by the Research Ethics Board at the university.

3.5.1 Survey Instruments.

A survey was used to gather information about the participants’ perceptions of their own mathematical knowledge and their own teaching knowledge of mathematics. The questions chosen also sought to understand the participants’ beliefs and attitudes about mathematics and teaching mathematics. The use of a pre- and post-survey was to seek the development of knowledge, as per the focus on this inquiry. As such, the pre- and post-online surveys were identical in regards to these sets of questions described. Each of the above described questions utilized a 4-point Likert scale (Strongly Agree; Agree; Disagree; Strongly Disagree). This choice of the 4-point Likert scale, with no neutral position was chosen to elicit an opinion from the participants. To compensate for this structure, both the pre- and post-online survey offered the opportunity to elaborate on any questions posed and invited additional comments or feedback. The common questions of both the pre- and post-online survey can be found in their entirety in Appendix D. What follows is a breakdown of the question sets accompanied by an
explanation of the information each question sought. In each case two sets of questions will be shown. The first set of questions is indicative of questions that sought to understand the respondents’ own level of knowledge. The second set of questions is related to their beliefs about that particular knowledge type.

**Common Content Knowledge**

Common content knowledge is the knowledge of mathematics that is not specific to teaching (Ball, et al., 2005; Ball, et al., 2008). That is, it is the knowledge of mathematics that any individual may know or possess. The questions below were posed in order to solicit information from the participants of their own common content knowledge of mathematics. The emphasis on conceptual knowledge of mathematics is an important aspect of knowledge for teaching mathematics as it is this deeper understanding that can mobilize an understanding of how to teach the mathematics.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I solve mathematical problems with ease and little effort</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am able to answer mathematical questions by drawing upon my own knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have difficulty understanding mathematical concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I understand the conceptual interpretation behind mathematical procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have difficulty generating strategies to approach mathematical problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beliefs**

The following two questions are related to the respondent’s perception of the subject of mathematics. Their perceptions of the domain of mathematics provide insight into the depth of their knowledge of mathematics (Kajander, 2007).
<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is usually only one way to solve a mathematical problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics is completing a set of steps that need to be applied in a certain way</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Knowledge of Content and Teaching**

The knowledge of content and teaching is the knowledge of mathematics as it links to teaching this mathematical knowledge. This idea mobilizes the notion that to teach mathematics requires a different type of understanding that goes beyond what one knows about mathematics itself. In seeking the comfort level of the participants in teaching concepts within the various areas of mathematics sought to understand their perceptions of their knowledge of content and teaching. In addition, the final question in this set, which asks about their ideas about how to teach mathematics, touches upon another piece of knowledge of mathematical content and how to teach that content.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am comfortable teaching:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arithmetic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have a lot of ideas about how to teach mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beliefs**

As related to knowledge of mathematics and teaching, the following questions sought to understand the respondent’s beliefs about whether students should be shown many ways to approach mathematics. This question was also seen to be related to whether the respondents felt that mathematics is a set of pre-determined steps or not, as discussed in the common knowledge of mathematics.
<table>
<thead>
<tr>
<th>Students should be presented with a variety of ways to approach mathematics</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

**Knowledge of Content and Students**

In addition to knowing how to approach mathematics in an instructional way, an understanding of the students and their mathematical understanding is another key aspect of knowledge for teaching mathematics. The following questions in the survey sought to understand how the participants felt in regards to working with student and mathematics. Being able to understand student questions and student work is considered an intricate part of knowledge of students and teaching (Ball, et al., 2005; Ball, et al., 2008)

<table>
<thead>
<tr>
<th>I am comfortable answering mathematics questions posed by students:</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am comfortable with students generating their own approach to solving any given mathematics problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable reading and interpreting student work.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beliefs**

Literature has shown that teachers may teach mathematics in the way that they understand the concepts and not in a way that helps the student understand the material (Harel & Lim, 2004). In order to not only see the level of comfort and ability with working with students, the following statement sought to understand if the participant’s beliefs were consistent with the responses to questions relating to working with students to develop their own strategies.

<table>
<thead>
<tr>
<th>Students should develop their own understanding of mathematical concepts</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>
**Specialized Content Knowledge**

In contrast to common content knowledge, specialized content knowledge is the knowledge of mathematics that is specific to what a teacher would mobilize. There were few questions posed in this area as the participants, in their second year of a 4-year degree program, have had little experience with teaching mathematics and working with students. In addition, samples of questions that elicit information of the respondent’s specialized content knowledge often requires mathematical statements (e.g. Ball & Bass, 2002). As this survey intended to understand the respondents’ self-perceptions, such questions were deemed inappropriate for this survey. However, it is recognized that posing such questions may have provided more concrete information.

<table>
<thead>
<tr>
<th>I am able to explain a given concept in different ways</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am able to show students how to apply the mathematics learned in school to their lives</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beliefs**

To complement information from the respondents in regards to their ability to show students how mathematics is applied in the “real world”, it was important to also understand if this was something they felt to be an important aspect of teaching. The following statements thus served this purpose.

<table>
<thead>
<tr>
<th>Students should be shown how mathematics is applied to the “real world”</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics is seen all around us.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Knowledge of the Curriculum**

In addition to the knowledge of mathematics and its integration in teaching and with students, a teacher must have knowledge of the curriculum. That is, knowledge of the program of instruction and the materials that can be used to support the program.
These materials are often computer technology and the use of manipulatives. Accordingly, participants were asked of their level of comfort using these materials in their mathematics lessons.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I see how I can integrate computer technology into my mathematics lessons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable using manipulatives in my mathematics lessons</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Beliefs**

Consistent with the other question sets, the following two questions complemented responses to the respondents’ abilities to integrate computer technology and manipulatives in their mathematics lessons and whether they felt such practices to be necessary and/or beneficial.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer technology is a valuable tool in the mathematics classroom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manipulatives have little use in developing understanding of mathematical concepts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Attitude**

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoy teaching mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Finally, the respondents were asked whether they enjoy teaching mathematics or not. This was posed in order, if necessary, to understand any dynamics that may have emerged in the online discussions that would warrant understanding their feelings towards teaching mathematics.

Where the pre- and post-online surveys differed was related to the information
available before and after participation in the online discussion forum. Namely, it would only be possible to ask how the online discussion forum was used, and if and how they found it to be a resourceful tool after their participation. Demographic questions were thus posed in the pre-online survey in order to make each survey approximately the same length.

**Differences in the pre-online survey**

In addition to the question sets described, the pre-online also solicited demographic information (sex) and the mathematical background of the participants (their furthest mathematics course completed.) See Appendix D for details of these questions. The latter information was sought so that it would be possible, if necessary, to link the participants’ mathematical education to their responses in the questionnaire and/or contributions in the online forum. The two part question regarding the last mathematics course was to account for those students who entered this degree-program from an out-of-province secondary school. A response of “secondary school” as their last mathematics course would mean very different things for someone who studied out of province where there is no CEGEP. Thus, the second part of the question allowed me to fully understand the response to the first question.

**Differences in the post-online survey**

The post-online survey, in addition to the question sets described, solicited information related to how the online discussion forum helped (if at all) their confidence in teaching mathematics and how they used the online-discussion forum. This information was sought in order to understand how the participants viewed the online forum as a tool. It was thought that how the tool was used would provide some information into the needs of the participants while they were engaged in their field experience. These questions can be found in Appendix D.

**3.5.2 Online Discussion Forum.**

In order to understand how our individual experiences affect our construction of new knowledge, I created a closed online discussion forum. The online venue was chosen
to overcome the physical distance between individuals while it also provided a means for the participants to collaborate with each other, to share ideas and experiences. The design of this space involved three aspects: designing the space, creating accounts for the participants and assigning accounts to the participants.

**Designing the online space:**

The venue of the online space utilized the WebCT Vista platform. This choice was made over other web-based platforms (e.g. Yahoo groups) to address any privacy and ethical issues. Although most web-based platforms allowed for individuals to create their own accounts and profiles, the WebCT platform in addition supported an online administration of questionnaires/tests. This was important in the administration of the pre- and post-surveys. Further, this platform was familiar to the participant-pool, as it is widely used at this particular urban university. This served to alleviate any technical difficulties in learning new technology. As the participants’ field experience was only three-weeks in duration, it was desirable to ensure the online space was as easy to use as possible (Hough, et al., 2004).

Since this platform was used by the university, for university course administration, the design elements available were limited to those defined by the university. In particular, threaded discussions were used to set up topics of discussion that were thought to be of relevance to these pre-service teachers. These topics included “Introduction”, “Mathematics Questions”, “About Teaching” and “Random”. In addition a journal space, “Share”, was set up where individuals could share resources they had developed, and a blog space, “Open Mic” was set up so individuals could share accounts of their day or to simply keep a “journal” of their day to share with others. There was also a section in which to specifically share websites that may contain relevant or interesting material. In setting this particular section, I had included some notable mathematics websites with useful resources for any teacher of mathematics.

It was important that the participants had a feeling of ownership with this space. Thus, to ensure that the participants had a voice in how the online space was used and looked, I created a “Suggestion Box” discussion, to invite comments and suggestions of how to improve the space.
Creating accounts

The creating of accounts was done through the support system of the WebCT Vista at the university. In order to create the accounts, however, account names had to be generated. These account names served as the pseudonyms for the participants, in order to maintain their privacy and to keep their identities concealed. The choice of the pseudonyms used in this inquiry took into account the demographics of the participant population. The particular cohort from which the participants were drawn was heavily skewed in regards to the female-to-male ratio (140:6). Thus assigning pseudonyms that were gender-associated names would have made any male participant more easily identifiable than the female participants. To alleviate this concern, it was decided to create pseudonyms from inanimate objects. Since the technological tool driving the online environment required account names to have both a first and last name, this led to pseudonyms that were generated from mostly food items (e.g. Apple Pie).

Assigning accounts to participants

Participants of the closed online discussion forum were provided with one of the created pseudonyms. A third party assisted in the assignment of the pseudonym to each participant. This ensured that I had no information regarding to which participant each pseudonym belonged, which maintained the confidentiality of each participant. The pseudonym was the participant’s identifier on the closed online discussion forum and their real identity could not be revealed. Participants were encouraged not to share their pseudonyms with each other. Further, statements made in the online discussion could not identify the participant. Participants were asked to ensure their contributions did not identify them in other ways (such as revealing the location of their field experience, the names of any cooperating teachers and/or students.) This also served to protect individuals who were indirectly involved in this study. In the reporting of the project’s results, only pseudonyms were used.

The assignment of these accounts was done three weeks prior to the beginning of this study. The choice of this was to provide ample opportunity to log in to the space and to not only become familiar with the space but to create an environment they would feel comfortable using and working in. The “Suggestion Box” discussion thread was created
with this particular time period in mind, to gather ideas of how to organize the space. The “Suggestion box” discussion space remained open for the duration of the study.

3.6 Data Collection Process

The data in this inquiry was generated from the transcripts of an online discussion forum and from the surveys delivered both before and after participation in the online forum. The following describes how each of the developed data collection tools was used. As my role and background is an intertwined aspect of the data collection in the online discussion forum, I have explained here how my dual roles were navigated throughout the data collection process.

3.6.1 Survey Instruments.

The pre- and post-online surveys were administered through the online venue. The established anonymity of the participants through the use of third-party assigned pseudonyms allowed for both a pre- and post-survey to be administered in an equally anonymous fashion. Participants responded to the survey questions through a web-based medium and responses were sent to me without any information about the respondent.

3.6.2 Online Discussion Forum.

Consenting participants were invited to use a WebCT-based online discussion forum during their field experience. Members of the discussion forum shared their practice teaching experiences and posed questions to each other as they engaged in their field experience. I hoped in such a venue that individual perspectives and experiences would come through so that on an individual level, one could develop in his or her own negotiated trajectory of learning (Wenger, 1998). With the varying forms of knowledge from the participating members, each individual had access to a certain level of competence (Wenger, 1998) and in turn ha their own knowledge in which to share. Further, through these interactions I hoped to generate collective learning, by discovering shared knowledge and identifying, for example, best practices or new practices (Wenger, 1998). Thus, the closed online space responded to the characteristics of the chosen methodology by creating a research setting that respects that knowledge is individual and
is linked to individual contexts (Lincoln & Guba, 1985). In addition, it served the notion that learning involves mutual engagement and discourse (Wenger, 1998).

I believe that for a teacher to understand or to be aware of his or her teaching knowledge, s/he must be fully engaged in their practice, in a reflective, dialogic manner that allows for elements of his or her teaching knowledge to surface. It is through the interaction of these individualized understandings of teaching that the tacit nature of knowledge for teaching is explicated. When a teacher engages with other teachers, dialogue about teaching, learning and students become the subject of conversations. Elements of their respective knowledge bases for teaching naturally come to the surface through the process. This connection also helps individual teachers to make explicit the knowledge of teaching mathematics s/he possesses as dialogue facilitate the verbal expression of thoughts or ideas related to teaching. Until a teacher is able to verbalize these ideas, this knowledge resides solely within her, and is based exclusively on her experiences. Despite the very contextual nature of her knowledge, there is a sense of understanding and familiarity when she dialogues with other teachers about her practice. Wenger’s (1998) idea of learning as doing (practice) accounts for this phenomena, where the common enterprise of teaching as a practice allows for meaningful interaction to occur. In turn, these teachers are together then able to validate and refine their knowledge of teaching and are able to develop new understandings of what it means to be a teacher.

**Navigating my positioning**

Reflexivity refers to being aware of oneself and how that self is changing as a result of one’s research (Lincoln & Guba, 2003). I believe my role as a teaching assistant, by my role as a researcher and by my experience as a mathematics teacher influenced how contributions in the online space were interpreted. Here I will elaborate specifically on each of the roles I had in this inquiry and its effects on the online community and research.

As the teaching assistant of the participants’ mathematics pedagogy course I had built a working relationship with the participants of this study. As the connections made with the participants of this study were of a completely professional nature, the “pre-online” interactions between the participants and I related solely to discussions
surrounding their course on teaching mathematics. In this sense, the online discussion forum served as a continuation of these face-to-face dialogues. I hoped the established face-to-face connection would enhance the dialogue in the online community (Hough, et al., 2004), and add richness to the data collected that may not have otherwise occurred.

As a researcher, I brought to the research site my motivation to generate dialogue amongst the participants. I sought to function mainly as a monitor of discussions to enable the observation of how interactions of individuals may lead to knowledge development. In this sense I remained at arm’s length to the participants in this study in order to allow the discourse between the participants to come through in an honest and open way. In addition, to ensure my motivation as a researcher did not affect the direction of the online discussions or even the outcome of having any dialogue, I maintained a journal throughout my participation in the online community to truthfully and thoughtfully plan my participation and actions (Gray, 2004).

As a mathematics teacher, I saw my participants not as teachers-in-training but as fellow teachers. However, I consciously chose to limit my participation, a stance that was informed by how I view my own experiences as a mathematics teacher in relation to the participants. With more practical teaching experience than my participants, I understood myself to be on a different learning trajectory than what may have been more typical of my participants. I hoped to not (over) influence the participants. However, I recognized that by simply having a presence in the online space included me as a contributor to the space. I adopted a critical stance in how I contributed, with the intent to encourage further discussion by my participants. That is, I chose to elaborate on ideas already presented rather than present new ideas; or attempted to redirect questions to the group rather than provide solutions to problems on my own (Simonsen & Banfield, 2006).

In moving between my multiple roles, a reflexive practice was required in order to find a balance between listening to the participants as they developed their ideas, and seeing how my relationships with the participants affected and interacted with my own assumptions (Luttrell, 2000). This reflexive stance and how I viewed my participants were to ensure I did not categorized my participants into a pigeonhole, which may have not allowed me to fully understand any observed phenomena (Luttrell, 2000). Further, by balancing my various positions and roles, and their respective effects within this inquiry,
helped me to extract and analyze the true essence of the ideas and dialogue of my participants.

As a mathematics teacher, my ability to interact with the participants was heightened and consequently my own mathematics knowledge for teaching may have shifted and changed as a result of this inquiry. However, my role as an inquirer had to be clearly understood in order to maintain an “objectively subjective” stance (Lincoln & Guba, 1985, p. 103) attuned to observe and to understand any phenomena. Thus I had to negotiate my participation from the perspective of my own teaching experiences and from the perspective of a researcher. A back and forth movement occurred between the conscious effort to meaningfully interact with my participants as well as to step back and “see” how the participants’ (and my) mathematics knowledge for teaching developed. It was through this cooperation and interaction with the participants that data was generated. This social constructivist perspective further shaped the interpretations made throughout the inquiry within a context of shared understandings and practices (Schwandt, 2000).

Put together, the discourse from the online discussion forum, the pre-online and post-online surveys created a rich data set and made possible and analysis that generated theories that were grounded in the data (Lincoln & Guba, 1985).

3.7 Data Analysis

Throughout my participation in the online discussion forum, it was evident that my participants brought with them, just as I did, different ideas and perspectives of what it meant to teach (mathematics.) This realization led to identifying another source of information that would add rich detail to these individual learning trajectories. The initial analysis stages of the data were thus “interrupted” with the examination of this additional data source, a reflective assignment from the participants’ Mathematics pedagogy course. This section will elaborate on both the use of this reflective assignment as well as the data analysis processes used with the data collection tools developed for this study.

3.7.1 Reflective Assignment.

Additional information about the participants was found in the reflective
assignments (see Appendix E) associated with the participant pool’s volunteer work tutoring at a local community centre. This assignment required students to explain their tutoring experience from a factual point of view and to then write a reflection based upon their tutoring experience. This asked students to bring together their course work, to make observations about how children learn mathematics and to begin generating theories for themselves regarding how to teach mathematics. In addition, students were asked to examine themselves as mathematics users, learners and teachers.

As the teaching assistant of the participant pool’s Teaching Elementary Mathematics course, I read and graded each assignment submitted. Consent from 123 of 146 students to use their assignments for research purposes was granted independently by a third party. Only after the course was completed were the assignments revisited, examining each one with a different lens, seeking to build a participant-pool profile. With a global view of the nature of the assignments, I chose to examine the responses from the last two questions of the assignment. Each of these questions is presented below, explaining my rationale for its inclusion in building a profile of the participants.

What is your personal mathematics relationship? (3 points)
Tell us about your journey as a mathematics learner (from elementary school until now). What kind of mathematics user are you? What kinds of teacher do you think you are now, and what kind of teacher do you want to be? (I know this question could be personal, but we are not going to judge you if you hate math. In fact, this exercise may be a good way to come to grips with your feeling about mathematics and mathematics education).

This question was chosen to further understand the participant pool’s attitudes and beliefs about mathematics and teaching mathematics. In recognizing that my own training as a mathematician versus that of a mathematics teacher was very different, I sought to understand the perspectives from the point of view of my participants.

What did you learn from these tutoring experiences? (5 points)
Again, be specific. We want to see a strong thinking about your experiences. Tell us your strengths, your weakness and what you plan to do differently in the future.

This question served as a summation of the entire assignment. It brought forth much of what the students learned not only through their tutoring experience but through
their year’s work in the classroom as students. By specifically identifying their own strengths and weaknesses, responses to this question supported their self-conceptions of their skills and abilities in both mathematics and teaching mathematics. An individual’s skills and abilities in mathematics and teaching mathematics are seen to be aspects of that individual’s knowledge for teaching mathematics. This background information thus provided a means to support the analysis.

In order to extract the themes that emerged from the reflective assignments open coding (Strauss & Corbin, 1998) helped to understand the underlying beliefs and perceptions of the participant pool. As broad categories of knowledge emerged, axial coding (Strauss & Corbin, 1998) helped to specify subcategories that brought forth an understanding of the participants’ background, beliefs and development as a mathematics learner and mathematics teacher. This information supported the analysis of the online discourse and validated responses from both the pre- and post-online surveys. Since the reflective assignment was completed well in advance of the beginning of this study, the information gathered also enabled an understanding of the “starting point” of this group in their teacher-education program. This provided insight into the learning trajectories of the participant pool and thus formed a better picture of the development of knowledge that occurred as a result of participating in the online discussion forum.

3.7.2 Online Discussion Forum.

Having worked as a mathematics teacher for seven years, I have inevitably come to develop and apply different aspects of my own mathematical teaching knowledge. When handling the data, then, it was important that I was able to separate my own understanding with what emerged from the respondents. For example, when discussions involved the common terms associated with a (mathematics) teacher’s practice, it was essential that the meaning of such terms was attributed to the respondent and not to how I understood its meaning (Lincoln & Guba, 1985). Although my mathematical background may be seen as a disadvantage in this respect, it is also my knowledge of mathematics and teaching mathematics that enabled a deep, meaningful analysis of the data that may not otherwise have been achieved by a non-mathematics specialist. Adopting what Lincoln and Guba refer to as a “realized level” (1985, p. 103) of consciousness allowed
me to draw upon my own experiences, subjectivity, and understanding in a thoughtful way that enhanced the inquiry.

The analysis of the online discourse was approached using the methods of a content analysis (Strauss & Corbin, 1998) as a guide. The process of combing through the data began with open coding, the process of “opening up the text and exposing the thoughts, ideas and meaning contained therein in order to uncover, name and develop concepts” (Strauss & Corbin, 1998, p. 102). Concepts are seen to be categories or phenomena that are derived from the data itself (Strauss & Corbin, 1998). Through this process of identifying categories and phenomena, two main layers came through that led the analysis into two directions: examining the content of the discussions and examining the structures of participation.

**Content**

In examining the content of the discussions, the theoretical framework describing the knowledge of teaching mathematics served as the guide. I sought to comb through the data to identify aspects of knowledge for teaching mathematics that the participants identified or utilized in their discussions. The framework for knowledge of teaching mathematics served this inquiry well as it allowed the analysis to distinguish between the different forms of knowledge required to teach mathematics and how that knowledge is used. By reading and re-reading the transcripts from the online discussion forum, it was possible to see aspects of the different types of knowledge used to teach mathematics.

**Participation**

When examining human interactions, open coding served as a pivotal step in order to make meaning of each person’s comments within the context of a conversation. In particular, I was interested in how each person contributed to the discussion, how those contributions helped individuals create new understanding, how the discussions transgressed and transpired, and what (if any) resolutions occurred. As this inquiry seeks to examine both time- and context-related idiographic statements (Lincoln & Guba, 1985), there was a need to extract meaning that was situated within a context. Thus, predetermined categories were not used in this aspect of the analysis as it did not allow
for context-based extraction; it was virtually impossible to predict beforehand all characteristics of or aspects of the online discussion. Instead, I continuously examined and re-examined the data in order to make meaning of units of information (Lincoln & Guba, 1985). This recursive strategy of examining and re-examining the online discussions allowed for categories of meaning to come forth; in other words, the essence of the pre-service teachers’ discussions. Wenger’s (1998) community of practice, specifically the three characteristics distinguishing such a community (mutual engagement, negotiated joint enterprise and shared repertoire) were retroactively used to structure the presentation of the data and the data analysis.

Open coding, thus, produced an initial examination of the data that allowed me to describe the themes and patterns in the online discussion through both their characteristics (properties) and the variation of a property along a continuum (dimensions) (Strauss & Corbin, 1998). For example, the participants used the online forum to ask questions of their peers. The depth of the questions, however, varied. What follows is a sample that showcases the variation of questions that were posed.

Hello!! I'm introducing Area on Monday for my grade three class, and my supervisor will be there evaluating me. I was wonder if anyone had any interesting ways in which I can introduce this topic. Thanks!

I am set to teach the lesson next week to a group of grade 4 students about how to multiply using expanded form. They are just now being introduced to multiplication using 2 digit numbers. The textbook they use has only 2 pages on this topic, one and a half of which is an example, so I do not have much to fall back on there. I was wondering if anyone had any ideas about interesting ways to approach this topic with the class. They are a somewhat difficult group and 'lecturing' tends to inspire misbehaving, but so does group work... Also, there is a substantial variety of abilities in the class... some students are still having difficulties with 'regrouping' when adding/subtracting large numbers... Any advice would be appreciated!! :)

With a larger field of view of the data, I continued to examine the data and the categories discovered to determine if there were any relationships that could be formed
This process, axial coding, should not be considered as a sequential step to open coding as it is rather a constant comparison and examination of categories and relationships between those categories (Strauss & Corbin, 1998). The constant comparative method, as described, is seen as a “continuously growing process – each stage after time is transformed into the next – earlier stages do remain in operation simultaneously throughout the analysis and each provides continuous development to its successive stage until the analysis is terminated” (p. 105). When analyzing that data, I moved continuously between individual contributions and the content of those contributions to a larger view of the entire discussion and how those contributions shaped the outcome of each thread.

### 3.7.3 Survey Instruments.

The survey instruments ultimately served to support the analysis of the transcripts from the online discussion forum and the information gathered from the reflective assignments. The data from the surveys were summarized to understand the “mean” stance of the participants in terms of their knowledge for teaching mathematics and their knowledge of mathematics, as well as their beliefs about both. The comments gathered through the survey instrument also supported the themes extracted from the transcripts of the online discussions.

The intent of administering a pre- and post-online survey was to gather information about knowledge development and to examine the overall shift (if any) of perceptions of knowledge of mathematics or teaching mathematics. However, the number of completed post-online surveys (n = 6) was not considered to be substantial enough to see such a shift when the number of completed pre-online surveys was considerably higher (n = 17). Thus, in the analysis, only possible effects and outcomes are presented.

### 3.7.4 Coding Structures.

With three different sources of data it was necessary to develop an effective coding system. It was desirable to have not only easy reference to the various pieces of data but to also know the source of the data should further elaboration or cross-referencing be necessary. The rationale for the choice of codes used was to immediately
identify which of the three sources the data originated from. These codes and the coding structure are presented here and are utilized within the analysis presented in the next chapter. Table 1 summarizes the codes used.

**Reflective Assignment (RA)**

To maintain the anonymity of the participant pool and thus the participants, the randomly ordered assignments were each assigned a number from 1 to 123. For sorting purposes, three-digit numeration was used (e.g. 1 was written as 001). In doing so I was able to refer to the statements made and the ideas presented in any particular assignment without knowing the identity of the author. The prefix RA- (reflective assignment) was chosen, followed by the appropriate number to identify the source of any data referenced from the reflective assignments.

**Online Discussion Forum**

The data found within the online discussion forum was found to carry many dimensions. As the online forum consisted of different topics of discussion in order to organize the space, where discussion items were located was of particular importance. As previously discussed, these topics of discussion were: Introduction (I); Mathematics Questions (MQ); Open Mic (OM); Share (S); Suggestion Box (SB); About Teaching (AT); and Random (R). These prefixes, preceded by a “D” (discussion) were used to identify data from the online discussion forum contributions and in which topic of discussion it was found in. In addition, since each initial contribution to any of these discussions requires the contributor to enter a subject, the discussion threads can be identified using this subject. For example, a discussion thread entitled “hello!” contributed in the Introduction discussion topic would be referenced “DI-hello!”. In order to identify the participants in each discussion, the pseudonym of the contributor was used. For example, DI-hello!-Baked Alaska indicates the contribution was made by Baked Alaska.

**Survey Instruments**

The data collected from the survey instruments were from either questions or
The pre- and post-online surveys were identical with respect to the 28 Likert-questions that elicited the participants’ perceptions of their own mathematical knowledge and their own teaching knowledge of mathematics, as well as their attitudes and beliefs about mathematics and teaching mathematics. These questions were numbered 1 to 28. In referencing data from these questions, a prefix was used to identify whether the responses were gather from the pre-online survey (PREQ-) or the post-online survey (POSQ-) followed by the number of the question.

Any comments collected from either the pre- or post-online survey was numbered, starting at 1. To identify the source of any comments from the surveys, pre-online survey comments have been prefixed PREC-, followed by the appropriate number; post-online survey comments have been prefixed POSC-, followed by the appropriate number.

In addition, the post-online survey consisted of additional questions that solicited information about how the respondent used the online discussion forum. These questions
3.8 Rationale for Methodology and Methods

A naturalistic inquiry weaved together the elements of this inquiry in hopes to create a cohesive whole between meaningful data, interpretations and results (Lincoln & Guba, 1985). The complex nature of mathematics knowledge for teaching invited the use of collaboration to develop this knowledge. In addition, there was a need for this collaboration to be done in relation to one’s teaching practice, which inspired the use of an online venue. A naturalistic inquiry, that understands knowledge and the knower to interact and influence each other, further nestled this idea well. Thus, by creating a means for teachers to collaborate with each other in practice thereby provided a natural setting to examine the development of knowledge for teaching mathematics. Adopting a reflexive stance and moving between my own roles as mathematics teacher and researcher allowed for meaningful interpretations to be made.

3.9 Summary

This chapter has served as an examination of how this inquiry handled the examination of the development of knowledge for teaching mathematics in pre-service elementary teachers. The naturalistic inquiry was explored as it was seen to bring together both the intricate properties of mathematics knowledge for teaching (H. C. Hill, et al., 2008) and how this knowledge may develop through communities of practice (Wenger, 1998). Finally, examining how my own identity and background influenced the inquiry helped to understand the inquiry as a whole, including the process of analysing the data and the interpretation of the results.

The next chapter will present the transcripts of the discussion threads from the online forum. Themes, as related to this inquiry, will be drawn out and supported with the other data collection tools developed and the other information sources used.
In order to understand how participation in an online discussion forum could aid in the development of knowledge for teaching mathematics, I set up an online discussion forum for use during the field experience of pre-service teachers in their second year of a four year teacher education program. This field experience was three weeks in duration, and took place immediately following the end of the academic year. The online discussion forum was open for six weeks in total: starting two weeks prior to the commencement of the field experience and ending one week following the end of the field experience. In addition to the online discussion, I collected data through a survey instrument, designed to understand the respondents’ assessment of their own knowledge for teaching mathematics. A reflective assignment from my participant pool’s mathematics pedagogy course provided further insight into the self-assessments of knowledge and revealed other information that contributed to understanding the online discussions.

To understand the emerging themes in the online discussion, it was important to first understand my participants. In light of this, I will first present the data from the reflective assignment and the pre-online survey in order to paint a picture of my participants’ epistemological stances (DeBlois & Squalli, 2002) as they entered their field experience (and the online discussions), and my participants’ level of knowledge for teaching mathematics. These tie the online discussions together and accounts for the phenomena observed in the participants’ discourse. Finally, to bring the analysis together in a cohesive fashion, connections will be made that show how the community naturally developed the knowledge required to teach mathematics.

4.1 Reflective Assignment

The reflective assignment was completed by my participant pool towards the end of the academic year, and coincided with the beginning of the field experience. With this timing I was able to get a feel for both the understanding and the assumptions that my participants would bring with them into their field experience and into the online discussions. Prevalent was that each individual was continuing to develop an
understanding of their teaching practice and their knowledge for teaching mathematics. The reflective assignments brought to light several factors that affected the pre-service teachers’ continual development as teachers. These factors were their own experiences as a student, their perceptions of their mathematics knowledge, and their perceptions of the knowledge required to teach mathematics.

### 4.1.1 Experience as a student.

The impetus for becoming a teacher and in turn how one’s teaching practice is shaped is affected by that teacher’s own experience as a student (Ball & McDiarmid, 1989; Brown, et al., 1999; DeBlois & Squalli, 2002). The reflective assignment found this participant pool to be no different. In almost one-quarter of the assignments there was explicit mention of positive and negative experiences as a student that have affected how they see their own teacher-identity (e.g. RA004, RA021).

“Much of the reason why I chose teaching as a profession was in a way to correct how I was taught, to make up for it and make a different in the lives of other students” (RA004).

“In my experience, however, I had teachers who gave math an edge. This "edge" was their ability to connect math with to our everyday life and keep it "real" for us as students and everyday math users. This type of teaching plays a significant role in the teacher I plan to be” (RA021).

That is, one’s own experience as an elementary school student is shown to affect one’s vision of an ideal teacher. This information was not specifically sought in the assignment. Accordingly, it is significant that 25% of my participant-pool volunteered to share their experiences as a student and to make links to how this shapes the teacher they hope to be. It is possible that others in this pool have their own personal learning experiences that motivate their desire to be teachers, but chose not to write about it.

The effect of personal histories was seen to be an important aspect as I examined the online discussions, as it provided some insight into the lenses my participants were using to see and make sense of their own circumstances. In addition, it was clear that

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4 Reflective Assignment
5 A summary of the coding procedures can be found at the end of Chapter 3.
these personal experiences will continue to affect how these individuals approach their teaching practice (see RA078, RA028 for specific examples of this expression). How these individuals see their experience as a student affecting their teaching practice also led to an understanding of how these individuals understand the nature of mathematics and what is involved in learning mathematics.

“… I was good at memorizing what needed to be done, which is why once I got to high school it was much more difficult for me” (RA005).

Many individuals suggested that mathematics is procedural in nature. For example, some indicated this exact understanding of mathematics as they recounted their experiences of learning mathematics (e.g. RA005, as shown above, and RA010), referencing the idea of “steps” and the procedures of mathematics. Generally, my participant pool’s understanding of mathematics came through as they recounted their personal learning histories as elementary school students, with many expressions of a weak mathematical knowledge base. However, when speaking or referring to their perceptions of their own mathematics knowledge, the distinction between mathematics knowledge and knowledge for teaching mathematics came through in an interesting way.

4.1.2 Perceptions of Mathematics Knowledge.

“I had a difficult time when trying to work out concepts I wasn't familiar about because it has been such a long time I have done elementary school mathematics” (RA016).

“At this point in time, I feel that my key weakness is my lack of ability to express the reasoning behind my understanding of mathematical concepts (I understand it, but I am not exactly sure why)” (RA118)

“Some mathematical concepts in the elementary curriculum have only been taught to me last semester, such as bases, whereas with others, I have lost practise with, such as long division. I can only hope to get better at explaining and doing math problems and computations over the years with practise” (RA041)

Almost one-fifth of my participant pool made explicit that they felt one of their weaknesses was the lack of knowledge of elementary school mathematical content. As

6 See Appendix C.
seen in the recollection of their own experience as an elementary school student, this mathematical knowledge was often referred to as a procedural entity. Furthermore, the many instances of these voluntary and candid expressions of low levels of mathematical understanding may indicate that there are more individuals who feel their mathematics knowledge is not strong. Of particular interest was the consistent mention of teaching mathematics while self-assessing their mathematical knowledge. That is, the stance taken to address their mathematical knowledge seemed to be within their role as a student in the mathematics pedagogy course in a B.Ed program. This is thought to be the case as my participant pool readily situated their respective knowledge of mathematics within their potential ability to teach mathematics (as opposed to their existing ability). For example, some individuals noted that their weak knowledge of mathematics would enable them to better understand student misconceptions (e.g. RA031, RA050). For others a weak understanding of mathematics served as motivation to solidify their understanding of mathematical concepts as it was only with this knowledge that they could truly be effective teachers (e.g. RA045, RA042).

My participant pool readily commented on the prospective effects of their mathematical knowledge, examining their teaching practice as a future entity. It is this projected look at their teaching practice that highlighted the student-stance of my participant pool. The reflective assignment did not allow for further analysis of the mathematical knowledge of my participant pool as any expressions of lack of mathematical knowledge were seen to be tied directly to some aspect of teaching mathematics. Thus, it was difficult to isolate mathematics knowledge as my participants readily tied knowledge of mathematics to knowledge of teaching mathematics.

How individuals were able to link their knowledge of mathematics to teaching mathematics also revealed, in some cases, a shift in perspective, from a student in a pre-service teacher education program to a teacher (see excerpts below, RA058 and RA071, for examples of this). That is, some in my participant-pool appear to have confronted their own challenges, no longer seeing mathematics as an obstacle and have positioned themselves to teach mathematics (Brown, et al., 1999). In turn, this lead to an understanding of what my participants saw as the necessary knowledge to teach mathematics.
“I have been looking at math all wrong my entire life … I don't just want to teach how to do math, I want my students to understand why we do things a certain way” (RA058).

“I really like the idea that there are fixed answers. However, mathematics these days have changed a lot since I was in elementary school. Many questions are open-ended, require exploration and experimentation, and certainly are different from how I was taught” (RA071).

4.1.3 Nature of what knowledge is required to teach mathematics.

The expressions of knowledge of mathematics and how it relates to teaching mathematics led to expressed ideas of what my participant pool saw as the required knowledge to teach mathematics. This brought forth an interesting dimension of knowledge of content and teaching (KCT): knowing many ways to explain one mathematical concept. This idea was explicitly repeated in 17% of the reflective assignments, where individuals felt in order to develop as a mathematics teacher they will need to first develop a repertoire of teaching methods for the various mathematical concepts in the curriculum. This idea is supported by the pre-online survey as well, where knowing how to teach mathematics was equated most often with having many teaching strategies (PREQ14). In addition, 40% of the respondents of the pre-online survey indicated that they were not able to explain a given mathematical concept in different ways (PREQ23). Being able to generate a “bank” of teaching ideas was thus seen as a possible motivating factor to participate in this study, as the online discussion forum allowed individuals to share their lessons and teaching ideas. In their reflective assignments, the participant pool directly linked the desire to develop multiple teaching strategies to the students in the classroom, recognizing that it is not sufficient to have just one method of instruction given the variety of learners in the classroom. The idea of variety of teaching approaches thus emerged as an important aspect of knowledge of content and teaching (KCT).

4.1.4 Summary – The emergent identity.

The reflective assignment made evident the different perspectives that my
participant pool was negotiating. As a whole, these three themes (the perception of mathematics, the perceptions of one’s own mathematics knowledge and the perceptions of the required knowledge to teach mathematics), represent the different epistemological stances (Brown, et al., 1999; DeBlois & Squalli, 2002) of these pre-service students as they navigate through their teacher-education program. As former students they have formed preconceptions about what teaching should involve. These conceptions are based on either rectifying negative experiences or validating ways of teaching from positive experiences. As university students in a teacher-education program, they are confronting their knowledge of mathematics and understanding the effects of their knowledge on how they will teach mathematics. Thus, this role as a university student is seen as a process that bridges the gap between the conceptions formed as a student (in elementary school) and the conceptions they develop as a prospective teacher (Brown, et al., 1999; DeBlois & Squalli, 2002). In this way my participants were confronting both their understanding of knowledge for mathematics and their understanding of being a teacher. Finally, as individuals entering the teaching profession, my participants also revealed their ideas concerning the knowledge required to teach mathematics well. This knowledge was found to be situated between the boundary of a university student and a teacher. These three stances affecting the collective identity of my participant-pool appear related to their understanding of both the knowledge of mathematics and the knowledge to teach mathematics. The pre-online survey was able to provide further insight into my participants’ collective knowledge of both.

4.2 Pre-Online Survey

The pre-online survey was designed to understand the level of knowledge for teaching mathematics that my participants possessed and used in the online discussions. Each aspect of the knowledge for teaching mathematics (Ball, et al., 2008) is examined in order to provide a view of my participants’ knowledge base for mathematics and teaching mathematics.

4.2.1 Common content knowledge.

Common content knowledge can be considered as the knowledge of mathematics
that any individual may possess, and is not specialized to teaching or any other profession or practice. The pre-online survey found that the majority of my participants perceived themselves to have competent mathematical abilities (PREQ19\(^7\), see Table 2). However, upon examining subsequent questions and their responses, there is less indication that this equates to a good understanding of the mathematical concepts themselves. It was expected with the high level of agreement of being able to solve mathematical questions on their own (PREQ19), that a high level of agreement would be repeated when asked if they can solve problems with ease and little effort (PREQ18). This trend was also seen, although with fewer “negative” responses, when asked if it is difficult for them to generate strategies to solve problems (PREQ22).

My participants’ waning confidence in working with mathematical problems may be explained by the responses given that relate to the understanding of mathematical concepts. One-third of my participants reported having both difficulties understanding mathematical concepts and understanding the rationale behind their procedural knowledge of mathematics (PREQ20, PREQ21 see Table 3). It is of interest to note that one-third of the respondents also indicated that they believe mathematics involves completing a set of procedures (PREQ12), although most agreed that there could be more than one way to solve a mathematical problem (PREQ10).

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\(^7\) Pre-online survey question
The responses to these questions were cross referenced to discover that a small portion of the respondents believed that mathematics only involves performing these procedures \( n = 3 \), see Table 4; however, these individuals also felt they had a conceptual understanding behind these mathematical procedures. The emphasized value indicates that the majority of the respondents felt that they have a conceptual understanding of mathematical procedures and understand that conceptual understanding to be a part of mathematics \( n = 8 \). Of those that felt their conceptual understanding was not fully developed \( n = 6 \), half appeared to understand that this conceptual understanding is lacking where the other half, who believe mathematics is a set of procedures, may not feel their understanding of mathematics is lacking in any dimension. However, not many individuals appeared to have a procedural-focus of mathematics. Of the individuals who believe that mathematics is a set of procedures, only two of them believed that there is only one way in which to solve a mathematical problem (see Table 5). The high number of responses that indicated mathematics problems can be solved in more than one way points to the notion that my participants do not see mathematics as a procedural entity but that deeper understanding, or at the very least, variety in procedures, is a part of mathematics.

My participants range in their understanding of both the nature of mathematics and their own mathematics knowledge. The pre-online survey indicated that the majority of the respondents have developed or are developing a conceptual appreciation of mathematics. However, there are still individuals who are continuing to develop a deeper understanding of mathematics, still needing to move past the procedures and to develop a conceptual understanding of mathematics. The indication (from the pre-online survey) of my participants’ varying levels of knowledge of mathematics is consistent with the data collected from their reflective assignments. The development of knowledge of mathematics is seen as an important advancement in order for a pre-service teacher to mobilize their knowledge in a teacher context (Ball & Bass, 2002). As will be seen within the other elements of the pre-online survey, my participants’ have more confidence in their specialized content knowledge, knowledge of content and teaching, and knowledge of content and students than what was expressed in their own mathematical knowledge.
Table 3

<table>
<thead>
<tr>
<th>PREQ20</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have difficulty understanding mathematical concepts</td>
<td>1</td>
<td>5</td>
<td>10</td>
<td>1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>PREQ21</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I understand the conceptual interpretation behind mathematical procedures</td>
<td>0</td>
<td>11</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>PREQ10</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is usually only one way to solve a mathematical problem</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PREQ12</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics is completing a set of steps that need to be applied in a certain way</td>
<td>1</td>
<td>5</td>
<td>10</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4

<table>
<thead>
<tr>
<th>Mathematics is a set of procedures</th>
<th>Have conceptual understanding</th>
<th>Agree / Strongly Agree</th>
<th>Disagree / Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree / Strongly Agree</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Disagree / Strongly Disagree</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Table 5

<table>
<thead>
<tr>
<th>Mathematics is a set of procedures</th>
<th>One way to solve a mathematics problem</th>
<th>Agree / Strongly Agree</th>
<th>Disagree / Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree / Strongly Agree</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Disagree / Strongly Disagree</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
4.2.2 Specialized Content Knowledge.

The pre-online survey elicited some information regarding mathematical knowledge specific to teaching. The importance of such knowledge was acknowledged by my participants, who agreed that mathematics is in fact seen all around us and that a student should be shown how mathematics is in fact applied in the “real world” (PREQ11, PREQ16, see Table 6). Further, most of my participants felt that they had the ability to show students the applicability of mathematics (PREQ27). This strong self-assessment of their specialized knowledge of mathematics was not considered to be consistent with my participants’ perceptions of their own mathematical knowledge. Knowing mathematics in a way that is specialized to teaching is seen as a higher order form of knowledge than knowing mathematics. Thus, the lower level of confidence of mathematical knowledge and the relatively high level of confidence of knowledge for teaching mathematics yields interesting results. My participants indicated that they see knowledge required for teaching as separate and unrelated to mathematical knowledge. It is noted that the questions posed in the survey did not specifically reference mathematical content and this may account for the response patterns seen in the pre-online survey. That is, by seeking confidence levels of teaching mathematics without specifying an area of mathematics, it is possible my participants’ high levels of confidence for teaching mathematics pertain only to certain areas of mathematics. For example, a response indicating ability to show students the applicability of mathematics to the real world may have been made with a specific example in mind as opposed to a more holistic vision of how mathematics is used in everyday life. Examining the responses related to the knowledge of content and teaching, and the knowledge of content and students allowed for further understanding of the occurring phenomenon.

4.2.3 Knowledge of Content and Teaching.

The knowledge of content and teaching describes the knowledge of how to teach a particular mathematical concept. In the pre-online survey, an overwhelming number of my participants indicated they are comfortable teaching arithmetic, geometry and measurement (PREQ1–3, see Table 7). There is less agreement in their comfort level of teaching statistics and probability (PREQ4–5). This overall confidence of my
Table 6

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREQ11</td>
<td>Students should be shown how mathematics is applied to the “real world”</td>
<td>12</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>PREQ16</td>
<td>Mathematics is seen all around us</td>
<td>13</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>PREQ27</td>
<td>I am able to show students how to apply the mathematics learned in school to their lives</td>
<td>0</td>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

participants’ ability to teach the various strands in mathematics is in stark contrast to their confidence in and their perception of their mathematical abilities. That is, the level of confidence portrayed in teaching mathematics is not commensurate to the level of confidence in their mathematical ability, offering further indication that my participants do in fact consider knowledge for teaching to be separate from their own knowledge of mathematics.

It should be noted that one of my participants clarified his/her responses in the pre-online survey by noting that with little teaching experience it is hard to know how effective they are at teaching mathematics (PREC4). Although s/he was the only one to suggest this idea, given that all my participants were at the same stage in their teacher education program, it is plausible that my participants were all in a similar situation. In this way, just as the reflective assignments revealed, the university student quality of my participants (in opposition to their teacher-quality), comes to the forefront as an important part of their identity.

4.2.4 Knowledge of Content and Students.

Knowledge of content and students is another realm of mobilizing one’s knowledge of mathematics, with a focus on the student and the student’s understanding and development of mathematical concepts. The pre-online survey indicated that many of my participants have a high level of comfort and
Table 7

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREQ1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable teaching arithmetic</td>
<td>2</td>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PREQ2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable teaching geometry</td>
<td>2</td>
<td>11</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>PREQ3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable teaching measurement</td>
<td>4</td>
<td>11</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>PREQ4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable teaching statistics</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>PREQ5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable teaching probability</td>
<td>0</td>
<td>7</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

confidence in their ability to work with students, to listen to student ideas, and to understand student difficulties (PREQ25 and PREQ26, see Table 8). This appears to confirm that my participants see their own knowledge of mathematics as unrelated to their ability to teach that mathematical content. In addition, this reveals a group of aspiring teachers who are truly focused on their students and the needs of their students. This is reiterated in a subsequent question in the pre-online survey, where all respondents agreed that it is in fact crucial for students to develop their own understanding of mathematical concepts (PREQ13, see Table 8). The reflective assignments support this high level of comfort, confidence and ability to work with students. Many of the reflections included in-depth description of student actions and student behaviours. This is a testament to the astute observation skills of many of these pre-service teachers and their intense focus on their students. On the other hand, when asked of their comfort level handling student questions (PREQ6, see Table 8), less confidence was found amongst my participants. Although the majority agreed that they were confident in addressing student questions, more individuals stated that they feel more
Table 8

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREQ25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable with students generating their own approach to solving any given mathematics problem</td>
<td>2</td>
<td>14</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>PREQ26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable reading and interpreting student work</td>
<td>1</td>
<td>15</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>PREQ6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable answering mathematics questions posed by students</td>
<td>2</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>PREQ13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students should develop their own understanding of mathematical concepts</td>
<td>8</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

trepidation when dealing with student questions than with any other aspect of teaching students.

Overall, there is a visible contrast in the assessment of one’s own knowledge of mathematics and one’s own knowledge of and ability to teach mathematics. As it is believed that knowing mathematics is the basis to be able to teach mathematics (Ball & Bass, 2002; Ball & McDiarmid, 1989; Shulman, 1986, 1987), it is possible that some of my participants have not yet been able to confront their own mathematical knowledge. This lack of confrontation was confirmed after examining how my participants see the place of curriculum resources in their teaching practice.

4.2.5 Knowledge of Curriculum.

Knowledge of the curriculum is a large component of a teacher’s work. Knowing the curriculum is synonymous with knowing what and how one must teach in the classroom. The pre-online survey revealed how my participants see the role of curriculum resources in their teaching practice.
“I found that without the guide of the book or a teachers (sic) manual I cannot teach math” (PREC1).

“I think that if I have a student math book to refer to that this will definitely (sic) help me a lot. I could use the student textbook to gauge how much students need to learn about a certain concept” (PREC3).

What both these individuals expressed was the belief that textbooks are the source of information regarding what content needs to be taught. In other words, the textbook is seen as the source of knowledge of the curriculum. This is particularly prevalent in PREC3, where the textbook is cited as the guide to knowing how much detail should be given to the mathematical content in a lesson. The comment in PREC1, that without a textbook this individual is unable to teach mathematics, also suggests the wealth of knowledge a textbook is perceived to provide. However, as this comment is vague in nature, the comment in PREC1 could also indicate an inability to teach because of a lack of knowledge of the depth that needs to be given to the content, or it may be linked to a lack of mathematical knowledge (common content knowledge) or any other form of knowledge required to teach mathematics (e.g. knowledge of mathematics and teaching, or knowledge of mathematics and students). A weak base in any form of knowledge for teaching mathematics is possible, as revealed in other aspects of the pre-online survey.

In relation to knowledge of the curriculum, the pre-online survey asked participants about their knowledge of using various technologies in the classroom. As using computer technology and manipulatives have become an integral part of learning in the 21st century, this was seen as an important attribute of the knowledge of the curriculum to examine. My participants indicated a high level of comfort using manipulatives in their mathematics lessons, but less so when it came to computer technology (see Table 9). It is also noteworthy that all respondents felt that manipulatives have value in the classroom, however not all of them felt computer technology has an equally prominent place. As such, it appeared that my participants were entering their field experience with little knowledge of what and how knowledge needs to be passed on to students (i.e. knowledge of the curriculum).

---

8 Pre-online survey comment
### Table 9

<table>
<thead>
<tr>
<th>PREQ7</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I see how I can integrate computer technology into my mathematics lessons</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PREQ8</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am comfortable using manipulatives in my mathematics lessons</td>
<td>8</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PREQ15</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer technology is a valuable tool in the mathematics classroom</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PREQ17</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manipulatives have little use in developing understanding of mathematical concepts</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

### 4.2.6 Summary – Characteristics of my participants.

The reflective assignment and the pre-online survey provided a picture of my participants as they began their practical experience in schools. The reflective assignment provided an understanding of the roles my participants were navigating as prospective elementary school teachers (a former elementary school student; a student in a teacher-education program; and a teacher). The pre-online survey revealed that my participants hold a relatively low level of mathematical knowledge and knowledge of the curriculum but a relatively high level of knowledge related to teaching mathematics. Consistent with the expressions made in the reflective assignment, the pre-online survey also revealed that my participants saw the knowledge of mathematics and the knowledge for teaching mathematics as disjoint bodies.

This constructed understanding of my participants and their collective knowledge base for teaching mathematics allowed me to analyze the online discussions in a reflexive way. By moving back and forth between the built understanding of my participants and their contributions in the online discussions, I was able to develop an insight that would not have been otherwise possible. What emerged was the effect of the navigating roles of student and of teacher on my participants’ knowledge for teaching mathematics. Further, I
was able to make sense of the community formation as I was able to extract meaning from the individual contributions and gauge their impact on the greater online community. There were clear patterns of how my participants interacted, what they interacted about and how their development as a teacher helped them collectively create an understanding of themselves.

In order to fully understand the online discussions, an overview of the nature of participation (e.g. the number of active contributors to the discussions and the levels of participation) are presented next. This will provide an understanding of the nature of the data set collected online before presenting the actual discussion threads.

4.3 Participation

In total there were ninety-nine login sessions amongst my participants throughout the six weeks that the online space was open for use. Although my participants were provided with access information (user names and passwords) three weeks prior to the start of their field experience, the level of participation and general activity in the online discussion forum was most active in the first two weeks of the field experience.

Within the six weeks, 23 participants logged-in to the online space. These participants each varied in their use of the online venue, in terms of both the number of contributions and the number of logins. Figure 1 illustrates a distribution of the levels of participation throughout the study by plotting, for each participant, the number of contributions made (y-axis) and the number of times they logged-in to the online forum (x-axis). Eight of these participants logged-in one time each and made no contributions to any of the discussions. Of these, four individuals completed the pre-online survey. Two of my participants logged-in twice, both early in the field experience, and both contributed just one item in one of the discussion threads. These two participants completed the pre-online survey. There were three participants classified as “lurkers”. These participants logged into the online space on multiple occasions throughout the field

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9 Due to the anonymous nature of the submissions, it was not possible to distinguish between the respondents of the online survey. However, since the survey intended to understand the general beliefs and conceptions of the entire participant-pool, all the data collected from the pre-online survey were used in the analysis, despite the respondent’s nature of participation.
experience but did not contribute to any of the discussions. In addition to these lurkers, four of my participants carried a similar characteristic that they logged-in on multiple occasions throughout the field experience and contributed to just one discussion thread. In most cases, this contribution involved introducing themselves and did not involve engagement in any discussions related to teaching or to mathematics. The core of the online discussions was between six participants who were engaged with the online space throughout their field experience. Five of these participants logged-in regularly, posed questions to the group and provided their opinion or feedback to the current discussions online. The sixth participant is who I have called “super-user” as s/he logged in just twice, about three weeks apart, but read all the discussions s/he had missed in her “absence”, and contributed to each.

The relatively low number of active participants in the online discussion can be attributed to a number of factors. Some participants experienced technical difficulties that prevented them from successfully logging-in. As it was not possible to coordinate a time to meet to resolve these issues in person, the participants were given the contact information of the university’s technical help desk. The added initiative to actively seek
out the help desk may have caused some individuals to self-withdraw from the study. Others revealed in the online discussion (DI – No Math For Me and DMQ – gr. 6 math) that they did not have the opportunity to teach mathematics in this particular field experience. This is due to the necessity that pre-service teachers follow their cooperating teacher’s timetable. For those that did participate, some revealed in the post-online survey that the short duration of the field experience did not allow for enough time to use the online space (see POSC2\textsuperscript{10}, POSC3). A cyclical consequence to the lack of time is the prompting of others to not use the space, as it was not seen as helpful when participants could not elicit the help and advice from their peers. However, with the feedback that was sought and given, my participants indicated that they found the online space to be beneficial for its collaborative features (e.g. POSC2, POSC4).

How my participants shared ideas and opinions with each other will be examined by analysing entire discussion threads from the online discussion forum. In order to understand the feel of the online discussion forum, discussion threads are presented in sequential order, based on the initial post. This will showcase how the discussions grew and evolved over the course of my participants’ respective field experiences. The online discussion forum was set up to promote collaboration amongst my participants. What I sought to investigate was how these collaborations affected the development of knowledge for teaching mathematics. Accordingly, the analysis of the discussions seeks to find evidence of community formation, drawing upon Wenger’s (1998) notion of community (mutual engagement, joint enterprise and shared repertoire) and the development of knowledge for teaching mathematics (Ball, et al., 2008). As each thread is presented, aspects of mutual engagement, joint enterprise and shared repertoire (Wenger, 1998) as well as the knowledge for teaching mathematics (Ball, et al., 2008) are examined as they emerge in the various online discussions threads. As each thread may not contain evidence of all these aspects, only relevant elements will be discussed. This presentation will show the cumulative development that occurred online.

In order to preserve the feel of the online venue and the voice of my participants, the transcripts from the online discussions are presented as entered by my participants within the online discussion. However, with the inevitability of typing errors in this

\textsuperscript{10} Post-online survey comment
asynchronous environment, I have taken care to correct minor typing errors to ensure comprehension of my participant’s voice, thoughts, and ideas.

4.4 The Online Discussions

4.4.1 “Good Luck”.

<table>
<thead>
<tr>
<th>DR – Good Luck</th>
<th>NL, 26 April 2009 20:41:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“Have a great first day, everyone!”</td>
</tr>
</tbody>
</table>

Chocolate Souffle, 28 April 2009 21:35:
“Thanks it was awesome. It was great to finally be back in the schools!”

Coconut Tart, 5 May 2009 20:23:
“It has been a great one and a half weeks. It goes by so quickly.”

Cinnamon Bun, 8 May 2009 18:05:
“I find that it goes by too quickly also. I wish we had our stages 8 weeks like Concordia. They get more hands on experience compared to us where we have lots of lectures/courses to attend...yuck. Some courses are helpful but I believe you only really learn what it is to be a teacher when you are actually in the classroom learning from the students and the cooperative teacher”

Corn Bread, 9 May 2009 00:30:
“It is such a wonderful feeling to be in the elementary school classroom. All semester long, we learn theory, and finally, we are given the chance to put theory into practice :) It’s almost as if everything is coming to life. Every time I teach, I am constantly reassured that this is my profession.”

**Mutual Engagement**

I initiated this discussion thread having noticed that in the lead up time to the field experience, my participants were logging-in, however, they were not making themselves visible by posting contributions. This posting did ultimately generate dialogue, although two days lapsed before the first response was made. Another week elapsed before any flow occurred in this discussion thread (and before other discussion threads were

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11 The coding structure used to reference the data is discussed in the previous chapter.

12 The indentation structure shown is reflective of the nature of the online discussions, illustrating the response pattern of each contribution. In the discussion “Good Luck” (DR – Good Luck), the indentation of both Chocolate Souffle’s and Coconut Tart’s contributions are to show their response to NL’s post; Cinnamon Bun’s contribution is further indented as it was in response to Coconut Tart’s contribution. Corn Bread’s contribution is “out-dented” as it was in response to the post made by NL.
created). This response-time is indicative of how my participants chose to engage with each other. As indicated in the post-online survey (POSC2), the infrequent postings made it difficult for others to use the space effectively. However, this did not change or seem to affect how my participants interacted with each other online. Long response times continued to be characteristic in subsequently generated discussion threads. Another characteristic of the engagement in this online venue was the pattern of dialogue. Although this discussion thread was initiated by a short remark, patterns in other discussion threads indicate that dialogue flowed readily when initiation was in the form of a question (e.g. DMQ – gr. 6 math, DAT – Area\textsuperscript{13}). When postings involved sharing thoughts or frustrations (e.g. DOM – Exams), feedback or response was not generated. Thus, how my participants engaged with each other followed a question-answer format.

*How* my participants chose to interact with each other ties in about what they chose to interact. That these two aspects of my participants’ communication were so intertwined with one another is indicative of what Wenger (1998) deemed as the complexity of how community members develop a means to engage in their practice. The “Good Luck” discussion thread provided a first glance at how the discussions amongst my participants helped me understand how my participants collectively understood themselves. In particular, this discussion thread developed as the discussion shifted to how my participants saw their role as pre-service teachers. As revealed in this discussion thread, and as will be shown in other discussion threads, my participants were manoeuvring between both a student-role and a teacher-role. The question-answer format of their engagement not only reflects this movement but indicates that my participants are leaning towards the student-role of their pre-service teacher identity. This was evidenced by the observation that answers, responses, and dialogue came only by first asking a question.

**Joint Enterprise**

As the discussion forum slowly came to life my participants expressed quite easily their desire to be in schools as a teacher (as opposed to being a student in their

\textsuperscript{13} These referenced discussion threads can be found in the verbatim. In addition, they are each discussed in detail later in this chapter.
teacher-education program.) The positive expression of being in the classroom could be explained by the long time-lapse since their last field experience. As these individuals are in the second year of their teacher-education program and their last field experience was at the beginning of their first year, it has been almost two years since they have been in the classroom. In this initial discussion thread, Cinnamon Bun\textsuperscript{14} brings to light another reason for the in-school preference of my participants.

“… we have lots of lectures/courses to attend...yuck. Some courses are helpful but I believe you only really learn what it is to be a teacher when you are actually in the classroom learning from the students and the cooperative teacher” (DR – Good Luck – Cinnamon Bun).

What comes out clearly is the idea that a pre-service teacher’s subjection to classes, which exposes them to theories about teaching, is not enjoyable. Cinnamon Bun’s comments conclude with the expression that theory is something they must simply endure until they can get into the classroom and learn. The idea that practical experience is what is sought in this teacher education program is consistent with Laferriere \textit{et al.} (2000) who have said that pre-service teachers often criticize their teacher education program for a lack of coherence between theory and practice. On the other hand, there is little indication within this thread of what aspects of teaching my participants are being exposed to in their respective field experiences. This is of particular importance as it has been seen that pre-service teachers are often brought into a utopian world in their first experiences in the field, and although beneficial, it does not promote the type of generative thinking and development that will endure in a teacher’s practice (Philipp, Thanheiser, & Clement, 2002).

There is a variation to the perspective of the lesser benefits of in-class sessions in teacher education. As illustrated by Corn Bread, and in contrast to Cinnamon Bun, there may be a complementary relationship between theory and practice.

“All semester long, we learn theory, and finally, we are given the chance to put theory into practice :) It’s almost as if everything is coming to life” (DR – Good Luck – Corn Bread).

Although there is little detail of exactly what is coming together for Corn Bread, we see

\textsuperscript{14} A pseudonym
how this individual sees their teacher-education more holistically than what Cinnamon Bun describes. The depth of the postings, however, does not allow us to see specifics about the pieces that are contributing to either positive or negative experiences in this teacher-education program. What is consistent, however, within both posts is the notion that my participants find themselves in two contexts of learning: that in the university setting as students and in the school setting as professionals (Brown, et al., 1999; DeBlois & Squalli, 2002). Within this online community, my participants began to navigate through these two roles as they developed a working-understanding of how to handle the two learning contexts. This joint enterprise developed within the online community is seen as an intricate part of the community because it is my participants’ shared struggle between student and teacher that they must understand and respond to as they move along the continuum from student to teacher. Where each participant located themselves along this continuum, and how the perspective of student and teacher overlapped each other, was seen to affect how and about what they interacted.

For example, many of my participants worked within a professional environment in a school with students in a classroom. This perspective of learning was seen to be inextricably embedded in the student perspective of learning. The data revealed that part of the struggle that some pre-service teachers experience is with the relationship they have with their cooperating teacher (CT). The CT is the classroom teacher who has agreed to work with a pre-service teacher in his/her classroom. In this sense, the CT plays a big role in a pre-service teacher’s field experience. As indicated in this discussion thread, many of my participants feel a real classroom (with a CT) is the main site in which they can learn about teaching. However, the learning experience is heavily bound by what the CT does, and what the CT provides and/or allows the pre-service teacher to do. As such, there is a constant reminder for my participants that they are in someone else’s classroom. This situation is typical of any pre-service teacher as their training enters a real classroom.

The discussion thread “Good Luck” focused on expressions of happiness to be working in a school classroom in a teaching capacity. In addition, this thread brought out my participants’ preference for a teaching role over the role as a student in a teacher-education program. The evidence of these duelling roles did not include any specific
practices that reveal a shared repertoire, to share ideas and knowledge, nor did it include the development of any knowledge for teaching mathematics. The next discussion thread reiterates the duelling roles of my participants, and it also reveals elements of my participants’ shared repertoire and their knowledge for teaching mathematics.

4.4.2 “gr. 6 math”

<table>
<thead>
<tr>
<th>DMQ – gr. 6 math</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baked Alaska, 27 April 2009 19:06:</td>
</tr>
<tr>
<td>“Hello people. I have been put into a grade 6 class for this stage. However, this is currently the time of the grade 6 provincial exams. I am also in an emmersion [sic] school, which means that I am only teaching LA and Math. Currently, the students are doing the LA exam, so all I have to teach is math. BUT! the teacher is doing review for the math exam. I have yet to see the exam and only know that fractions and measurement will be on it. Can anyone give me any tips?”</td>
</tr>
</tbody>
</table>

| NL, 30 April 302009 14:51: |
| “hmmm ... I am not familiar with how the provincial exams work in Quebec. Would the MELS website have some information that might help you? Maybe someone else has some ideas or knows of a resource that can point you in the right direction? In the meantime, I'll keep an eye out for anything useful. This sounds like a great opportunity for you! BTW - I have posted a handful of mathematics-related websites in the "weblinks" section of this space. If you have any to add, please do.” |

| Coconut Tart, 5 May 5 2009 20:18: |
| “I am in the same position and had a chance to look at the exam today. You may want to teach changing fractions into % as well as probability. I am lucky my CT showed me some of the situational problems from the past years, and I am using those to review for the math exam. Hope that helps” |

**Mutual Engagement**

The fact that Baked Alaska posed a specific question related to his/her teaching situation appears to have helped bring forth feedback and ideas from other participants. Although the discussion did not involve dialogue, individuals did suggest ideas of where to find resources for the provincial exam, which illustrates how the interactions occurred in this online venue. It is noteworthy to see that I too responded in this question-initiated

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15 Language Arts
16 Ministère de l’Éducation, du Loisir et du Sport
thread, but failed to respond, like my participants, in threads that were initiated by comments or reflections.

In addition to the form of initiation, the resolution of this thread was ultimately made by Coconut Tart, who presented information in an absolute way, referencing his/her access to the provincial exam itself. This point is further discussed in a subsequent section, related to the shared resources of this community. What is of interest here is that Coconut Tart brought forth his/her information almost a week after the initiation of this thread. We see again the long response time, although this is perhaps more reflective of Coconut Tart’s participation. Coconut Tart, who was the earlier mentioned “super-user”, did not log-in to the online space frequently but when logged-in, s/he read any new messages and contributed to discussions. His/her contribution here is indicative of that and reflects that s/he had relevant information to share. As Coconut Tart’s contribution indicates, s/he and Baked Alaska had similar teaching settings.

**Joint Enterprise**

This similar learning situation further proved to provide Coconut Tart with the ability to help Baked Alaska as they both handled a similar struggle in their field experience. Baked Alaska’s expression of frustration is perhaps not as forthcoming as Coconut Tart’s. However, there is a clearly presented conflict. In seeking some classroom teaching time with students, Baked Alaska explains that her placement in an immersion school leaves only Language Arts and Mathematics in his/her repertoire. However, since students are writing the provincial exam in Language Arts (implying that there are currently no Language Arts lessons to deliver) and since the CT is reviewing mathematics with the students, this leaves nothing for Baked Alaska to do. In this sense we see the familiar teaching perspective embedded within the student learning perspective. On the other hand, Baked Alaska does not seem to be able to emerge from this embedded

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17 Although the university is located in a French-speaking province, the language of instruction is in English. However, many of the students who attend this university are bilingual (French and English) and may complete their field experience in either a bilingual or immersion (French) classroom, based on their comfort level. Others may choose to complete their field experience where English is the language of instruction. This may be the case in Baked Alaska’s situation. Alternatively, Baked Alaska’s cooperating teacher may only instruct the Language Arts and Mathematics components of the elementary school curriculum. As a pre-service teacher in a field experience, Baked Alaska would then follow his/her cooperating teacher’s timetable.
perspective as Coconut Tart did. This illustrates how the development of each individual varied in this community. However, as information was shared amongst my participants, it became evident that some shared development occurred in way of knowledge for teaching mathematics. In this case, we see that Coconut Tart has information, but Baked Alaska does not. However, once Coconut Tart shared this information, both individuals know the same information. The passing of information between Coconut Tart and Baked Alaska allowed the other members of the community, by way of their participation (i.e. reading the interaction between Coconut Tart and Baked Alaska), to also acquire the same information.

**Shared Repertoire**

Coconut Tart’s and Baked Alaska’s parallel experiences not only serves to solidify the enterprise that the members of this community find themselves (between student and teacher) but also shows how collaboration allowed for the passing of information that may otherwise not have been able to be shared. That is, Coconut Tart was able to provide some insight as s/he developed some knowledge in an area in which Baked Alaska sought.

“I am in the same position and had a chance to look at the exam today. You may want to teach changing fractions into % as well as probability. I am lucky my CT showed me some of the situational problems from the past years, and I am using those to review for the math exam. Hope that helps.” (DMQ – gr. 6 math – Coconut Tart).

Both Baked Alaska and Coconut Tart inferred that knowing the provincial exam required seeing the provincial exam itself. There was a feeling of absolute truth related to the information that the provincial exam provided. That my participants understand the curriculum through “secondary resources” (that is, not from the curriculum documents) is indicative of how they understand the teaching practice. They have built their knowledge of what to teach by using resources built from the curriculum but not the curriculum itself. This was evidenced earlier in the pre-online survey (PREC1, PREC3), where textbooks were regarded as another source of curriculum knowledge. In addition, the lack of knowledge of the curriculum documents themselves rendered my own suggestion (to
visit the province’s Ministry of Education website) to be unaddressed. This is thought to have been because using such direct resources of the curriculum was not within the scope of my participants.

In using the provincial exams as a source of information also suggests that my participants have a certain understanding of how information is passed along. In the way Coconut Tart passed on knowledge from the provincial exam suggests that “official” Ministry documents served as a part of a shared repertoire (Wenger, 1998) of this community. The provincial exam was seen to contain information that helped my participants understand how to prepare students for the provincial exam. However, this repertoire is not unique to this online community but is a part of the community of teachers that my participants are also a part of. Thus, what appears again is the embedded student perspective within a teacher perspective. Particularly evident here is how my participants viewed the provincial exam as a source of information that may differ from that of a practising teacher.

In examining my own positioning within this community, there is a clear distinction in how my participants and I interpreted and used these curriculum resources and materials. The participants of this study find themselves closer to the student end of the continuum from student to teacher, and I find myself closer to the teacher end. Our respective knowledge of the curriculum varied in an analogous way. Being an outsider to this province, my initial assessment of my knowledge of the provincial exam was on par with my participants. However, I considered my interpretation of how to prepare students for a provincial exam to be different than that of my participants, recognizing that the provincial exam itself is not the only relevant resource to help prepare students. As such, how my participants use and interpret the curriculum resources available to them is seen as specific to this community and a mode of their repertoire of sharing information. This phenomenon is seen again in other discussion threads where my participants discuss the use of textbooks when preparing for a lesson.

**Knowledge for Teaching Mathematics**

The focus on the provincial exam brings forth another aspect within this community related to how my participants’ development of knowledge affects how they
are able to engage with each other. In reviewing Baked Alaska’s contribution, the following excerpt stood out.

“I have yet to see the exam and only know that fractions and measurement will be on it. Can anyone give me any tips?” (DMQ – gr. 6 math – Baked Alaska).

As the content of the provincial exams related directly to the curriculum documents of this province, Baked Alaska alluded to a lack of knowledge of the curriculum (Ball, et al., 2008). That Baked Alaska specifically noted that s/he had not seen the exam itself insinuated that this was the reason for his/her lack of knowledge in this area. In addition to a lack of knowledge in way of curriculum content, Baked Alaska’s comment also indicates how s/he is unaware of other resources that could provide the information s/he seeks. In this sense we also see the lack of curriculum knowledge in way of materials. For example, the provincial curriculum documents would contain insight into the contents of the provincial exam. This resource, however, is not evidenced as a shared repertoire of this community. In my own contribution to this thread, my immediate suggestion was to reference the province’s Ministry of Education website for information. This point did not seem to be acknowledged. But what appeared to have resolved the discussion thread was Coconut Tart’s contribution, which sourced information from the provincial exam itself.

This discussion thread elaborated upon the two perspectives my participants were navigating: student and teacher. The question-answer format of my participants’ interactions was revealed, and was seen to be indicative of the student-perspective with which my participants viewed their learning. However, there was evidence that my participants were aware of and using common teacher resources, such as the provincial exam, to facilitate their work. Although this work mimicked the characteristic work of a teacher, the student-perspective was seen to dominant over the teacher-perspective. Overall, the content of my participants’ discussion was directly related to grappling the roles of student and teacher.
4.4.3 “multiplying in expanded form”

MAT – Multiplying In Expanded Form

Date Square, 30 April 30 2009 21:05:
I am set to teach the lesson next week to a group of grade 4 students about how to multiply using expanded form. They are just now being introduced to multiplication using 2 digit numbers. The textbook they use has only 2 pages on this topic, one and a half of which is an example, so I do not have much to fall back on there. I was wondering if anyone had any ideas about interesting ways to approach this topic with the class. They are a somewhat difficult group and 'lecturing' tends to inspire misbehaving, but so does group work... Also, there is a substantial variety of abilities in the class... some students are still having difficulties with 'regrouping' when adding/subtracting large numbers... Any advice would be appreciated!! :)

NL 4 May 2009 14:28:
You bring up a good point that the textbook does not always offer us teachers enough to go on to build a lesson around. Just so we are all clear, what do you mean by "multiplying using expanded form"? Maybe an example would help?

Date Square 6 May 2009 21:35:
| 54 x 3 = |
| 5 tens + 4 ones x 3= |
| 15 tens + 12 ones= |
| 16 tens + 2 ones = |
| 1 hundred + 6 tens + 2 ones= 162 |

I know this seems like an odd way to multiply... but it gets around the 'double digit' issue some new learners have, as it breaks the equation up into tens and ones... then the students have to 'regroup' and add to get the answer.

NL 6 May 6 2009 21:47:
This is interesting. It really seems to me that it brings home the idea of place value. I wonder if base-ten blocks could be available for students to use to represent the multiplication? Maybe letting them work together to "piece" the product together? Or is there another tool that could be used? I am just thinking "out loud" right now ...

**Mutual Engagement**

Noteworthy within this discussion thread was the lack of contributions from other
members of the community. My attempt to bring others in by eliciting further explanation related to Date Square’s term “multiplying in expanded form” drew no responses from other individuals. Also noteworthy was that the level of detail in Date Square’s posting was unparalleled in the other discussion threads. This point is even more significant when one takes into account that the posting was one of the first queries posted in the online forum. The engagement of participants in any community is first and foremost based on the competency of all members (Wenger, 1998). Given the post was made so early in the study, my participants were just shifting from the student perspective to teacher perspective. It is possible that the lack of responses was due to the inability of my participants to engage with Date Square’s relatively detailed observations and insightful comments. The result was a discussion between only Date Square and me, possibly the only two members of the community at a certain level of competence. That is not to say my participants were not competent in way of teaching but rather they had not yet developed a means in which to discuss teaching ideas in such detail. In a complementary observation, when my participants shared some common ground they were able to engage with each other with apparent ease (DMQ – gr. 6 math). This connection suggests that the position of an individual along the student-teacher continuum affects with whom that individual can engage with in discussion. The discussions that were able to generate contributions from a wider range of members of the community were those that seemed to tap into the student perspective of my participants.

It also appears that where an individual is in their teacher development also relates to their depth of knowledge for teaching mathematics. Although this point is discussed later, it suffices to point out now that Date Square reveals s/he has a high level of understanding of his/her students. It is also believed that one’s knowledge for teaching mathematics is reflective of one’s place along the student-teacher continuum. In turn, the student-teacher continuum affects not only with whom one interacts but also affects the content of the interactions. In this sense, the joint enterprise between the members of the community (i.e. the duality of student perspective and teacher perspective) may function co-dependently with the knowledge for teaching mathematics. For example, contrasting Date Square (DAT – multiplying in expanded form) and Baked Alaska (DMQ – gr. 6 math), we see that being further along the continuum towards a teacher and away from a
student also results in more advanced knowledge of content and teaching, and knowledge of content and students.

**Joint Enterprise**

As revealed in the discussion threads, my participants were moving along a continuum between student and teacher. That my participants were unable to engage with and assist Date Square with his/her question provides some indication of where my participants lay along the student-teacher continuum. As suggested in their previous interactions, the student-perspective appears to be the dominant lens used in the discussions. Date Square, on the other hand, may be further along this continuum and is closer to the teacher end of the spectrum. That is, s/he has displayed more advanced observations related to teaching that suggests his/her teacher-perspective is more balanced with his/her student perspective. In Date Square’s particular case, it is not believed that s/he is seeing his/her practice from a complete teacher lens. This is due to how Date Square referenced the use of a textbook within his/her teaching practice which, as discussed earlier, suggests an elementary view of knowledge of the curriculum.

**Shared Repertoire**

As Date Square provides a context for his/her situation, teaching multiplication to grade 4 students, the dilemma posed centres on the textbook having limited content related to the topic of interest.

DAT – multiplying in expanded form – Date Square:
The textbook they use has only 2 pages on this topic, one and a half of which is an example, so I do not have much to fall back on there. I was wondering if anyone had any ideas about interesting ways to approach this topic with the class.

There is evidence here of the limited view of resources that may help one develop an understanding of the curriculum and how to teach that material. Like the issue with the provincial exam as the only source to know what is on the provincial exam, there appears to be a lack of resourcefulness in way of materials to draw upon to create lessons. Furthermore, Date Square’s comment, which sought ideas of how to teach “multiplication
in expanded form”, was interpreted as a lack of knowledge of content and teaching. The rationale behind this is the specific request for teaching ideas as s/he found the textbook to not provide enough information in which to base a lesson.

How my participants used resources such as textbooks and provincial exams could be a result of the fact that my participants are pre-service teachers with little experience in the field. For many of them, this particular field experience may be the first time they have been provided with teaching opportunities, as the first year field experience is devoted mostly to classroom observations. With these first teaching opportunities, pre-service teachers are only now engaging in lesson planning and as such, are only beginning to familiarize themselves with teaching resources. This explanation for their behaviour is embedded in the idea that their student-lens dominates their view of teaching.

**Knowledge for Teaching Mathematics**

Despite the lack of previous practical experience, Date Square indicated a strong level of knowledge of mathematics and students. As the discussion thread developed, Date Square described, in detail, the clientele in the classroom, as well as a fairly comprehensive set of observations related to the difficulties the students were experiencing.

DAT – multiplying in expanded form – Date Square:
They are a somewhat difficult group and 'lecturing' tends to inspire misbehaving, but so does group work... Also, there is a substantial variety of abilities in the class... some students are still having difficulties with 'regrouping' when adding/subtracting large numbers...

I was interested to see how Date Square’s question would develop into a discussion amongst my participants. After a few days there were no responses to Date Square’s query, despite the fact that other discussion threads had begun or were developing at the same time. In an attempt to generate some discussion, I asked Date Square for an example of what “multiplying in expanded form” involved, thinking there may be a gap in understanding the terminology Date Square used. Date Square’s relatively prompt reply, although one week after the initial query, led me to reconsider the lack of
knowledge of content and teaching that I originally saw in the initial post.

<table>
<thead>
<tr>
<th>54 x 3 =</th>
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<tbody>
<tr>
<td>5 tens + 4 ones x 3 =</td>
</tr>
<tr>
<td>15 tens + 12 ones =</td>
</tr>
<tr>
<td>16 tens + 2 ones =</td>
</tr>
<tr>
<td>1 hundred + 6 tens + 2 ones = 162</td>
</tr>
</tbody>
</table>

“I know this seems like an odd way to multiply... but it gets around the 'double digit' issue some new learners have, as it breaks the equation up into tens and ones... then the students have to 'regroup' and add to get the answer” (DAT — multiplying in expanded form — Date Square).

Date Square was able to not only present the material as an example, but s/he provides a rationale for using this method of multiplication with students who are just learning how to multiply 2-digit numbers. As such, Date Square is drawing upon knowledge of content and teaching as well as knowledge of content and students, by considering the teaching benefits of this method, while also integrating an understanding of the difficulties students may experience learning this content. Date Square has shown here that the knowledge of content and teaching and the knowledge of content and students are subtly related. Specifically, Date Square refers to the “double digit” issue that students experience when learning how to multiply, and then presents the expanded form of multiplication as a way to present the material to overcome the cited student difficulties.

The “multiplying in expanded form” thread provided further insight into the effects of the student- and the teacher-perspectives my participants were navigating. This discussion revealed a student-teacher continuum of growth and how one’s placement in this continuum affected both who could engage in particular discussions and about what those discussions consisted. In particular, what was seen was that an individual who was further developed in his/her teacher role was unable to solicit help from his/her peers whose thinking was dominated by a student-perspective. It was also revealed that along with provincial exams, textbooks served as another vehicle in which my participants passed on knowledge of mathematics and teaching mathematics. The evidenced use of
this shared repertoire further embeds my participants within the greater community of teachers, but also revealed their level of knowledge of the curriculum.

4.4.4 “help with something for stage?”.

<table>
<thead>
<tr>
<th>DS – help with something for stage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baked Alaska 5 May 2009 19:26:</td>
</tr>
<tr>
<td>Hi, people. As most of you know, we have to do an article review for our seminar. Any one (sic) know of a good place to find teacher journals?</td>
</tr>
<tr>
<td>Coconut Tart 5 May 2009 20:20:</td>
</tr>
<tr>
<td>Look in the database on the McGill Library web site, you will find all the articles there.</td>
</tr>
</tbody>
</table>

**Mutual Engagement**

This question-answer format was typical of the form of engagement that the members of this community adopted. That is, the question-answer format of discussions was prevalent throughout the forum and in fact was the only circumstance in which discussions were created (as opposed to single posts). As such, the mutual engagement of the members of this community was fuelled by the posting of questions, seeking answers or ideas. As evidenced by another discussion thread (see DOM – Exams), posted reflections did not generate any discussion, even when those reflections voiced common feelings of my participants (e.g. struggling to find a way in which to work with the cooperating teacher and to find an active role (i.e. teaching) in the classroom.) In this sense the community did not serve as a means of support but rather as a place in which to share and/or pass on information.

**Joint Enterprise**

With the specific reference to the seminar course my participants attended each week of their field experience, my participants’ student perspective creeps back into the community. Similar to other discussion threads presented, the existence of a question in the initial post prompted someone to respond, creating a, albeit short, discussion thread.

This short discussion thread, between two participants functioning within their
student-role, does not touch upon the development of knowledge for teaching mathematics. In addition to the immersion in this student-role, there is no evidence of a shared repertoire related to teaching mathematics. What is noteworthy is the dominance the student-role took in this discussion and re-iterates the general dominance of this perspective over that of a teacher amongst my participants. This was seen in the question-answer format used to transit information. The passing of information through questions and answers is seen again in the final presented discussion thread (see “Area”). This discussion thread brings to question the motivation in which my participants sought information, suggesting that the student perspective of my participants took a front seat to the teacher perspective.

4.4.5 “Exams”

DOM – Exams

Coconut Tart, 5 May 2009 20:23:
I was very frustrated at the beginning of my Stage because the students are in exams as well as there is very little time to teach due to the other class such as art, gym, music as well as science and a special project that has to be done by the end of May. I wanted to be able to teach lessons, but I didn't know what to teach because my CT told me that she had stopped teaching. Things changed today when we got a hold of the Math exam, and now we as a team are working together to prepare the students. I am now really really enjoying my stage.

Mutual Engagement

This particular posting by Coconut Tart did not receive any feedback from the other participants. As seen, the means of engaging in this community followed a question-answer format. Here, Coconut Tart is not seeking help or posing any questions but rather is sharing his/her first week’s experience in their field experience. The answer-only-when-asked form of communication is again evident and serves to confirm the question-answer engagement of this community. Upon reflection, my own participation

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18 In this province, students write a compulsory provincial exam at the end of Cycle 3, which in most cases coincides with the successful completion of 6 years of elementary school education. Students write an examination in Mathematics (Ministère de l’Éducation du Loisir et du Sport (MELS), 2005c), in English Language Arts (MELS, 2005b) and in French Language Arts (MELS, 2005a), covering material that is intended to be in the spirit of the province’s curriculum program. Students also write an examination in French Language Arts at the end of Cycle 2, or year 4 of elementary school. Further information can be found at the Ministry of Education website for this province.
showcases a similar form of communication. It is noteworthy that I also chose not to respond to this post. That I adopted this means of communication may further emphasize the modes of interaction in this community.

*Joint Enterprise*

Coconut Tart reveals a somewhat “hands-tied” stance that all pre-service teachers must take. That is, although Coconut Tart hoped to deliver lessons as part of his/her field experience, this was not possible because of the circumstances presented (other subjects to teach, a special project, and upon arrival in this school, the CT was no longer presenting new material to the students). In a turn of events, Coconut Tart suggested a much more positive experience once s/he was in a collaborative relationship with his/her CT. This collaborative working relationship with his/her CT is seen to have helped Coconut Tart develop as a teacher. That is, Coconut Tart found him/herself engaging in a working relationship with another teacher, treated as a partner rather than student by his/her CT. As seen in another one of his/her contributions (in DMQ – gr. 6 math), there is indication that through this working relationship Coconut Tart also developed both in confidence of and general facility with the knowledge for teaching mathematics.

The “Exams” discussion thread is a post in which one participant shared his/her feelings and emotions about their field experience. The single post clearly outlines Coconut Tart’s personal field experience context, and does not lead to any development of teaching mathematics nor a shared repertoire between s/he and the other participants. However, the lack of response in this thread is indicative of how my participants interacted with each other, and further developed the idea of struggle between the role of a student and (wanting to be) a teacher. Despite the clear desire to “be” a teacher, this discussion thread reinforced the dominant student-perspective of my participants.
4.4.6 “Area”

DAT - Area

Boston Cream, 7 May 2009 21:35:
Hello!! I'm introducing Area on Monday for my grade three class, and my supervisor will be there evaluating me. I was wonder if anyone had any interesting ways in which I can introduce this topic. Thanks!

Cinnamon Bun, 8 May 2009 18:00:
maybe you could use the area of your classroom, like we did in math lab. hopefully you have good measuring manipulative to measure the floor. You could first use informal measuring unit such as cut out giant's feet then use formal measuring unit such a metre stick.

NL, 9 May 2009 09:18:
Good idea! I was thinking something along the same lines in terms of using the classroom. I was thinking about painting a mural on one side of the classroom (well, on mural paper that is the size of the wall ... painting the actual wall may not be the best idea!) and creating a frame for the mural. I say the latter only to try to link/distinguish between perimeter (something they already know?) and area.
I also like your idea about using some pre-cut shape to measure. Maybe this could be a good way to have the class discuss ways in which they could estimate the length of the room.

Mutual Engagement

The general form of interaction illustrates again a question-answer format of discussion. As requested, ideas were generated, however details were lacking. A lack of detail and rationale was seen in my own contribution to this discussion. In retrospect I was surprised as I re-read my contribution for its lack of detail and reasoning. In particular, in my recalled attempt to bring in the comparison between area (painting a mural) and perimeter (framing the mural) I failed to elaborate on the reasoning for this (that students learning area may confuse area with perimeter). Thus as I engaged in this study (participated in the online forum), I found myself having to change my way of communication in order to find a common ground in order to communicate with other members of the community. This was evidenced in the “Exams” discussion where like my participants, I did not respond to a post that did not take the form of a question. This
mode of interaction was seen to be an important realization. In contrast, Date Square (in “multiplying in expanded form”) maintained a high level of detail, of observations and provided rationale for his/her statements, but was unable to participate in the same dialogic way that other discussion threads revealed.

Joint Enterprise

Boston Cream’s initial post generates two interesting points. The first is related to the mention of an evaluation. As discussed earlier, the pre-service teachers are supervised during the field experience. Part of the supervision process involves an evaluation of the pre-service teacher in a teaching capacity. The fact that Boston Cream was soliciting ideas seems to be a direct consequence of an upcoming evaluation. This again reveals the student-perspective dominating over the teacher-perspective of my participants. The second point of interest relates to the description of the teaching context. In particularly, the considerable lack of detail provided by Boston Cream in comparison to what Date Square provided in DAT-multiplying in expanded form. This contrast saw an inverse relationship in response time to the request for ideas. In Date Square’s case, no contributions were made even 3 days after the initial post; Boston Cream gathered ideas within 24 hours. It is difficult to determine the exact reason for this. However, after reflection, it is evident that Boston Cream’s query effectively taps into the student perspective of the members by presenting the experience of an evaluation, and presents a relatively less complex problem by not elaborating on the context of his/her upcoming lesson. Together, this made responding much easier as generic ideas could (and were) presented.

The ideas generated also makes visible the embedded professional experience within the student learning perspective. Examining the response by Cinnamon Bun illustrates this idea well.

“maybe you could use the area of your classroom, like we did in math lab. hopefully you have good measuring manipulative to measure the floor. You could first use informal measuring unit such as cut out giant's feet then use formal measuring unit such a metre stick” (DAT – Area – Cinnamon Bun).

First, it is noted that Cinnamon Bun references an activity in which the members engaged
during their mathematics pedagogy course (math lab). This is reflective of resorting back
to the student-perspective of the community, drawing upon their recent course learning.
In addition, contrasting this with Date Square’s question and the lack of responses to that
query, we also see a clear continuum in terms of knowledge base. Here, ideas are
presented to handle an introduction to area. This is considered a form for knowledge of
content and teaching as it relates to teaching ideas and activities for area. The responses
provide little detail of how the activities will pan out and no rationale is provided for
choosing these activities. We see a simple pooling of ideas. In its true form, however, the
knowledge of content and teaching should comprise of ideas of how to teach a particular
topic and an understanding of why such ideas (may) work (Ball, et al., 2008).

**Knowledge for Teaching Mathematics**

In initiating this discussion thread, Boston Cream touches upon a recurring theme
related to my participants’ ideas of knowledge for teaching mathematics. In 26 (21% of
the respondents) of the assignments, students explicitly expressed the desire and
importance of making mathematics “fun” or “enjoyable” for students. Perhaps in reaction
to many of their negative experiences learning mathematics, their perception is that
mathematics must be portrayed as an interesting subject in order for students to be
engaged. Boston Cream’s query to seek ideas of how to teach a particular mathematics
topic engages this idea.

“I was wonder if anyone had any interesting ways in which I can introduce
this topic” (DAT – “Area” – Boston Cream, emphasis added).

There appears to be an understanding that it is important to present material in an
accessible way that appeals to students. This notion is seen as a form of
knowledge of content and students, as the individuals are bridging the
mathematical content with a fun and engaging activity for the students. In this
realm, understanding how this may be accomplished involves knowing what
students will be able to identify with so that they have a jumping-off point to then
investigate the mathematics involved. Further evidence of this form of knowledge
of content and students is found in DAT – “multiplying in expanded form”.

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“Area”, one of the last initiated discussion threads, predominantly showcased my participants’ student-roles overshadowing their teacher-roles. This is evidenced by the reference to both a supervisor’s evaluation as well as the mathematics pedagogy course (math lab). With the isolated reference to the math lab, the mathematics pedagogy course is not seen as a predominant form of a shared repertoire. However it is possible that my participants formulated their respective postings based on the information they gathered through their pedagogy course. In this sense, the materials and the content developed and discussed in the mathematics pedagogy course may serve as shared repertoire, however, this is not evidenced within the holistic view of the discussion threads of the online discussion forum.

4.5 Summary

The reflective assignment revealed that my participants’ respective teaching practices are affected by their experience as an elementary school student. As prospective teachers, my participants also found themselves moving between their roles as a university student and a teacher. The online discussions further revealed that my participants were leaning towards the student-perspective of learning. An assessment of their knowledge for teaching mathematics is consistent with this stance, as shown in the pre-online survey as well as the content of their online discussions. In particular, how my participants created a way to interact with one another and about what they interacted highlighted that my participants were still in the early stages of teacher development. How these highlighted themes impacted the development of knowledge to teach mathematics in this professional online community is discussed in the next chapter. This discussion brings together the online discourse in a holistic way in order to understand how the knowledge for teaching mathematics is developed in a community of practice.
5 Discussion - Understanding the Online Community

This chapter will reflect upon the themes that emerged in the data. In doing so, I hope to bring together ideas seen within this inquiry and to situate these themes in and among the existing research. This inquiry sought to understand how pre-service teachers’ participation in an online professional community would impact their development of knowledge to teach mathematics. In this sense there are two areas in which the discussion must focus on: the formation of an online community; and the development of knowledge to teach mathematics. The examination of the discussion threads from the online community made it possible to understand the sense of community that was built. This examination made it possible to not only understand my participants’ level of knowledge for teaching mathematics but also how their knowledge affected the formation of their community. By observing the interactions and discourse in this online community, it was possible to extract the different types of teaching knowledge that pre-service teachers possess; to examine how the various forms of teaching knowledge were used in practice; to understand what collegiality and relationships formed online; and to understand how those relationships can help individual teachers develop their respective teaching practices. What was evidenced was that my participants’ level of knowledge to teach mathematics affected the type of community formed. This community was characterized by a certain way of communicating that spoke to the student role of my participants. In a cyclical relationship, this student-identity was also tightly woven with their level of knowledge to teach mathematics, which in turn affected the community that formed.

What this highlights is that the community itself and the characteristics of the community members are integral to the development of knowledge to teach mathematics. Although the analysis sought to identify aspects of community formation through mutual engagement, joint enterprise and shared repertoire, I was also looking for evidence of knowledge specific to teaching mathematics. What was found was the community itself, in way of how my participants interacted with each other (mutual engagement), how they understood their group-identity (joint enterprise) and the means to share and pass on information (shared repertoire) was inextricably tied to what they currently know about teaching mathematics. In turn, the community helped to develop my participants’
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collective knowledge to teach mathematics. Thus, in order to discuss the formation of this community, it is necessary to embed aspects of the knowledge to teach mathematics within the functioning of the community. Table 10 summarizes the overarching results of the analysis, highlighting the aspects of knowledge for teaching mathematics and their effect on the various aspects of community formation. This chapter will elaborate on each of these emerging themes in order to make full meaning of the results.

5.1 Mutual Engagement

5.1.1 Levels of participation.

Contributions to the discussions in this online venue were made by a handful of
individuals. However, there still existed varying levels of participation in the online community: from active contributors to those that logged-in frequently without making postings. This level of participation, in terms of numbers of contributing participants and how often the online community was used, replicates the participation levels of other online venues used in both educational and non-educational settings. In studying online teacher communities, Selwyn (2000) observed similar heavy use by only a small portion of the participants, attributing the lack of activity to members feeling stronger ties to another face-to-face community, such as their own school setting. This may be a contributing factor in this inquiry, as my participants attended a weekly seminar course during their three-week field experience. As discussed in a previous chapter, this seminar course allowed my participants some face-to-face time with each other, where they had some opportunity to share thoughts and reflections on their respective field experiences.

The fact that my participants were able to connect with each other and other pre-service teachers in a face-to-face meeting could have hindered the dialogue in the online discussion forum. For example, if support and advice was solicited in the seminar course, any one of my participants may not have felt it necessary to log-in and pose the same question to the members of the online community. Accordingly, one of the contributing factors to successful online discussion is membership that comprises of competent individuals with a shared interest of work but find it difficult to meet face-to-face (Riel & Levin, 1990). However, the existence of face-to-face interactions is not consistently accounted for in the literature. Where face-to-face interactions have been found to decrease participation levels online (Stephens & Hartmann, 2004), others have attributed high online participation levels to established face-to-face relationships which also increase trust issues in online spaces (Hough, et al., 2004)

This implies the face-to-face connection my participants found in their seminar course was not the only factor affecting the use of this online forum. However, the fact that my participants had a seminar course to attend emphasizes the student-perspective of my participants. This perspective did affect the online community. In particular, it was seen that how my participants interpreted their surroundings was predominantly done from the point-of-view of a student, rather than that of a teacher. As individuals learning to be teachers, my participants used the online community as a means to collaborate with
each other, to share ideas and to develop a repertoire of teaching ideas. Although these activities are characteristic of a teacher, other aspects of their participation (subsequently discussed) revealed that my participants were still in the early stages of their teacher-development. This is not necessarily an alarming observation as my participants were drawn from the second year of a four-year teacher-education program, considered to be within the beginning years of one’s teacher development. Examining individuals further along in their teacher-education program may have yielded different results and different perspectives adopted by the participants. As evidenced in other studies, participants near the end of their teacher-education program, for example, yield individuals who are leaning more towards the teacher-perspective of their learning and work (e.g. Dalgarno & Colgan, 2007; Goos & Bennison, 2008).

How far along each of my participants were in this development from student to teacher was found to affect which individuals interacted with whom. In discussions where the student-perspective dominated the content of the discussion there were more individuals involved (e.g. DR – Good Luck, and DMQ – Area). On the other hand, in discussions that did not allow the student-perspective to prevail yielded fewer individuals involved in the discussion (e.g. DAT – multiplying in expanded form). What is posited is that the ability for individuals to interact with each other is based on their current position along this student-teacher continuum. That is, whether or not individuals can relate to one another and whether or not they speak the same “language” is seen to affect what, if any, dialogue can occur between individuals. Previous studies involving online communities have all connected individuals from similar backgrounds (e.g. beginning teachers (Goos & Bennison, 2008), coordinators of a learning council (Gray, 2004)) and thus there was a means in which those members could communicate with each other, and there were topics to discuss. This online space also drew members from similar backgrounds (students from the same teacher-education program). However, my participants appeared to have variation in their characteristics that affected their ability to communicate with each other. Why my participants were able to generate dialogue ultimately related to how my participants used the online discussion space and how they interacted with each other.
5.1.2 Structure of online discourse.

As the members of the community worked together they developed a way in which to collaborate with each other. The analysis indicated my participants were building an understanding of their movement from a student-context into a professional-context. This in turn found the members of the community to be simultaneously forming their discourse in the online environment. Consequently, much of the dialogue occurred in a linear pattern of questions and answers. This “respond only when asked” phenomenon appears to have been the adopted means of discourse within this community. This was evidenced by observing that initiation of most discussion threads were in the form of a question. Furthermore it was observed that comments and reflections, which did not generate any dialogue, stopped appearing in the online discourse past the first week of the study. As such, it appeared that the members developed an understanding that questioning was the only way in which this community could communicate.

This means of communication is seen to be indicative of the learning perspective of a university-student. This phase of development towards a teacher coincides with an early stage, where individuals are shifting from answers to processes (Brown, et al., 1999). Thus, my participants are still developing the generative inquiry skills required in a teacher’s practice. Further evidence of this primary mode of thinking, my participants’ responses to queries also lacked justification of the methods chosen. Instead, they simply listed ideas that could be employed (in a classroom) without further reason. It is possible that the lack of classroom experience does not allow these participants to delve into further detail than what they showed in their discussions. This level of sharing and reflection is generally considered to be at a low level of functioning (Kanuka & Anderson, 1998; Manouchehri, 2002), where individuals are describing, sharing and comparing information without any evidence of seeking explanations or linking these ideas to theory.

In addition to the lack of justification of suggested ideas (in response to queries), there also lacked follow-up from the individuals seeking the information. For example, when ideas were presented in response to a query, there was neither recognition of receipt of the information nor whether the information was helpful or not. This lack of
consideration possibly affected the overall levels of participation, where the core contributing participants were low in number (n = 6). The lack of consideration may also account for the difficulty my participants seemed to have in generating discussion. In addition to the short data collection phase, these myriad of factors created a barrier to the depth of development that could occur. Where discussing and dialoguing with others is seen to be of benefit when learning to teach (or in developing one’s teaching practice) (Barnes and Todd as cited in Manouchehri, 2002), the engagement in this online space by these participants could only generate discussions/dialogue when help was explicitly requested.

Regardless of the lower levels of detail and reflection, the established engagement of question-answer format of discourse allowed for dialogue to occur between my participants. In this sense my participants took to supporting each other and they felt some responsibility to contribute to the online discussions in the name of helping out their peers. This sense of responsibility is pivotal in being able to generate discussion (Riel & Levin, 1990) and could be attributed to the established face-to-face relationships between the online community’s members (Hough, et al., 2004). On the other hand, the quality of the responses may also suggest another view that questions the depth of responsibility my participants felt towards their membership and participation in the online discussion forum. However, it should be noted that my participants not only volunteered to be a part of this inquiry but also voluntarily used this online space. Where 76 individuals volunteered to take part in this inquiry, the 13 who further participated in the online space illustrates the initiative and interests these individuals took to the online community. It was not a matter, then, of responsibility to the community. Rather the quality of the responses and the level of engagement found in the online discourse can be attributed to the individuals themselves and their way of communication. As well, the participants found this particular field experience to be short and some indicated that this did not allow them to develop or be creative with their teaching (POSCOM2). This may have also had a contributing role to the limited online participation and speaks to the type of learning and development from within the community.

This is not to say, however, that learning did not occur in this online community. Rather, the learning in this community was seen to be a direct result of my participants’
themselves – students in a teacher-education program. This identity informed how my participants interacted with each other and why they interacted with each other. For example, the desire to develop a repertoire of teaching ideas in order to prepare for an evaluation (DAT-Area) was one instance in which the student-perspective of my participants (versus the teacher-perspective of my participants) was seen as the underlying basis of learning. Learning was also visible in an indirect way. This particular community was found to have a substantial number of lurkers, individuals who did not contribute to discussions, but participated by regularly logging-in and reading the posted discussion threads. This form of peripheral learning (Wenger, 1998) can be described as an observer-learner, where an individual prefers to listen to discussions but not to participate in the discussion (by contributing his/her own thoughts or ideas). Online communities have found such forms of participation to enable development and learning by following the community in a silent way (Gray, 2004). This form of learning is further discussed when aspects of my participants’ enterprise are revealed.

Not only did the members of this community form a way in which to communicate, what they chose to discuss and dialogue about also characterized their engagement. In the analysis of the discussion threads, clear themes emerged within the content of their discussions: the clear absence of any mathematics talk; and the clear focus on teaching and teaching mathematics. Embedded within each of these themes is an implication related to my participants’ competence in their collective knowledge for teaching mathematics. As will be discussed, my participants’ knowledge for teaching mathematics was related to their role as students in a teacher-education program.

5.1.3 Absence of Mathematics Talk.

There was a clear absence of any “pure” mathematics talk in the online discussion. This observation was prevalent and stood out most prominently in the discussions that centred on how to teach particular mathematical content. Discussions related to teaching mathematical concepts did not include any detail about the mathematical concepts. It should also be noted that there were no questions posed in the online discussions that related to any mathematical content. Although this may be
interpreted as my participants’ generally strong knowledge base of mathematics, other sources of data (i.e. the pre-online survey and the reflective assignments) led me to think otherwise. The lack of mathematical content in the online discussions are a result of my participants’ collective knowledge of mathematics (common content knowledge) and the knowledge of mathematics specific to a mathematics teacher (specialized content knowledge).

5.1.3.1 Common Content Knowledge versus Specialized Content Knowledge

The pre-online survey indicated some wavering aspects of mathematical knowledge, particularly in way of conceptual understanding of mathematics. The contrasting high levels of confidence with teaching mathematics and working with students affected the nature of the online discourse. This was visible in the form of an increased presence of discussions related to teaching and students over that of mathematics itself. This aspect of the online discourse is subsequently discussed. Regarding knowledge of mathematics, the development of common content knowledge through participation in the online discussions was seen to be weak and embedded in both the participants’ perceptions of mathematics and the perceptions of their mathematics capabilities.

Sanders and Morris (2000) observed three types of reactions pre-service teachers have in response to revelations of their weak common content knowledge: nettle graspers, ostriches or mañanas. Nettle graspers were those who could both acknowledge there was a problem and worked to improve their knowledge of mathematics; Ostriches were those individuals who did not actually believe there were any gaps within their mathematical knowledge; Mañanas could acknowledge their weak mathematical knowledge yet did not do anything to rectify the problem. The effects of the online community and the reported use of the community indicate that there existed both ostriches and mañanas. The absence of mathematics and mathematics questions was seen as evidence that my participants did not take any measures to improve their mathematical knowledge. In fact, that the majority of the discussions occurred in absence of mathematical content indicates that my participants see mathematics and teaching mathematics as two distinct pieces of knowledge types that do not interact. The
specialized knowledge that is required to teach mathematics, however, is considered a higher form of knowledge than common content knowledge (Ball, et al., 2008), and thus there appears to be some discrepancies with how these pre-service teachers view the knowledge to teach mathematics. The understanding that my participants see mathematics and teaching mathematics as disjoint bodies of knowledge is consistent with the nature of their discourse and engagement, and accurately accounts for the absence of mathematics talk in their discussions.

5.1.4 Prevalence of Teaching Talk.

The lack of mathematics talk was countered with the prevalence of talk about teaching mathematics. The online discussions were laden with talk about teaching and teaching mathematics, and this was seen immediately in early contributions. For example, the members of this community quickly voiced their preference for being in schools (DR – Good Luck). This observation coincides with the participants’ collective perception of their knowledge for teaching (knowledge of content and teaching) and their level of comfort working with students (knowledge of content and students). In turn, this leads to a deeper understanding of the type of learning that occurred in this online community.

5.1.4.1 Knowledge of Content and Teaching

The high level of confidence in teaching arithmetic, geometry and measurement (PREQ1 – 3), and the predominant occurrence of these same strands of mathematics in each participant’s field experience (POSQ28), may have allowed the discourse of teaching mathematics to flow with relative ease. That is, the teaching context of my participants involved mathematics that my participants were comfortable teaching. As a result, the prevalence of teaching talk may be accounted for in these circumstances. Generally speaking, the phenomenon of preference for teaching (and thus teaching talk) is consistent with the “magical” first classroom experiences of a pre-service teacher (Philipp, et al., 2007; Philipp, et al., 2002), where pre-service teachers are more enthralled with the euphoria of being in a “real” classroom rather than the issues related to teaching. This may better account for the phenomenon observed in the online community, given that this was my participants’ first field experience in an 18-month
period. The thrill of being “back in the classroom” seemed to dominate much of my participants’ early online discussions.

Since the excitement of being in a classroom setting can be overpowering, it is important to examine whether these first experiences and the resulting dialogue promotes generative thinking (Philipp, et al., 2007). This is in opposition to engaging in a field experience without critically thinking about or reflecting upon the experience. As well, this could also involve engaging in a field experience without developing (new) ways to improve one’s teaching skills. As indicated by the question-answer format of the discussions, my participants were not able to move their inquiry into a more advanced stage. The way in which my participants interacted with each other further indicated that they were motivated more by successful completion of their field experience (as a requirement of their degree-program) rather than the more intrinsic motivation to learn and grow in their teaching practice. What is again evident is a duel between the student- and the teacher-perspectives of my participants. The student component of my participants is seen as the dominant factor affecting my participants’ collective behaviour. Although the teacher-perspective of my participants may appear to dominate their discussions and may indicate significant progression from student to teacher, there is reason to believe this is not the case.

During the development from student to teacher, pre-service teachers are initially concerned with students and pedagogical aspects of mathematics (Brown, et al., 1999; Philipp, et al., 2002). This is consistent with the observed phenomenon in the online discussions that are focused on teaching and students. The focus on pedagogy and students was also seen in the reflective assignments and the pre-online survey. Accordingly, the prevalence of teaching-talk in the online discussions is not indicative of highly-skilled teachers but rather of my participants’ lack of experience in the classroom. Furthermore, it is only after the concerns of students and pedagogy are examined that pre-service teachers begin to engage with and think about the actual mathematical content (Philipp, et al., 2002). Thus, the lack of mathematics talk can also be attributed to the fact my participants are at the beginning stage of their teacher training. As suggested, with more experience and time, concerns of students and pedagogy will shift to concerns of the mathematical content (Philipp, et al., 2002). Although this was not possible to observe
in this study, due to a short field experience and thus a short data collection period, there is evidence of progression in way of developing pedagogical repertoires. More time to develop ideas and teaching practices may have allowed for mathematical talk to enter in the online discourse.

5.1.4.2 Knowledge of Content and Students

My participants revealed both a high level of confidence of working with students and in some cases, a high level of *functioning* and understanding when it comes to students and working with students. This came through in the pre-online survey where my participants expressed confidence in their ability to listen to student conceptions of mathematics, and to interpret student solutions. This knowledge is not trivial. In order to develop high functioning knowledge of students and understanding their conceptual understanding requires a lot of experience (Seymour & Lehrer, 2006). However, many of my participants self-proclaimed that they have a lack practical experience, and as such their (perceived) high level of functioning here is out of the ordinary. Thus, what was striking is the way my participants were seemingly so advanced in this particular piece of knowledge for teaching mathematics even with: 1) their lower level of confidence with the actual mathematical content that they are responsible for teaching and 2) their lack of experience. Both of these points, however, are encompassed in the literature’s finding that pre-service teachers first focus on their students over the content of instruction (Brown, et al., 1999), and is accounted for in the stance adopted by my participants. As my participants lacked experience in the classroom, they focused their discussions on teaching. With more experience, my participants may have been able to move their discussions towards mathematics, and in turn may have been able to develop their respective and collective knowledge of mathematics.

Teaching mathematics, after all, requires that the teacher understands not only the mathematical content but understands how students may perceive and learn that mathematical content (Ball, et al., 2008). The online discussions only found one instance in which an individual referred to his/her students when seeking teaching ideas for a mathematical concept (MAT – multiplying in expanded form). The majority of my participants simply asked for general teaching ideas and activities without any context of
the classroom or of the students in that classroom. Thus, although my participants spoke frequently about how to teach, their mode of questioning reveals a surface view of teaching. There was a consistent view that generating teaching ideas need not consider to whom the lesson would be delivered. This view may be informed by the reflective assignments, where a high number of individuals in the participant pool pledged to devote their practice to making mathematics fun and interesting. This pledge was often hinged on their own negative experiences of learning mathematics in elementary school. This is consistent with Brown et al (1999) who found elementary teachers in training are moving from their roles as a student in a teacher-training program to a teacher in a school, and that this movement is affected by that teacher’s own experience in elementary school. However, in my participants’ desire to make mathematics “fun” and “interesting”, there is no mention of the students. For this reason, it is possible that my participants are not in the phase of development where they are thinking about pedagogy and students, but perhaps are entering this phase, where they are concerned with pedagogy only, but not yet students.

The online discussions revealed community formation through the mutually developed mode of discourse. How and what my participants interacted not only helped understand how they communicated with each other but also revealed that the nature of their discourse was dependent on their collective knowledge of teaching mathematics. The depth of this knowledge was intricately related to the development of each participant from student to teacher, which was highlighted within all aspects of their discourse. This ultimately proved to be the very essence of how my participants understood themselves as an entity.

5.2 Joint Enterprise

The mutual engagement of the members of this online community was seen to be a result of my participants navigating a means in which to work with each other. In doing so, my participants revealed two clear and distinct perspectives that they brought to the community: a student perspective and a professional perspective. As the community developed, it was clear that the student perspective prevailed, with any professional
learning clearly situated within the student perspective. In addition, the general overview of all the contributions reflected a low level of reflection and detail, indicative of a developing teacher (Philipp, et al., 2007). This level of competence, however, is equally shared amongst my participants, and thus the level of engagement should be commensurate. Hough et al (2004) noted that in previous studies involving online communities, where only beginner practitioners came together and no experienced member could be relied on for “advice” and “expertise”, there was a lack of success. However, with my active participation, as someone with teaching experience, the behaviour observed in the online space is not considered to be “unsuccessful” but rather is indicative of the discourse adopted by the community. In fact, as a participant in the online discussions, I found myself to adopt an uncharacteristic, low-detail and lack-of-justification form in my own contributions (DAT – Area). Thus, the low level of reflection, the few ideas generated from queries, and the lack of consideration appears to not only be a part of the community’s means of engagement but also a part of how my participants made meaning of their environment. This meaning-making was manifested through how my participants understood their learning situation, which in turn revealed a continuum of development that reflects the enterprise of my participants.

5.2.1 Joint meaning of a learning situation.
How my participants made sense of their learning-in-practice environment (i.e. their field experience) was seen to be defined by and was affected by how they saw themselves. In most instances, my participants let their role as a student prevail over that of a prospective teacher. These two distinct roles were indicative of how my participants chose to engage with one another. In addition, a third epistemological stance (DeBlois & Squalli, 2002), each participant’s own elementary school experience, affected how my participants identified with each other and revealed a dichotomy of what it means to be a pre-service teacher. As described by Wenger (1998), putting meaning to one’s experiences involves a duality of participation and reification. That is, members of a community together make meaning of their current contexts and how to function within that context. In this community, the context of learning centered on navigating the classroom of another teacher (the cooperating teacher, CT) as a student in a Faculty of
Education. The relationship with the CT played a prominent role in my participants’ field experiences and was evidenced as an integral part of the participants’ learning to be a teacher. As my participants engaged in their respective field experiences, they revealed that the CT determined not only what activities they would engage in while in “their classroom” but also what knowledge or information they would acquire. The discussions evidenced, for example, the lack of opportunities to prepare and execute lessons (e.g. DMQ – gr. 6 math and DOM – exams), as well as information acquisition as a form of luck of the draw with a cooperating CT (i.e. Coconut Tart in DMQ – gr. 6 math).

The data also showed, in addition to the student role and teacher role, my participants’ approach to how to teach mathematics is also affected by their personal experiences as a mathematics student. These varying stances are concurrent with the three phases of development from a math student to a math teacher (Brown, et al., 1999). The reflective assignments indicated the multitude of perspectives my participants gained from their days as a mathematics student (in elementary school.) Where some participants expressed feelings of comfort and confidence with mathematics, others certainly displayed a level of fear and anxiety. As they moved from these memories, to their teacher-education program, and then into a school, my participants have formed their own views of the ideal mathematics classroom (Brown, et al., 1999). However, as my participants navigated their way through their respective field experience, there was a clear clash between the ideal and reality (Brown, et al., 1999). The online discussions, which revealed this clash, also reflected the dominant perspective of teacher-context (Goos & Bennison, 2008) with the majority of the discussion focused on teaching and mathematics. However, as previously discussed, the level of engagement and detail of these discussions is indicative of the student-perspective intertwined within the development of the professional self. The student-prevalent stance was also visible in some of the expressed frustrations with working with the cooperating teacher, emphasizing the notion that my participants were learning to become teachers, rather than being teachers themselves.

5.2.2 Developing from a student into a professional – A learning continuum.

That the members of this community were moving between the student- and
professional-perspectives of learning makes visible a continuum between these two perspectives. As members of the community, each of my participants could be seen in their own unique position within this continuum. The fact that a means of engagement with one another was possible reflects that the spread within this continuum is not sparse. That is, in the continuum from student to teacher, most members found themselves to be located in close proximity to one another. In this particular community, most of the members were still leaning towards the student perspective. This was reflective in the focus on teaching mathematics and pedagogical concerns without considering any mathematical content itself. As shown in the discussions, the exception to this was one individual who appeared to be able to draw more from his/her knowledge of teaching and knowledge of students. This individual was able to consider pedagogical concerns as well as address issues related to the mathematical content. The consequence of this saw that the majority of the community was unable to dialogue with this person (see DAT – multiplying in expanded form).

In this sense, it appears that in addition to requiring a shared interest and goal (Adajian, 1996), discourse within an online community for pre-service teachers is also dependent on the close proximity of the members along their development from student to teacher. This shared competence is directly related to the enterprise of the members of this group and speaks to the complexity of engagement as it is tied to how individuals put meaning to their learning situations (Wenger, 1998). This is not to say, however, that individuals who are outside a perimeter of proximity cannot participate in a community. Similar to Vygotsky’s zone of proximal development (1978), individuals best develop and learn as they interact with those who are not at their current level of knowledge but those who are slightly more advanced. In turn, each individual may experience a different form of learning, based on with whom they interact. Within this online community, these various levels of learning were evidenced by the varying levels of participation.

**5.2.2.1 Learning Trajectories and Peripheral Participation**

A learning trajectory (Wenger, 1998), is an individual’s own path of learning, defined by our histories and where we have been, and is projected by where we are headed. In established communities, individuals who are new to the community often
participate in a observatory way that allows them to learn the “customs” of their new environment before they attempt to engage in a more participatory way (Wenger, 1998). In addition, each individual, by nature of their individuality, may move through this observatory stage at different speeds: they may learn the customs of the new community swiftly and with considerable ease, or they may require more time in which to transition into their new environment. Each individual course of action is thus that individual’s learning trajectory. This form of peripheral participation (Lave & Wenger, 1991) was characteristic of many members of the community. For example, “lurkers” were seen to have come into the online space without contributing to any of the discussions.

What can be gained through quiet participation may be the same gains of a contributing participant. For example, individuals in the online forum were able to bring forth insightful observations related to their students. Although this was not the norm within this participant group, that an individual “verbalized” his/her thinking and high level of observation (e.g. Date Square’s contribution in DAT - multiplying in expanded form), records and demonstrates for others this form of critical thinking. In turn, it creates a medium for others to make similar considerations in their own contributions to discussions or in their own reflections about teaching mathematics (Manouchehri, 2002). Within an online community this kind of learning, that involves acquiring new ideas that may affect their practice, is possible for all members (Gray, 2004). Thus, individuals may learn simply by finding themselves in an environment bursting with new ideas and new ways of thinking.

Alternatively, an individual may be working within a community but find themselves to be more advanced than the majority of the members. In this community, Date Square (see DAT – multiplying in expanded form) was considered to be on a learning trajectory quite unlike the other members. As a result of this, the notion of peripheral participation took on an interpretation not related to the induction of new members but rather as a member who was working on a path that was quickly heading outside of the community’s boundaries. Although active in way of making contributions to discussions, Date Square’s participation can be characterized more strongly by his/her frequent log-ins to the online community and reading the discussion threads of other participants. In dialogue Date Square did not seem to be able to engage with the members
of the community. However, the fact that s/he returned to the community often and more frequently than any other member indicates both his/her desire to participate and the benefit of observing (listening in on) the discussion of others.

What is visible is an intermediate perspective, between university student and teacher, which is characteristic of Date Square. A “student-teacher” is a term often used to describe a teacher-in-training. In the context of this discussion and in understanding the continuum between student and teacher, “student-teacher” quite appropriately describes the intermediate stage between the two ends of the spectrum. Date Square shows signs of a university-student, however s/he has started to think of his/her experiences in the context of a teacher, a more advanced stage than my other participants. By virtue of his/her place in a teacher-education program defines Date Square as a student-teacher and not a teacher, yet accurately distinguishes him/her from those individuals who were still finding a means to see past his/her university student perspective.

The joint enterprise of my participants evolved to reveal the growth from student to teacher. In a symbiotic relationship, this development affected the nature and mode of engagement. This development-of-a-professional also symbiotically affected the modes of sharing and passing of information. As will be discussed in the next section, the shared repertoire of this community helped to understand the locality of this community in relation to a greater community of practicing teachers.

### 5.3 Shared Repertoire

The short data collection phase did not allow for a rich view of the shared repertoire that the participants developed as they worked with each other in this online space. As the discussions emerged, however, it seems clear that how the individuals chose to engage each other played a part in the building of shared repertoires (Goos & Bennison, 2008). For example, the use of questions and answers to build a bank of teaching ideas is one way that my participants stored the resources and the ideas that they developed together. This means of recording interactions, through asynchronous discussion threads may point to an information storage system that makes teaching
knowledge accessible and public. This form of recording may help develop and understand the knowledge base of teachers (Hiebert, et al., 2002). Through posing and recording questions and their answers, my participants created a databank of resources and ideas to use and access at any time of day. The high number of non-contributing participants who still logged-in frequently may indicate the usefulness of recording dialogue in this way, to disseminate information and share teaching ideas. In the context of this inquiry, the means by which my participants shared information enabled one to see their collective knowledge of the curriculum as well as the proximity of this community in relation to the community of practicing teachers.

5.3.1 The use of resources for information sharing.

My participants took to sharing information with each other by making use of references such textbooks and provincial exams. How my participants used these materials was consistent with the observed dominant perspective of student over that of teacher in the majority of my participants. That is, the use of the materials took on a somewhat elementary view, and revealed my participants’ collective level of knowledge of the curriculum.

5.3.1.1 Knowledge of Curriculum

If not related to teaching ideas, the questions posed by my participants were related to the content of the curriculum. That questions were posed in this realm of teaching is indicative of a lower level of knowledge of the curriculum. In addition, how my participants answered questions related to the curriculum was seen to be in absolute fashion. They did not accept that the curriculum could involve gray area but rather questions related to the content of provincial exams and the depth in which to teach a certain mathematical topic involved black and white answers. Discussion threads related to the curriculum content ended as soon as an individual was able to provide a specific reference, and answers were stated as facts. For example, the first excerpt below is in response to a curriculum question whereas the second excerpt is in response to a query for teaching ideas. The resolution of the curriculum question carries a more final tone, suggesting that because s/he has seen the provincial exam that his/her response is final.
“I am in the same position and had a chance to look at the exam today. You may want to teach changing fractions into % as well as probability.” (DMQ – gr. 6 math, Coconut Tart)

On the other hand, the example below that is in response to generating teaching ideas brings forth a feel of uncertainty and provides room to interpret how to teach the mathematical content (area).

“maybe you could use the area of your classroom ...” (DAT – Area, Cinnamon Bun – emphasis added)

This black and white view of the curriculum also manifested itself in how my participants were observed to use the various resources available to them. For example, textbooks were seen to be the source of curriculum content (MAT – multiplying in expanded form), rather than a resource that interprets the curriculum in a certain way. My participants also understood that the only way to prepare their students for the upcoming provincial exam was to see the provincial exam itself and then teach to the exam (DMQ – gr. 6 math). In these ways, how my participants were able to know the curriculum had a limited view. Further, no one was able to reference the curriculum document itself and understand the information it provides about the curriculum. On the other hand, my participants’ use of documents such as textbooks and the provincial exam as sources of information points to this community’s proximity to the greater community of practicing teachers.

5.3.2 Shared resources of the greater community.

Sources such as the provincial exam and textbooks are resources commonly used by practicing teachers in their everyday work. My participants readily used these resources, revealing the overlap of this online community to the greater community of practicing teachers. Figure 2 provides a depiction of the participants’ proximity to the community of teachers. The proximity of each group in the diagram is purposeful to showcase that there are individuals who may lay distinctly in one of the two circles. In particular to this inquiry, there were individuals within this community who were much closer to the student end of the development continuum. The overlap of the circles
represents those pre-service teachers who are further along the continuum, and who possess and use the knowledge for teaching mathematics in a similar way to a practicing, seasoned teacher. Thus, the overlap is representative of the student-teacher perspective, the intermediary between student and teacher.

With this understanding of how my participants were situated within the greater community of teachers, it is evident that the shared repertoire of the community completes the link. The means of sharing information ties together both the enterprise and engagement of my participants in this online community. The idea of development from student to teacher is tied not only to how my participants understood their identity, but also formed how they engaged with each other and relates to how they shared and disseminated information.

5.4 Bridging into a Community of Developing the Knowledge to Teach Mathematics

The formation of a community to develop the knowledge for teaching mathematics is a complex entity. The mutual engagement of the members is dependent not only on the modes of interactions and dialogue, but also on the content of these discourses. In further complication, my participants were also negotiating how to understand their different learning contexts. Developing from student to professional intricately weaved together how my participants interacted and about what they interacted. This development also affected how my participants developed and used shared repertoires, revealing their place in the larger teaching community.

Thus, a community to develop the knowledge for teaching mathematics is formed through a mutual relationship between learning contexts and knowledge.
development. In order to build a vision of this multi-dimensional growth, I propose that we consider first the development of knowledge from a student perspective and then the development of knowledge from a professional prospective. As suggested by Ball et al. (2008) (see Figure 3\textsuperscript{19}), this separates the knowledge into two entities, as shown in the left side of the figure and the right side of the figure, respectively.

![Figure 3](image)

The modification of the original diagram depicts the levels of knowledge of my participants in this inquiry. The more heavily shaded region shows the relative strength of that form knowledge over those less shaded regions. Thus, the diagram shows the inflation of knowledge on the pedagogical side of the diagram, coupled with an imbalance of knowledge of the subject itself\textsuperscript{20}. This perspective is consistent with Brown’s et.al (1999) idea that pre-service teachers must first address pedagogical concerns before they can examine the mathematical content itself. This result further reiterates the call for teacher-education program to develop both content and pedagogical knowledge (Ball, 2000).

In this inquiry, however, the development of knowledge for teaching

\textsuperscript{19} (H. C. Hill, et al., 2008)

\textsuperscript{20} Knowledge at the math horizon did not ultimately affect this inquiry. This knowledge involves knowing the continuum of mathematical skills and concepts that lets a teacher see the larger picture of mathematical ideas and concepts, as well as the locality of a given mathematical concept within this picture. The results of this inquiry that revealed little common content knowledge (CCK) and no specialized content knowledge (SCK) in the online discussions, it is consistent that no math at the horizon knowledge was revealed in the online discussions.
mathematics has been examined in parallel to the development from student to teacher. As my participants found themselves having to do, there needs to be a means to examine the merging of both levels of development. What is proposed is a three-dimensional model (see Figure 4). This three-dimensional axis allows one to see the development of knowledge for teaching mathematics in the context of the development from student to teacher.

Along the Student-Teacher plane, it is possible to locate individuals along the continuum of development. This plane allows one to see the joint enterprise of any community of pre-service teachers. Figure 2, depicting the overlap of communities is not only accounted for in this plane, but allows for more specificity in regards to precise “composition” of student and teacher. The student-teacher perspective would be an area right in the middle of the Student-Teacher plane.

Aligning with the separation of knowledge types, common content knowledge, specialized content knowledge and math at the horizon are forms of knowledge developed within a pre-service teacher’s student perspective. The Student-Knowledge plane, thus, allows one to see the development of common content knowledge (CCK) and specialized content knowledge (SCK). The knowledge of content and students (KCS), knowledge of content and teaching (KCT) and knowledge of the curriculum (KC) are forms of knowledge that are developed in a context involving students, or in the pre-service teacher’s own teacher perspective. The Teacher-Knowledge plane thus accounts for the development of KCS, KCT and KC.

The three-dimensional plot allows for a pre-service teacher to be represented by a single point that shows their position along the student-teacher continuum and their level of knowledge for teaching mathematics. However, by “flattening” the plot, it is possible to see an individual’s level of each aspect of knowledge for teaching mathematics. As the discussion thread revealed, the development of any individual along the student-teacher continuum related also to that individual’s own knowledge base for teaching mathematics. In this sense, one may examine the three-dimensional plot in three different views: 1) where the individual is along the Teacher-Student continuum (Student-Teacher plane); 2) where each aspect of their knowledge for mathematics lies (CCK, SCK) (Student-Knowledge plane); and 3) where each aspect of their pedagogical content
knowledge for mathematics lies (KCS, KCT, KC) (Teacher-Knowledge plane).

Considering where all the individuals within a community lie along any of these planes is expected to visually look like a set of points that are in close proximity to each other. That is, in order to be able to negotiate an understanding of the learning contexts and to be able to engage with another in a meaningful and productive way, individuals in the community should be in similar “positions” within their development. This was seen in this community, where dialogue occurred only between individuals who were able to relate to each other in terms of their learning perspectives (i.e. student or professional).

The Teacher-Student plane provides a visual of the joint-enterprise of the community. As mentioned, it is expected that the individuals who are able to engage with each other are situated in close proximity to each other within the plane. In addition, where those individuals are located in the plane also shapes the nature of their interactions. As interactions occur between individuals, their respective positions within the Teacher-Student plane may shift as they develop knowledge and learn together. This in turn will shift their position in either of the other two planes, depicting a shift in knowledge for teaching mathematics (the Teacher-Knowledge and Student-Knowledge planes). Members of the community were not able to maintain discussion related to knowledge they did not possess. However, by participating in the community, unknown
knowledge became known as information was shared and discussed. It is through the interactions of the members of a community that their positions “move” along these planes, representing individuals developing along the continuum from student to teacher, and developing their knowledge for teaching mathematics. Thus, by examining the shifts of these plotted points (representing individuals) we can visualize the formation and evolution of the community as the members learn together and develop their practice together.

5.5 Summary

The results of the analysis of data from the online discussion forum revealed the complex growth of pre-service teachers from student to teacher while developing knowledge for teaching mathematics. The online community showed that it is possible for individuals to develop in both these realms. As individuals worked together there was a sense of knowledge building at an individual level and in a collective way.

Being able to quantify and qualify the knowledge base of a profession such as teaching is an intricate task that involves taking pieces of information tied to a specific practice (but not so much that it is individualized) and making it public and shareable (Hiebert, et al., 2002). Using an online community served to address this need by recording, through discussion threads, the interactions of individuals as they shared teaching ideas and resources. This inquiry also led to an understanding of how pre-service teachers’ knowledge for teaching mathematics develops.

A three-dimensional plot is suggested as a model to examine the development of knowledge for teaching mathematics in a community of professionals. Further studies may examine a means to precisely use the three-dimensional model, by developing measures of growth from student to teacher, as well as measures to gauge each aspect of knowledge for teaching mathematics. Where studies have developed and examined the growth from student to teacher (Kajander, 2007) and pre-service teacher’s knowledge for teaching mathematics (H. C. Hill, et al., 2004), future studies that emerge from within this inquiry will merge these two aspects of teacher development.
6 Conclusion

This inquiry sought to understand how the knowledge to teach mathematics may develop in a collaborative online environment. The participants of this study were pre-service teachers, chosen because they were completing a mathematics pedagogy course in their teacher-education program (a site where theoretical knowledge for teaching is built) and entering their field experience (a site for building practical knowledge for teaching). In order to understand how the knowledge for teaching develops in practice, the timing of the inquiry coincided with the participants’ respective field experiences, and utilized an online discussion forum as a medium for participant interaction. This chapter summarizes the themes that emerged from this inquiry, and discusses the implication of the results for teacher-education programs and for professional development programs. Finally, suggested directions for future research that may rise from this inquiry are discussed.

6.1 Themes

This inquiry sought to understand how the knowledge for teaching mathematics develops as pre-service teachers engaged in an online discussion forum. The inquiry revealed two features of the development of pre-service teachers: 1) That pre-service teachers are in a unique position, moving back and forth between a student- and teacher-perspective; 2) That the development of knowledge for teaching mathematics is affected by this dueling perspective. Together this helps to understand the holistic development of pre-service teachers.

6.1.1 Dueling identities of pre-service teachers

With the combination of in-class and field experiences in teacher-education programs, pre-service teachers are learning about different aspects of teaching in different contexts. With these differing contexts, pre-service teachers may inadvertently use different lenses in which to view their learning: that of a student and that of a teacher. These very distinct lenses sometimes cross-over into other contexts. For example, in this inquiry it was found that pre-service teachers often used their student-perspective lens to interpret their learning in the field (a professional context). Although pre-service teachers
are keen to start their teaching practice, this inquiry revealed that switching to a complete teacher view-point is not easily attained. The discourse online showed that these first teaching experiences are first seen through the perspective of a student. In fact, early field experiences are often characterized by learning that is not necessarily deep and meaningful (Philipp, et al., 2007). This form of learning may be a result of a pre-service teacher’s tendency to lean towards their student-role.

This student-role has two meanings in this context: a student in a teacher-education program but also as a former student in an elementary school. In the case of the latter experience, pre-service teachers form conceptions about the nature of mathematics, as well as an idea of what it means to be a teacher. In the former experience, pre-service teachers are confronting these conceptions of mathematics and are building upon their vision of a teacher. The implication of this saw that my participants were determined to rectify their own elementary school experiences, motivated to be the kind of teacher that they did not have, or motivated to be the kind of teacher that made a positive impact on them. Regardless, this motivation led my participants to focus mainly on teaching mathematics and not on developing their own knowledge of mathematics. As the knowledge to teach mathematics starts with knowing mathematics, the development of mathematics knowledge cannot be ignored. Consequently, focusing on teaching mathematics without developing mathematical knowledge relates to a somewhat shallow form of learning. This is because the development of knowledge for teaching mathematics is not complete or uniform. As the inquiry revealed, developing the knowledge to teach mathematics is not trivial and appears to be a continual process that is affected by past experiences and how one makes use of their current learning contexts.

### 6.1.2 Development of knowledge for teaching mathematics.

How the knowledge for teaching mathematics developed in this online community was related to the dueling identities of my participants. What my participants were able to gain in way of knowledge was restricted by the dominant student-perspective of their learning. The tendency to stay within the student role affected what kind of knowledge for teaching my participants were able to discuss, and also exposed the depth of their knowledge for teaching mathematics.
My participants revealed both their student-stance and their level of knowledge for teaching through their discourse. By using the online discussion forum, my participants were able to share ideas with one another. These ideas were largely related to aspects of teaching mathematics and not mathematics itself; or these ideas were linked to student-related contexts, such as assignments. These themes are evidence of the predominant student-stance of my participants. As indicated through their dueling roles, my participants were keen to discuss pedagogy-related knowledge for teaching mathematics while ignoring the need to develop their own knowledge of mathematics. This tendency is a result of my participants’ focus on developing as teachers. However, despite this focus, the immediate tendency to “want to be a teacher” actually reveals an immature teacher, a more student-based individual who is “acting” as a teacher. Furthermore, this affected what aspects of knowledge for teaching mathematics my participants could discuss and develop. Namely, this development was limited to pedagogy.

The nature of these pedagogy discussions was somewhat shallow, focused on passing along ideas of how to teach a particular mathematical concept. When ideas were suggested, there was a noticeable lack of justification and detail. The focus on teaching mathematics and the lack of justification was the result of the student-dominant perspective of my participants. My participants revealed that their collective level of knowledge for teaching mathematics was not only lopsided but also lacked the desired depth.

The themes seen within this inquiry replicates other studies (e.g. Brown, et al., 1999; Sanders & Morris, 2000), pointing towards the role teacher-education programs need to play in developing pre-service teachers’ knowledge for teaching. What stood out most prominently in this inquiry was the link between the different perspectives of pre-service teachers and the knowledge for teaching mathematics. The knowledge for teaching mathematics is multi-faceted, consisting of 6 different pieces (Ball, et al., 2008). The different aspects of knowledge for teaching mathematics make the level of knowledge of each individual a difficult entity to measure. However, understanding that pre-service teachers are developing between two perspectives, helps to understand the development of knowledge for teaching mathematics. This leads to a way in which to
examine the overall development of pre-service teachers.

6.1.3 Holistic Development of pre-service teachers.

The analysis revealed that the development of pre-service teachers is affected by the dueling roles of student and teacher and in turn, their knowledge for teaching mathematics. A three-dimensional model can account for the holistic development of pre-service teachers that encompasses the growth from student to teacher and the advancement of knowledge for teaching mathematics. This model examines the simultaneous development of the individual from student to teacher and the development of knowledge for teaching mathematics.

As pre-service teachers engage further in their field experiences, they begin to develop as a professional and inevitably, their knowledge to teach mathematics. However, it was seen in this particular inquiry that only certain aspects of the knowledge to teach mathematics were developed: those that related to pedagogy and curriculum. Elements of knowledge for teaching mathematics related to mathematics knowledge itself were not a part of the pre-service teachers’ development. The reason for this lopsided development is due to the stage of development of each individual.

Brown et.al (1999) reported that pre-service teachers use three different stances in which to interpret their work: a former elementary school student, a university student, and a teacher. Much of their knowledge of mathematics is first formed as a former elementary school student. As a university-student in a teacher-education program, this knowledge is (re-) developed (Philipp, et al., 2007), and forms into a higher form where individuals begin to think about mathematics in the context of teaching mathematics (Ball, et al., 2008). These themes were evidenced in this inquiry. Within the field experience context of a teacher-education program, however, my participants found themselves confronting their pedagogical ideals and this confrontation dominated their discussions. For this reason, pedagogical knowledge for teaching mathematics was seen to be most prevalent in the online discussions, where development of any mathematical knowledge itself was absent.
The growth of a pre-service teacher

The model presented in the previous discussion is shown again (see Figure 5). In order to understand how this model may be used, the following discussion presents how the patterns seen in this inquiry may be applied with the model.

The Student-Teacher plane is a visual depiction of the growth from student to teacher. As an individual develops from student to teacher, it is expected that the pattern of points will form a negative growth pattern (see Figure 6). That is, as an individual sheds more of their student stance, their teacher-perspective becomes more dominant. At the mid-point of this growth, we find the student-teacher perspective, the “crossing-over” from student to teacher. As the growth from student to teacher occurs, it is expected that
both knowledge of mathematics and pedagogical knowledge of teaching mathematics is
developed. As indicated in this inquiry, this development of knowledge, particularly that
of mathematics itself, will occur over time. Regardless, on the Student-Knowledge plane
(see Figure 7) the “growth path” would look the same as that shown above in Figure 6.
On the Teacher-Knowledge plane, however (see Figure 8), there is a positive “growth
path”; as the teacher-stance takes over, more knowledge for teaching mathematics is
acquired.

It should be noted that although the data revealed the participants of this study were able
to develop mostly pedagogical knowledge, knowledge is plotted as a whole. That is, as a
pre-service teacher grows as a teacher, knowledge is growing as well. The model, as
presented, does not distinguish between the different types of knowledge for teaching
mathematics. In other words, the lop-sided growth of knowledge seen in the inquiry is not
visible within the model. However, the model is able to depict the development (or lack
of development) of the knowledge for teaching mathematics as a whole.

When these three 2-dimensional plots are put together into one three-dimensional
plot, the general growth pattern of a pre-service teacher is visible. In a hypothetical case,
one might expect to see an individual begin with a complete student-perspective (with no
teacher-perspective available or any knowledge for teaching mathematics), and who
grows to think more like a teacher and simultaneously develops some knowledge for
teaching mathematics. This hypothetical growth is shown in Figure 9, starting from the
far-right corner on the base of the grid (complete student-perspective with a low level of knowledge), moving towards the upper left corner on the top of the grid (complete teacher-perspective with a high level of knowledge).

In order to see how each form of knowledge for teaching mathematics is developed, the model can be modified to not plot knowledge as a whole, but to plot each form of knowledge on its own. Thus, there would be six separate plots representing the growth of an individual pre-service teacher.

Although this model was developed through the analysis within this inquiry, and patterns in the data were used to illustrate how this model could be used, it is in future research that the model would need to be further explored. This discussion is intended to serve as an illustration of how this model could be used in future research. The results of this inquiry, that revealed the type of development of knowledge for teaching mathematics, also have implications for teacher-education program.

![Diagram](image)

**Figure 9**

### 6.2 Implications for Teacher-Education Programs

#### 6.2.1 Focus of teacher-preparation programs.

The result of this inquiry shed light on the factors that affect how a pre-service teacher develops. The varying perspectives that pre-service teachers are negotiating as they learn to teach is an important facet to understand. Of particular importance is the
movement from student to teacher and its close link to the development of knowledge for teaching mathematics. With evidence that pre-service teachers are keen to discuss pedagogical concerns of teaching mathematics, the development of a pre-service teacher may become unbalanced, where the development of pedagogical knowledge is not countered with the development of knowledge of mathematical content. What is desirable is a uniform development of the pre-service teacher, where knowledge of both pedagogy and subject matter are emphasized. Thus, teacher-preparation programs need to ensure that pre-service teachers are engaged in courses that enable a balanced development. In addition, this balance should be achieved in a complementary way where mathematical content and pedagogical content are developed together, and not in disjointed contexts.

6.2.2 Length of field experience.
In order to facilitate a more balanced development of knowledge for teaching, extending the field experiences may create a better equilibrium between the time spent in the classroom as a student and the time spent in a classroom as a teacher. As the field experience helps pre-service teachers see first-hand the very work of a teacher, this practical learning venue also helps to make sense of the learning in the in-class portion of teacher education. As seen with the participant pool of this study, pre-service teachers may engage in discussion about teaching mathematics, but without the ability to link these discussions to their own personal experience, these discussions cannot be situated into practice. This inquiry provided a means to continue these in-class discussions to the field experience. This link between the two contexts of learning in teacher-education relayed the benefit of being able to discuss an experience while having the experience. The lack of coherence between theory and practice is not unique to pre-service teachers and calls for the need to re-examine professional development programs as well.

6.3 Implication for Professional Development Programs
Although this inquiry examined pre-service teachers and their development as teachers, the development-in-practice model points to the impetus to give practicing teachers the same opportunities in their own professional development. Many professional development programs are done in isolation to a teacher’s practice (Schlager,
et al., 1998). This inquiry revealed that when engaged in professional dialogue while in practice, relevant issues are brought to the forefront. My participants were able to steer the focus of their discussions, resulting in dialogue and learning that were relevant to my participants and were tied directly to their current classroom situations. Providing such in-practice professional development for practicing teachers is a valuable tool in order to make professional development meaningful for the participants. In addition, this would serve as a form of on-going professional development, infusing the notion of life-long learning into our schools. As schools and school boards are looking for professional development designs that support learning communities, this inquiry adds to the existing research that reveals the most beneficial professional development programs are those that are tied directly to a teachers’ practice. Furthermore, the online location of professional development takes down any geographical barriers and helps to gather individuals from all parts of the city, country or world.

6.3 Limitations of the Inquiry

This inquiry provided a look into the development of pre-service teachers while in their field experience. Due to the short data-collection period, the results are limited as the amount of data collected cannot compare to that of longer studies. It is suspected that with a longer data-collection period (i.e. a longer field experience) there would have been more in-depth discussions, as well as increased participant follow-up. This inquiry could not make use of the post-online survey due to the low number of respondents in relation to the pre-online survey. Thus, there was little information gathered related to the perceived effects of using an online discussion during the field experience. For researchers interested in using this research design in subsequent work, it is recommended to add to the qualitative data by using exit interviews that would provide further elaboration of the responses to the surveys, as well as the online contributions.

6.4 Future Research

This inquiry touched upon an area of research that examined the development of knowledge for teaching mathematics in pre-service teachers. The outcome from this inquiry points towards a direction of future research that relates to the development of
elementary school teachers, and the use of community-based learning to develop the appropriate knowledge to teach mathematics well.

Being able to understand how pre-service teachers develop from student to teacher and to relate that to how knowledge develops is an important aspect of developing a community that supports the development of knowledge for teaching mathematics. As revealed in the inquiry, how individuals develop as teachers appears to affect their online interactions. There was indication that the characteristics of a given individual affected with whom s/he may interact. This inquiry was concerned specifically with the stage of development from student to teacher. Future research may wish to further examine this further. Understanding who interacts with whom in online discussions as it relates to levels of and development of knowledge would help understand how to create effective support mechanisms that are similar to the online discussion forum in this inquiry.

The three-dimensional model proposed in this inquiry may aid in this understanding. This inquiry did not allow for an in-depth demonstration of how the model could be used. Although the discussion presented a preliminary look at how the model may be used, future research may seek to further develop this model and to use it as an analysis tool to examine online discussion forums.

Finally, understanding the development of knowledge for teaching should also extend to examine in-service teachers. Providing in-service teachers with a means to connect with one another while in practice in a similar (or otherwise) online forum can enable an analogous examination of teachers’ discourse and of their level of knowledge for teaching mathematics. This will broaden the understanding of the knowledge for teaching mathematics. This will also serve to design and implement effective professional development programs that encourage the development of knowledge for teaching mathematics.
References


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Appendix A

Information Session script

Thank you all for attending this brief information session. My name is Natasha Lamb. I am currently a first year Master’s student at McGill University in the Department of Integrated Studies in Education. Prior to arriving in Montreal, I spent seven years teaching Mathematics, Physics and Technology. Under the supervision of Dr. Annie Savard, I am conducting research on the knowledge that teachers use when teaching mathematics. Specifically I am interested in how we can help teachers, like you, develop the knowledge they need to teach mathematics.

I would like to invite you to participate in a closed online discussion forum during your field experience this year. This will give you the opportunity to connect with each other, particularly since you will all be in schools throughout the city and will no longer be able to meet in your classes. For example, you will have a means to pose questions to each other, to share ideas or mathematical activities that you have developed while teaching, to share your experiences or just to express any concerns you might have. In other words, it will provide you with a support system during your field experience.

Participation will involve two aspects: 1) your anonymous participation in the closed online discussion forum to connect with your peers from your mathematics class and 2) your responses in two anonymous questionnaires: one will be administered before the online discussion is active and one will be administered after you use the online discussion.

Please note that this online discussion forum is closed. This means that the only people who have access to this forum will be you and me. What this also means is that your cooperating teacher and supervisor will not have access to this discussion forum and in fact, your participation in this study is completely independent of your field experience. Your participation on the online forum will also be anonymous in that you will be given a pseudonym and you will use that name to identify yourself online. In order to protect your anonymity, you will also be asked to not use the names of any students in your classroom, cooperating teacher or supervisor; or the location or school name in which you your field experience takes place.

Further information is provided on the consent form. Please be assured that every measure will be taken to ensure that you will remain entirely anonymous throughout this research study. Your participation will help provide effective professional development to mathematics teachers and help improve the teaching of mathematics to students.

I thank you for your consideration in participation in this study. Please return the signed form by 1 April 2009 if you wish to participate in this exciting project. Forms may be dropped off in room 310 in the Faculty of Education building.

Thank you again for your attention. At this time I welcome any questions or concerns you may have. Alternatively, please find my contact information on the consent form should you have questions at a later time.
Dear Prospective Teacher:

My name is Natasha Lamb. I am currently a first year Master’s student at McGill University in the Department of Integrated Studies in Education. Under the supervision of Dr. Annie Savard, I am conducting research on the knowledge that teachers use when teaching mathematics.

I need your experience and expertise in order to maintain and improve the quality of the teacher-education programs across the country. As a student teacher, you are immersed in an environment that allows you to constantly absorb the knowledge you need to be a teacher. In the spring you will be dispersing from this enriching environment into your respective field experiences. It is my intent to examine how the knowledge you have gained to teach mathematics is used, is applied and how it can be continually developed outside of the university setting.

I would like to invite you to participate in a closed online discussion group, where you will be able to connect with your fellow prospective teachers during your respective field experiences. For example, you will be able to ask each other questions or share any ideas with your fellow teachers, which you may find of benefit while engaged in your field experience. Along with this, I would like to ask you to provide me with your honest opinions and feelings about your views of mathematics and teaching mathematics, before and after your participation in the online discussion group. As such, there are two short questionnaires that will require your attention should you choose to participate in this study. The information collected in the questionnaires will in no way be linked to you personally.

To ensure your anonymity, your consent form will be used solely to identify where to direct any follow-up contact. Furthermore, a third party will provide you with an “online name” for the closed online discussion group. Please note that since this is a closed online discussion forum, the only persons with access to the forum will be you (the participants,) and me. As such, your cooperating teacher and supervisor will not be able to see any content from the discussion forum. The above-mentioned questionnaires will be administered online and your responses will be sent to me anonymously.

Participation in this study is completely independent of your field experience. Participation is also completely voluntary and you may, at any time, withdraw from this study. With your help, I hope to shed light on how we can improve the teacher training of aspiring teachers, such as yourself, as well as the professional development of practicing teacher. If you are interested, I would happy to share my findings with you at the completion of the study by providing you with a brief report.

Please find enclosed a consent form where you can indicate your willingness to participate in both the closed online discussion and to provide responses for two short questionnaires.

I thank you for your time and consideration. If you require any further information, please do not hesitate to contact me, Natasha Lamb at 514-849-1592 or Dr. Annie Savard at 514-398-5150.

Sincerely yours,

Natasha Lamb
Consent Form

I understand that Natasha Lamb, a Master’s student at McGill University, is conducting a research project and she would like me to participate. She is working under the supervision of Dr. Annie Savard.

I have read a description of her proposed study and I understand the purpose of the study and the methods to be used. I understand that she will be gathering information through an online discussion forum and through two questionnaires.

Specifically, I understand that my participation will involve:

- The use of an online discussion forum while I am on my teaching round. I understand that I will be given an online name to keep my identity from the researcher. I also understand that my contributions to the online discussion should be made so as to not identify the location of my school, my associate teacher or any students in my classroom.

- Responding to a short, anonymous questionnaire before I engage in the online discussion forum

- Responding to a short, anonymous questionnaire after I engage in the online discussion forum.

I understand that my participation is completely voluntary, that it is completely independent of my field experience and that I will receive no compensation for participating. I also understand that I may withdraw from this research project at any time and that doing so will not result in any penalty.

Please take my signature below to indicate my voluntary participation in this research study.

Name: (please print): ______________________________________
Signature: _______________________________________________
Date: ___________________________________________________
Signature of Researcher: ___________________________________

Completed forms may be dropped off in room 310 in the Faculty of Education building by 1 April 2009.

**Please note that this form will be kept in a safe area for the duration of the study. It will in no way identify you in the discussion forum or in the questionnaires.**
Appendix C
Verbatim

Pre-online survey comments

<table>
<thead>
<tr>
<th>Prec1</th>
<th>I found that without the guide of the book or a teachers manual I cannot teach math. It is difficult and there was little help with the math course to teach us how to teach certain subjects.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prec2</td>
<td>For a few of the questions it would have been useful to have a neither agree, not disagree, or partially/sometimes agree button choice.</td>
</tr>
<tr>
<td>Prec3</td>
<td>I believe that my mathematical skills are adequate. However, I am a little unsure about teaching math. I think that if I have a student math book to refer to that this will definitely help me a lot. I could use the student textbook to gauge how much students need to learn about a certain concept. I strongly believe that I should try to explain a concept in many different ways and use manipulatives to ensure that all students understand.</td>
</tr>
<tr>
<td>Prec4</td>
<td>I have not had much experience teaching mathematics to children, so for the questions on how comfortable I feel teaching certain concepts, I was really not sure. For some of the other questions, I was usually in the middle of agree and disagree. I would have liked having an option to choose between those two statements.</td>
</tr>
<tr>
<td>Prec5</td>
<td>I have nothing else to add.</td>
</tr>
</tbody>
</table>

Post-online survey comments

<table>
<thead>
<tr>
<th>Posc1</th>
<th>I really was at a loss as how to appropriately teach math as I felt unprepared. the classes we had did not help with the concepts of math. What I learned to teach was from my own knowledge or what my CT taught me.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posc2</td>
<td>The online forum would have been more useful if there were more people using it, and so more posts (more frequently too). It would also have been a better tool for the third year stage, when we are teaching for three straight months, instead of just three weeks... this would have left more opportunity for us to be creative in our teaching and to seek the advice of our peers.</td>
</tr>
<tr>
<td>Posc3</td>
<td>This stage was so short that I hardly ever used the forum. Would be a great tool for our 3rd stage!</td>
</tr>
<tr>
<td>Posc4</td>
<td>It was really nice to hear and share ideas, thoughts and opinions with each other. I hope that this forum/study will still be operable in the coming 3rd field experience.</td>
</tr>
</tbody>
</table>

Reflective Assignment

<table>
<thead>
<tr>
<th>Ra002</th>
<th>I was able to see that tutoring (teaching) the way that I learned the material- not the way the student might understand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ra003</td>
<td>I am scared to teach it</td>
</tr>
<tr>
<td>Ra003</td>
<td>I was amazed at how much math has changed since I have been in school</td>
</tr>
<tr>
<td>Ra004</td>
<td>Much of the reason why I chose teaching as a profession was in a way to correct how I was taught, to make up for it and make a different in the lives of other students</td>
</tr>
<tr>
<td>RA005</td>
<td>… I was good at memorizing what needed to be done, which is why once I got to high school it was much more difficult for me</td>
</tr>
<tr>
<td>RA005</td>
<td>Right now, I don't feel as thought I am a strong math teacher, I still feel like I need a lot more experience in this subject</td>
</tr>
<tr>
<td>RA007</td>
<td>I believe I am a very good mathematics teacher and I have a very good knowledge of elementary school mathematical concepts</td>
</tr>
<tr>
<td>RA009</td>
<td>I have realized that being good in math does not make a person a good teacher</td>
</tr>
<tr>
<td>RA010</td>
<td>I need to learn different approaches to the concepts in which I am going to teach so that I can adapt to the learning needs of all my students</td>
</tr>
<tr>
<td>RA010</td>
<td>My first attempt when a student is confused is to teach them a set of steps to complete the problem. I know this does not always work for all students but I always try it first because it better develops my understanding of the problem before attempting another approach with the student</td>
</tr>
<tr>
<td>RA010</td>
<td>My weaknesses include not being completely comfortable with math concepts … Before I begin teaching math, especially higher levels of math, I need to become more comfortable with the concepts before I begin to teach them.</td>
</tr>
<tr>
<td>RA012</td>
<td>I have a tendency to make things more complex rather than concise. Although I have a great understanding of the concept, describing it aloud to others is much more difficult</td>
</tr>
<tr>
<td>RA013</td>
<td>… I have come to discover that no matter how strong or weak you are in math, it is more important that you take the time to understand why a process is being done rather than how to get about solving the problem.</td>
</tr>
<tr>
<td>RA013</td>
<td>Unfortunately I have had teachers through elementary and high school who explained how to solve an equation but never answered why we were going about doing it in such a way.</td>
</tr>
<tr>
<td>RA016</td>
<td>I am hoping with more experience, to being in more resources that we have used in lab, such as math on class, or ideas we have used in lab activities, to bring to the classroom and share them with the students</td>
</tr>
<tr>
<td>RA016</td>
<td>I had a difficult time when trying to work out concepts I wasn't familiar about because it has been such a long time I have done elementary school mathematics</td>
</tr>
<tr>
<td>RA016</td>
<td>My teachers in the past weren't enthusiastic in math and I think it makes a huge impact on students who struggle with mathematical concepts. … I want to be a teacher who explores with her students, and to be enthusiastic about the learning we are undertaking</td>
</tr>
<tr>
<td>RA017</td>
<td>I will never forget how they struggled and how the teacher never gave new ways of understand a concept</td>
</tr>
<tr>
<td>RA017</td>
<td>There was nothing fun to it, all the problems looked the same and if you didn't understand one problem, the others had no chance in being resolved. I think I have become a teacher that does not stick to a single method for all students</td>
</tr>
<tr>
<td>RA019</td>
<td>I feel I need to work on my confidence, because I am so accustomed to being &quot;the student&quot; for the last 20 years that I find it difficult to take on the role as teacher</td>
</tr>
</tbody>
</table>
I also need to work on my knowledge of the QEP and remember which essential knowledges students in certain cycles should understand

Because I do not have that much experience teaching math (yet!), I had difficult verbalizing what I wanted to say when I was explaining certain things to students

In my experience, however, I had teachers who gave math an edge. This "edge" was their ability to connect math with to our everyday life and keep it "real" for us as students and everyday math users. This type of teaching plays a significant role in the teacher I plan to be

... I realized one of my weaknesses was that I need to learn more math, especially in terms of how I can teach mathematical concepts. Although, I've had a semester of experience, I still feel like I need to learn more, especially on how I can teach fractions, numeracy and geometry

I also like to tell my students that it is alright if they get the wrong answers. Those mistakes are part of their learning process and it tells the teacher a lot about the student's thinking process

I was never challenge to try something harder and I don't remember any positive words of encouragement from my teachers

I have come to realize that it is because of teachers like Mrs. L that have inspired me to become a better teacher

My weakness is that I do not have an extensive knowledge of mathematical concepts

The way I learn mathematics will affect the type of teaching I will be. I will certainly use a lot of examples and will not just lecture to the students and expect them to do problems. I have learned through my own experience that you need to show examples and do problems as as class before having individual work.

** a lot here

I also learned that I have ot be ready to find multiple aproaches when teaching a particular concept and I have to be able to lmake the material suitable for every child's individual level

I believe that the struggles I have encountered throughout school will help me when it comes to teaching math, since I can relate to my students and the difficulties that may arise

Tutoring helped me understand the different struggles children encounter in math and test out my ability to help children overcome them

... I know that my strenghts are my patience and my ability to be able to take a certain concept and manipulating it in different ways for the students to understand

I believe that my weaknesses are to have a better knowledge in math, to know more the concepts and find different wants to teach it so that every child with different needs could understand it properly

I think that because I was put down as a child ny many of my teachers, it gives me an advantage to know what not to do and try and help my students

Because of my own experience in math, I am someone who encourages the use of manipulatives, visual aids and calculaors for anyone who does math.
| RA036 | I want to follow in her footsteps - have patience, always be clearn in my explanations, give extra practice problems available to students, tell children they can accomplish anything if they just put their hearts to it |
| RA037 | (after explaining her experience) … When I become a teacher, I will ensure that students whose first language is not the language of instruction are able to get help in their first language. I will not be so quick to assume that a student who has poor results in math is struggling because they don't the concepts, perhaps it is not being delivered to them in a way that makes sense to them. |
| RA038 | I think my weakness is that I tend to give in too quickly to students who ask for help and say "I don't know" and I don't give them sufficient time to think about the problem. |
| RA039 | … I am still not as confident as a teacher should be. I have to continue growing and developing my teaching identity, on that includes confidence and appreciating for math for its own sake |
| RA039 | Occassionally, I did not know how to find a solution for a problem that a student was having difficulty with |
| RA041 | Furthermore, I must continue to familiarise myself with the competencies and essential knowledges provided in the Mathematics section of the QEP. |
| RA041 | Some mathematical concepts in the elementary curriculum have only been taught to me last semester, such as bases, whereas with others, I have lost practise with, such as long division. I can only hope to get better at explaining and doing math problems and computations over the years with practise |
| RA042 | Although I have confidence in my own math abilities, I do not have confidence in my math teaching skills. I have not had the opportunity to formally teaching math in front of a classroom and therefore I am unsure that I have enough knowledge of math strategies to teach |
| RA042 | I did not feel confident in my instructions, despite my sound knowledge of multiplication procedures |
| RA042 | I would like to improve my explanation abilities. During my fourth tutoring session, I was not able to explain why we borrow a group of ten when subtracting, or why we carry over ten when multiplying … however as a teacher, one must be aware of the plethora of different strategies that have been developed to obtain the correct answer, for all students learn differently |
| RA044 | I feel more confident in learning how to teach the subject rather than struggling to learn in |
| RA045 | I also feel that I need to spend more time mastering the spectrum of mathematic topics I will be teaching student so that I can concentrate on teaching without having to worry about my own comprehension |
| RA045 | I need to and I will spend more time learning different strategies for teaching more abstract concepts so that I can better help students who "just don't get it". |
| RA046 | From not knowing anything about being a tutor before I started, to learning how to explain mathematical concepts and seeing how much certain students appreciate the help has really opened my eyest to being a teacher |
| RA048 | I like math for the most part but I am unsure about myself in teaching it. It has changed so much since I last attended elementary school. There are new ways of doing things such as multiplying by listing all the partial numbers. It's not something I covered when I was in elementary school and though it seems easy enough, I feel unready to teach it to the student because I was never taught this method myself.  
| RA048 | In the future, or rather in the present, I intend to revise my multiplication table since I have a lot of self-doubt. I should be more adept in math before teaching it.  
| RA049 | I am able to break down questions into different parts and utilize illustrations and manipulatives (i.e. visuals) in order to facilitate understanding for students.  
| RA049 | I still have quite a bit to learn about the different approaches and processes to go about teaching mathematics.  
| RA049 | I strongly believe that this is not because I was incapable, but rather because my teachers did not fully make use of resources to help students construct their own understanding and knowledge of mathematics. … My currently feelings about mathematics as a university Education student are that this subject can be very enjoyable and rewarding to students if the teacher makes proper use of resources and conveys a positive attitude towards the subject.  
| RA049 | My weaknesses may include not being completely thorough in my knowledge of mathematics, although this can and will be definitely changed in the near future as I continue to review and challenge my own comprehension and knowledge.  
| RA50 | However now I feel like it's okay that have trouble, and that my limitations are what will make me more understanding when dealing with students who have difficulty.  
| RA50 | In my last report I states "I could remember the concept from my own school years", whereas this time around I could remember the only the concepts, but the innovative teaching techniques from class.  
| RA50 | Working with the children at Tyndale reminded me of some of the negative math experiences I had growing up, and it made my realize that I never want to make my students feel that way.  
| RA51 | I also learned that there are different ways to solve problems and there is no method that is better than the other.  
| RA51 | My grade 7 teacher destroyed my passion for math. He would not teach us what we were expected to know to solve problems by ourselves. His exams were extremely difficult and he never held tutoring sessions or would give retakes of exams so that students who failed could make up for their points lost. My experience with that teacher made me realize the type of teacher I DO NOT want to become.  
| RA52 | From working with all of the children at Tyndale, I think I have gained a better idea about how to tell whether they really grasp a concept or not.  

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| RA052 | I have learned what kind of questions are important to ask and what types of thing I can do to support their learning, rather than just doing their work for them |
| RA053 | I feel I have progressed greatly in my methods of teaching math, but I still know that I have ample knowledge to still acquire and make use of in my teaching |
| RA053 | It is not until you are in the classroom setting helping children, who each have distinct strengths and weaknesses, that you realize the importance of having a bank full of teaching strategies |
| RA054 | I would like to one day be a math teacher that was as effective as those two teachers that I had. Both were patient, understanding and would take the time to make sure that every student understood the material. |
| RA054 | The only weaknesses I found out about myself were that I still find math difficult and sometimes confusing. When I was shown a couple of math problems, I had to go over them a couple of times in order to fully understand what the student had to do. |
| RA056 | I love working with children, but I questioned my ability to be able to adequately pass on mathematical knowledge and skills when I myself felt uncomfortable about my abilities |
| RA057 | As a math teacher now, of which I got a very small glimpse of at Tyndale, I need to review mathematical concepts and reconstruct that basis which was poorly constructed in my own mathematical education |
| RA057 | I've also learnt that there are several ways to approach mathematical concepts and problems … It is important, I realize, to be aware of several methods in order to understand my students' work and recognize its validity |
| RA058 | I have been looking at math all wrong my entire life … I don't just want to teach how to do math, I want my students to understand why we do things a certain way |
| RA059 | (things she would like to improve) … the ones that stood out the most during my tutoring experience, is once again a short list of alternative explanations to offer the students that do not understand my first explanation. |
| RA059 | However, I also believe that when I begin teaching math concepts, I will gain a better understand of the material and will thus be able to explain it to the students in a more efficient manner |
| RA059 | I have found that I am only able to come up with a short list of activities to do with manipulatives given a specific concept. I believe this is so because when I was in elementary school we used manipulatives in a very limited way, therefore I was not aware of all the possibilities that manipulatives have to offer until this semester |
| RA059 | re: using manipulatives - While I have been able to come up with numerous activities with the manipulatives, it takes me a lot of time to think of activities that will be effective and easy to understand |
| RA059 | Unfortunately, I often find myself running out of ways to explain things in an easy way when it comes to mathematics. I believe this is so because the last math that I have had and have been taught was advanced math, therefore, I sometimes have troubles seem math through simplistic eyes |
| RA061 | Now that I am re-exploring math concepts, I can begin to rebuild my confidence. As a teacher today, I think it is a fear of mine. I fear that I will not be able to teach my students to the best of my ability because of my bad experience |
| RA064 | My main weakness at the moment is that I do not have many strategies to teach them but I know that with experience I will get many of them |
| RA065 | … it is important to work together and formulate questions to solve any given situation as a team. I have learnt that if, as a group, we can manipulate the ideas put forth then we will all have a better understanding of what is being asked of us |
| RA065 | … The uneasy feeling that you are not sure of something struck me more than once throughout the experience |
| RA065 | As a future math teacher I have come to learn that no matter what skills it is important to understand why something is being done. I had many teachers in elementary and in high school who taught me how to apply any given math equation into a formula |
| RA065 | I knew from my text books that I have read over the last two semesters has explained that students learned differently and that we should incorporate all of different intelligences stipulated in Howard Garden's theory, but I never once experienced it first hand. The tutoring experience gave me the opportunity to become of the reality I will soon face in the classroom |
| RA066 | I realize that the learning process will not always be smooth and that continued and varied explanations (like Dr. Brindley's) are the only way to capture the different levels and learning styles of my future students |
| RA067 | Also, I feel as though I must learn better approaches when explaining to student certain concepts. With time and practice, I wish to develop methods to help me overcome this |
| RA067 | One of my greatest weaknesses in teaching mathematics is to help a student go about solving a problem. I find at times I give the student too much guidance and information that leads them straight to the answer, therefore I am not allowing them to exercise their critical thinking. |
| RA068 | After the initial shock, I realized that all I had to do was peel off layers of fear of the subject, and hatred towards old teachers in order to reopen that corner, and develop it with the new ideas and approaches that we were covering in class |
| RA069 | My greatest weakness is I do not know the best method to use to explain a specific concept to a certain student |
| RA070 | … how vital it is to have a concrete understanding of mathematics as well as the strategies and techniques for teaching and explaining mathematical terms and ideas. If we, as the teacher, do not have a full understanding of what we are explaining then we can't expect to offer an adequate explanation to our students |
| RA070 | … I hope to acquire a greater bank of ways to explain things to students as well as ways to bring in manipulative for students to use … |
| RA071 | I really like the idea that there are fixed answers. However, mathematic these days have changed a lot since I was in elementary school. Many questions are open-ended, require exploration and experimentation, and certainly are different from how I was taught |
| RA071 | I would like to improve on using different manipulatives to support my mathematical lesson and ease students' understanding. As well, I would like to learn all the possible ways to teach mathematical concepts … |
| RA072 | I think my weakness was that I sometimes doubted my knowledge about certain things, both in math and in language arts. |
| RA072 | In our program we spend so much time learning how to teach, but we don't get to use what we learn very often at this point. |
| RA073 | I definitely don't want to become like the math teachers I had growing up, who just taught the concepts to get them covered. |
| RA073 | I think that my biggest weakness (actually fear) is not knowing enough math to become a math teacher … |
| RA075 | Much like science, there is a specific numerical answer which, when you get the right answer, you know you have understood the topic and you are ready for the next topic. |
| RA075 | Though I have had many great teachers, my school experience has made me realize that I want to change the way math is taught. |
| RA076 | … I also learned overall from this is that I do not know the QEP as much as I thought. |
| RA078 | I think that being strong in math has caused a challenge in becoming a good math teacher because I have always understood the concepts right away. I have found it difficult to come up with my own ways of explaining the concept without giving away the answer. |
| RA078 | My grade ten teacher was worse teacher. She would come into class, explain something, and give us work. If we had questions we had to ask them right away, once she was done talking we had to figure it out for ourselves. I disliked the way she taught, and I know that I will never like that. |
| RA082 | As mathematics is fun and easy for me, I sometimes have difficulties explaining very simpler concepts. At the same time, I have to learn to take advantage of the different manipulatives available to explain those simple concepts. |
| RA085 | I would be lying if I said that becoming an English elementary school teacher was not, in some way, influenced by the idea that math would never need to come near me ever again. |
| RA089 | I think my biggest weakness is that I haven't had a lot of experience in teaching, so I don't know many of the different ways that I can try and break something down for a student, or how many different ways a student may need to see something. |
| RA091 | I have an advantage because I am able to relate to the students' common mistakes and misconceptions on a deeper level. |
| RA092 | I have come to learn that memorizing how to do a problem in mathematics is what works best for me. |
| RA095 | My strengths included the ability to pick up on students' train of thought. |
| RA098 | I don't necessarily hate math, but I've grown to dislike how it being approached in the classroom. This experience pushes me in becoming the best math teacher I can be. |
| RA098 | Strategies geared towards computing operations are vast and this points out my weakness. I know such minimal amounts of strategies that can be used in
| RA100 | I feel I am the type of math teacher who still need to know more about how to teach all the areas of math and who needs to work on her weaknesses, like problem-solving. I wouldn't be confident teaching something that I'm not comfortable with |
| RA101 | As a teacher, I believe this mathematical knowledge is a blessing and a curse. It is a blessing inasmuch as the math that I teach will always bed imbued in logic - I will not engage students in countless stencils that further the gap between theory and practice in math. ... Much as it is a bless, though, it is also a curse. Because many math skills came to me so naturally, I am not well-versed in tricks and techniques; I am only now training myself to use manipulatives and math materials. |
| RA101 | I have yet to build my my repertoire of effective tips and analogies for various math concepts. |
| RA105 | reference to varying ways of teaching |
| RA106 | Right now, I think I am the type of teacher who has the will to teach mathematics, but I am missing the experience to know the correct techniques to approach different themes |
| RA107 | I do believe, however, that I still have things to learn, such as becoming more aware of the different mathematical concepts that children learn at different levels in their education, and what stages of mathematical comprehension are most students at in a particular grade. |
| RA107 | I hope to be a teacher that is not like the ones from my learning experience. I do not want to allow any students to fall into the background and cut their learning short because they don't understand something when I first explain it. |
| RA109 | I think that one thing that will really help me once I am in the classroom is that I will have a math textbook. The reason that I like this idea is because it will give me a definite direction to take. … Once I know what grade I will be teaching, and I will have the textbook in my hands, I will have a more clear understanding of what I have to teach |
| RA11 | I believe that at this moment I am capable of teaching mathematics because I understand the QEP's essential knowledges. Nonetheless, I feel I lack the manipulatives and classroom tools I believe are absolutely necessary to teach math |
| RA111 | At the moment, I feel as a math teacher I still lack the ability to make students fully understand what they are doing. |
| RA112 | I learned that I need to be more patient with students by offereing them more "wait time". This is my biggest weakness, as I sometimes have trouble taking the time to listen to what they're saying, so I may be rushing oor overwhelming them without even realizing it. |
| RA113 | My biggest weakness was my insecurities with my own math skills. |
| RA114 | I believe that, right now, I do not know all the best strategies that exist in order for me to teach mathematics to children |
| RA115 | Thus due to my passion for mathematics, I believe that I am a good mathematics teacher |
I would have to say that the best thing I learned from the four tutoring experiences I completed, was that as a teacher I must be prepared for any kind of obstacle and know how to teach my material in many different ways. At this point in time, I feel that my key weakness is my lack of ability to express the reasoning behind my understanding of mathematical concepts (I understand it, but I am not exactly sure why). I wish I had known of other ways that I could have helped him. However, I still need to improve myself in relating the mathematics concepts to the real life situations. I have this difficulty because when I learned mathematics in my primary and secondary school, I learned in the traditional way. Mathematics was a game for me in which I played with numbers without relating them to the real life problems. I will follow my college teacher's approach in teaching my students. She made math accessible by explaining the concept, providing different examples, and going over material we had covered and most importantly she made it meaningful to me. As of right now, I think I am a mathematics teacher who is a little unsure of how to come up with creative ideas for planning lessons and activities. I tend to rely a lot on simple and and basic activities, and have trouble "thinking outside the box" when it comes to math. My biggest weakness as a mathematical teacher is probably that I still struggle personally with recalling certain elementary school concepts. If I were to focus in on my weaknesses, I would have to say that my prime weakness lies in my ability to properly explain mathematical concepts. As someone who is not entirely strong in the mathematical area, I find it challenging when trying to explain concepts, on a basic level, to students.

Online Discussions

**DI – Who is online??**

**NL, 25 April 2009 11:04:**
Hello Teachers! I see some of you have logged in; Thank you to those who have filled out the survey already. How are you feeling on this weekend before you begin your field experience? I take it you know where you will be placed by now. What grades will you working with? Looking forward to hearing from you! If you have any questions, ask away! I am adding a "random" section to our discussion, just so we have a space to put in random comments/questions that may not fall under the other categories. I hope you are all enjoying the warm weather! Natasha

Coconut Tart, 5 May 2009 20:16:
I am teaching a Split cycle three, focusing on Math right now due to the fact that they are preparing for their Ministry math exam after I finish stage. The students are currently doing their ELA Ministry exams.
D1 – split class
Cinnamon Bun, 25 April 2009 19:26:
I will be teaching Language Arts grades 1 & 2 and Mathematics for grade 2!

Boston Cream, 27 April 2009 21:00:
Hello, I'm teaching language arts, math, and science for grade 3!

D1 – No Math for Me
Corn Bread, 27 April 2009 22:14:
I am with a grade 2 English class. The teacher strictly focuses on English Language Arts. As far as I am concerned, I will not be experiencing any mathematics during this second stage.

NL, 28 April 2009 12:40:
hi Corn Bread! I hope you will stay to share your experiences as we are all developing teachers and developing our teaching practices! . Maybe others will be in the same boat as you, or maybe we can help generate ideas for Language Arts. ? I hope day #2 was a good one!

D1 – Split class
Jaw Breaker, 28 April 2009 17:37:
At first I was upset that I would be in a media class and a grade 5 English, Math class but my teacher is amazing and I am paired with a great student. I am learning a lot about media which is great because I really need it! The smartboards in the school is also amazing! The media class I have two and half days a week grades 2-6 and the rest of the days I am in a grade 5 English, Math class.

D1 – 5-6 Split
Funnel Cake, 28 April 2009 19:48:
Hi everyone. I am teaching a 5-6 split that focusses mainly on math and english language arts. My CT has incorporated a program entitled 'Peace4Kids' which has been interesting to learn about.

Jaw Breaker, 2 May 2009 17:12
What do you do? What is that?

D1 – Resource
Butter Pecan, 29 April 2009 15:37
Hi everyone, I am in a resource class teaching mainly kindergarten, Grade 5 and 6. I teach students Math, Language Arts and some French one on one and in small groups. It is a little less intimidating teaching to only a few students, but at the same time they are the students with learning disabilities and behaviour issues so it's going to be a challenge for me to really reach them.

D1 – Grade 3
All Bran, 29 April 2009 19:23:
Hi everyone, I am student teaching in a grade 3 classroom. My CT teaches Math and English Language Arts.
D1 – 3 – 4 split class, and 4 solo

Date Square, 30 April 2009 07:06:
I am placed with a teacher who has a 3/4 split class, as well as a completely grade 4 class. (The switch back and forth for half of each day). We are responsible for teaching LA and math, so the teaching time is split evenly between these two subjects.

D1 – Grade 5

Almond Cookie, 30 April 2009 18:33:
I am in a grade 5 class and my teacher is responsible for math, language arts, social studies and science. The only subjects that she does not teach are gym and French. It will be great to have experience teaching in all the different subject areas.

D1 – Grade 1

Graham Crackers, 6 May 2009 20:19:
Hey everyone, I'm teaching grade 1 and realized just how exhausting it can be to keep up with these active, young kids! However, I must say that it is nice to be greeted by them in the morning :)

DR – Good Luck

NL, 26 April 2009 20:41:
“Have a great first day, everyone!”

Chocolate Souffle, 28 April 2009 21:35:
“Thanks it was awesome. It was great to finally be back in the schools!”

Coconut Tart, 5 May 2009 20:23:
“It has been a great one and a half weeks. It goes by so quickly.”

Cinnamon Bun, 8 May 2009 18:05:
“I find that it goes by too quickly also. I wish we had our stages 8 weeks like Concordia. They get more hands on experience compared to us where we have lots of lectures/courses to attend...yuck. Some courses are helpful but I believe you only really learn what it is to be a teacher when you are actually in the classroom learning from the students and the cooperative teacher”

Corn Bread, 9 May 2009 00:30:
“It is such a wonderful feeling to be in the elementary school classroom. All semester long, we learn theory, and finally, we are given the chance to put theory into practice :) It's almost as if everything is coming to life. Every time I teach, I am constantly reassured that this is my profession.”
DMQ – gr. 6 math

Baked Alaska, 27 April 2009 19:06:
“Hello people. I have been put into a grade 6 class for this stage. However, this is currently the time of the grade 6 provincial exams. I am also in an emmersion [sic] school, which means that I am only teaching LA and Math. Currently, the students are doing the LA exam, so all I have to teach is math. BUT! the teacher is doing review for the math exam. I have yet to see the exam and only know that fractions and measurement will be on it. Can anyone give me any tips?”

NL, 30 April 2009 14:51:
“hmmm ... I am not familiar with how the provincial exams work in Quebec. Would the MELS website have some information that might help you? Maybe someone else has some ideas or knows of a resource that can point you in the right direction? In the meantime, I'll keep an eye out for anything useful. This sounds like a great opportunity for you! BTW - I have posted a handful of mathematics-related websites in the "weblinks" section of this space. If you have any to add, please do.”

Coconut Tart, 5 May 2009 20:18:
“I am in the same position and had a chance to look at the exam today. You may want to teach changing fractions into % as well as probability. I am lucky my CT showed me some of the situational problems from the past years, and I am using those to review for the math exam. Hope that helps”
MAT – Multiplying In Expanded Form

Date Square, 30 April 30 2009 21:05:
I am set to teach the lesson next week to a group of grade 4 students about how to multiply using expanded form. They are just now being introduced to multiplication using 2 digit numbers. The textbook they use has only 2 pages on this topic, one and a half of which is an example, so I do not have much to fall back on there. I was wondering if anyone had any ideas about interesting ways to approach this topic with the class. They are a somewhat difficult group and 'lecturing' tends to inspire misbehaving, but so does group work... Also, there is a substantial variety of abilities in the class... some students are still having difficulties with 'regrouping' when adding/subtracting large numbers... Any advice would be appreciated!! :) 

NL 4 May 2009 14:28:
You bring up a good point that the textbook does not always offer us teachers enough to go on to build a lesson around. Just so we are all clear, what do you mean by "multiplying using expanded form"? Maybe an example would help?

Date Square 6 May 2009 21:35:

<table>
<thead>
<tr>
<th>54 x 3 =</th>
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<tbody>
<tr>
<td>5 tens + 4 ones x 3=</td>
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<tr>
<td>15 tens + 12 ones=</td>
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<tr>
<td>16 tens + 2 ones =</td>
</tr>
<tr>
<td>1 hundred + 6 tens + 2 ones= 162</td>
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</table>

I know this seems like an odd way to multiply... but it gets around the 'double digit' issue some new learners have, as it breaks the equation up into tens and ones... then the students have to 'regroup' and add to get the answer.

NL 6 May 6 2009 21:47:
This is interesting. It really seems to me that it brings home the idea of place value. I wonder if base-ten blocks could be available for students to use to represent the multiplication? Maybe letting them work together to "piece" the product together? Or is there another tool that could be used? I am just thinking "out loud" right now ...

DS – help with something for stage?

Baked Alaska 5 May 2009 19:26:
Hi, people. As most of you know, we have to do an article review for our seminar. Any one (sic) know of a good place to find teacher journals?

Coconut Tart 5 May 2009 20:20:
Look in the database on the McGill Library web site, you will find all the articles there.
DOM – Exams

Coconut Tart, 5 May 2009 20:23:
I was very frustrated at the beginning of my Stage because the students are in exams as well as there is very little time to teach due to the other class such as art, gym, music as well as science and a special project that has to be done by the end of May. I wanted to be able to teach lessons, but I didn't know what to teach because my CT told me that she had stopped teaching. Things changed today when we got a hold of the Math exam, and now we as a team are working together to prepare the students. I am now really really enjoying my stage.

DAT - Area

Boston Cream, 7 May 2009 21:35:
Hello!! I'm introducing Area on Monday for my grade three class, and my supervisor will be there evaluating me. I was wonder if anyone had any interesting ways in which I can introduce this topic. Thanks!

Cinnamon Bun, 8 May 2009 18:00:
maybe you could use the area of your classroom, like we did in math lab. hopefully you have good measuring manipulative to measure the floor. You could first use informal measuring unit such as cut out giant's feet then use formal measuring unit such a metre stick.

NL, 9 May 2009 09:18:
Good idea! I was thinking something along the same lines in terms of using the classroom. I was thinking about painting a mural on one side of the classroom (well, on mural paper that is the size of the wall ... painting the actual wall may not be the best idea!) and creating a frame for the mural. I say the latter only to try to link/distinguish between perimeter (something they already know?) and area.
I also like your idea about using some pre-cut shape to measure. Maybe this could be a good way to have the class discuss ways in which they could estimate the length of the room.
Appendix D

Pre-Online Questionnaire

Thank you for agreeing to participate in this study. Prior to participating on the online discussion, I would appreciate your honest opinions of mathematics and teaching mathematics. The following questions are intended to provide me with such information.

Please answer the following questions by checking the appropriate box.

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>I am comfortable teaching:</td>
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<td>I am comfortable answering mathematics questions posed by students:</td>
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<td>I see how I can integrate computer technology into my mathematics lessons</td>
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<td>Students should be shown how mathematics is applied to the “real world”</td>
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<td>Mathematics is seen all around us.</td>
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<td>Manipulatives have little use in developing understanding of mathematical concepts</td>
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<td>I solve mathematical problems with</td>
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Sex: M   F   
Please check which best applies to you:

The last mathematics course I took was in ...

- Elementary school
- Middle school
- Secondary school
- CEGEP
- At the university level (outside the B.Ed program)

I completed my secondary school education ...

- In the province of Quebec
- Outside the province of Quebec

Thank you for your time and participating in this study.
Good luck on your teaching rounds and “see you” online!
Post-Online Questionnaire

Thank you for your participation on the online discussion.

Please answer the following questions by checking the appropriate box.

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I used the online discussion to (please check all that apply):
- Ask math questions of my fellow teachers
- Ask teaching questions to my fellow teachers
- Share a story (stories) that happened to me
- Share something I developed
- Ask my fellow teachers for advice
- To find a resource that a fellow teacher was sharing
- Just to see how other people were doing
- Other (please specify): ____________________________________

During my field experience, the mathematics lessons I observed and/or taught fell under these strands:

- Arithmetic
- Geometry
- Measurement
- Statistics
- Probability
- Other (please specify): ____________________________________

The online forum helped me to develop the following (please check all that apply):
- Classroom management strategies
- Cooperative learning opportunities
- Effective lesson plans
- Organization in my board work
- Other (please specify): ____________________________________

The online forum helped me to build confidence in (please check all that apply):
- My own mathematical knowledge base
- Listening to different interpretations of mathematics
- Choosing appropriate mathematical problems for students
- Implementing the Quebec Education Plan for Mathematics
- Other (please specify): ____________________________________

Are there any other benefits you found from your participation in the online forum? Please explain your response with as much detail as is necessary.

____________________________________________________________________________________
____________________________________________________________________________________

Thank you for your time and for participating in this study.

Have a safe and happy summer!
Appendix E

This assignment is a reflective report of your teaching experience at Tyndale St-Georges. Capitalize of your learning and link your teaching experience at Tyndale St-Georges with activities presented in this course, especially your reading. You may submit a hard copy of your assignment anytime after March 1, 2009. Reports submitted after March 27 may not be read and scored before the final examination.

The Tyndale St-Georges report you completed last semester is required in the appendix of this assignment.

This report must be three to five pages in length, excluding the appendix.

NOTE: Up to three points will be removed for poor writing that does not exhibit the sophistication and understanding appropriate for a teacher (i.e. spelling errors, poor syntax, lack of organized sentences and paragraphs, etc.).

1. Give each date of visits. (6 points)

For the following questions, please be as specific as possible. Only deep reflections and specific answers will get full marks. You will learn a lot of things on teaching, but we expect that you will focus your reflections on mathematics education.

2. What mathematical concepts were covered during your visits and what activities were done to cover this material? What did you do? (2 points)

It is a good place to show us your learning about mathematical knowledge (Musser, Math on Call and Van de Walle). This is an example of our expectations:

_During my first visit, the fourth grade student had a worksheet on subtraction of three digit numbers with grouping. The stencil consisted of ten problems, each involving grouping of the tens place and hundreds place (e.g. 942–654). I helped to construct an understanding of the math by breaking the problems down into parts, then teaching the student how to use the ‘missing addend’ approach to solve each part of the equation. By reviewing the importance of graphically ‘setting up’ the equation to be performed (ensuring the place values are inline), the student made fewer grouping mistakes._

_Though I did not work with the same student during my second visit, I worked with a student in the same class. This time, they were working on interpreting pictographs and deciding on scales in their construction of bar graphs. Students worked out of a math book from which students were asked several questions referencing pictographs therein. They were asked to interpret how many unit were represented in a given section of a pictograph, to add and subtract ‘grouped’ values, and to evaluate whether certain inferences with regard to the data were correct (e.g., Lily claims that a pie chart split midway represents 21 persons with brown hair and 11 persons with blonde hair. Do you agree with Lily? Why or why not?) Then, students were given a small section of graph notebook and a table of values. They were told to decide what scale would best fit a graph given this data. They had to then construct the graph per their scale._

3. What challenges did you meet? How did you overcome these challenges? (4 points)

Be specific. By challenges, we want to know if it was a challenge on how to explain a certain mathematical concept or was it a behavioral challenge. If it was a behavior challenge, do you think it was caused because of the task or something else? Can you link this challenge with your reading? Focus on math as much as possible.

4. Which analysis can you do about your last semester report? (5 points)

With the new knowledge you constructed this semester, what can you say about what you did last semester? Talk about the mathematical knowledge you covered or you witnessed, changes in your teaching practices (especially in mathematics), and the different ways children learned mathematics during your four visits (I.E. your two visits in the fall and your two visits in the winter).
5. What is your personal mathematics relationship? (3 points)
Tell us about your journey as a mathematics learner (from elementary school until now). What kind of mathematics user are you? What kinds of teacher do you think you are now, and what kind of teacher do you want to be? (I know this question could be personal, but we are not going to judge you if you hate math. In fact, this exercise may be a good way to come to grips with your feeling about mathematics and mathematics education).

6. What did you learn from these tutoring experiences? (5 points)
Again, be specific. We want to see a strong thinking about your experiences. Tell us your strengths, your weakness and what you plan to do differently in the future.