Preservice Mathematics Teacher Efficacy: 
Its nature and the contributing factors of the preservice program

By

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In a mixed method study, teacher efficacy and contributing theoretical constructs of teacher concerns and teacher orientation with preservice teacher candidates were examined. Intermediate/Senior mathematics preservice teacher candidates from two major Ontario Universities’ Faculties of Education participated in this study. Data sources included a web-based survey containing two teacher efficacy scales and short answer questions, interviews with the preservice teacher candidates, and Intermediate/Senior mathematics course and program information collected from course instructors. Complexity theory provides support for the mixed methods methodology and the integrated and complex nature of teacher efficacy and its contributing factors. The literature on teacher efficacy rarely ventures into the secondary school mathematics preservice teacher level of teacher professional development. The study more clearly identifies teacher efficacy with preservice mathematics teachers and how teacher efficacy relates to teacher concerns and teacher orientation. The findings deepen the understanding of the connections between the constructs of teacher efficacy, teacher concern, and teacher orientation. Following from these findings, changes and considerations for preservice teacher preparation programs in order to more fully prepare secondary school mathematics teachers are described.
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I am inspired by the people a reader of this thesis will never know because they have been made anonymous with pseudonyms. I believe in professionalism as a foundational element to quality teacher practice, and each and every one of the preservice teachers who participated in this study have shared with me their own professionalism and commitment to the teaching and learning of mathematics. I thank each of them for sharing their professional practice with me in this study.

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Chapter One

1.1 Introduction

The purpose of this research is to understand intermediate/senior mathematics teacher preparation, in particular the preservice teachers’ sense of teacher efficacy and some possible contributing factors. I am a mathematics teacher and educator, a baseball coach, a musician, an actor and director and stage manager, and father and husband, and in all these roles and responsibilities I have learned that my efficacy can do more for me and my personal and professional development than any other single factor. In my role as a preservice intermediate/senior mathematics education instructor, I see this play out in the development and growth of novice teachers. I continually seek new, improved, and alternative ways to help preservice teachers become the secondary school math teachers they imagine themselves to be. This chapter outlines the formulation of my inquiry, the purpose of the study, the contributions of my personal background, and the outline of this thesis.

1.2 Research Context

The landscape of preservice mathematics teacher education defined by Ponte and Chapman (2008) is the research context for this study. Figure 1 illustrates the relationships of defined key components of preservice teacher preparation, preservice teacher knowledge of mathematics and of teaching, identity, teachers’ professional community, and influential and/or pertinent external elements to the nature of the preservice program, for example, societal issues, institutional and program elements. This study will focus on particular aspects of this landscape, or, in other words, on particular aspects of preservice mathematics teacher development.
We need to know more about the influences and contributing factors to preservice teacher development. This question is brought into sharp focus by the work of a PME-NA 2007 Discussion Group, “The pedagogical preparation of K-12 mathematics teachers: A discussion group on methods courses and related work” chaired by Bob Ronau (University of Louisville) and Mark Taylor (University of Tennessee). They are attempting to create and define a theoretical framework for mathematics teacher preparation. This theoretical framework would connect and support the various mathematics and mathematics education research that informs our professional practice and articulates the dimensions and facets of mathematics teacher
knowledge. The six particular components to this framework include: subject matter and pedagogy and their interrelationships (called Field), as well as orientation and discernment consisting of beliefs, concerns, and dispositions (called Mode), and the individual and environmental considerations of school, practicum, and classrooms (called Context).

Preservice teacher preparation in Ontario currently exists in a number of structural variations of a one-year program. The one-year program runs from September to April or May and is called a consecutive program because it is attended after an initial undergraduate degree has been completed. This one-year program is also offered on a part-time studies basis in some Faculties of Education. A multi-year program runs concurrently with the initial undergraduate degree and is called, appropriately, a concurrent degree. This kind of program often uses the consecutive program components and spreads them out over the course of four or five years. Extended practicum and added practicum experiences, and special Education undergraduate elective courses may be included in the concurrent program. Along with the required coursework, a minimum of forty practicum days must be included in the bachelor of education program.

In my classes, which contain consecutive and concurrent preservice teachers, preservice teachers’ comments about their worries and fears, wondering if they can teach, and how to ‘do’ classroom management, appear contradictory to their success at creating lesson plans, presenting technology assignments, teaching peers about manipulatives, creating summative activities and associated assessment plans. This has left me wondering about what it is in the preservice program that can increase its value as a teacher preparation experience, so that preservice mathematics teachers can feel more confident that they can successfully implement what they have learned in the mathematics education course, into their own secondary school classrooms.
1.3 Purpose of the Study

The purpose of this study is to explore the nature of teacher efficacy in preservice secondary school mathematics teachers in the context of their teacher preparation program. Context is defined as the situatedness of teachers’ practice, the teachers’ physical and intellectual space. Specifically, the preservice program, which includes the mathematics education class and practica component, is the context for the discussion of preservice teachers’ professional learning, and the secondary school mathematics classroom is an additional context for the inquiry into preservice mathematics teacher efficacy in relation to the teaching and learning of secondary school mathematics. The motivation for this study is a desire to understand more deeply the nature of teacher efficacy with preservice teachers. We, as certified teachers in Ontario, have all been preservice teachers. Our sense of teacher efficacy as in-service teachers formally began in a preservice program. As an in-service teacher, taking on the role of an Associate teacher and mentor to preservice teachers during practica, and as a faculty of education mathematics instructor teaching preservice teachers, I contribute to their development as a teacher.

It feels necessary and important to create a theoretical framework to more fully understand preservice mathematics teacher efficacy and the possible contributing factors such as teacher concern (Fuller & Bown, 1975), teacher orientation (Feimen-Nemser, 1990), and preservice program factors. This theoretical framework should encompass the identified contributing factors, and add to the knowledge and understanding of preservice teacher efficacy. The purpose of a ‘snapshot in time’ inquiry into preservice teacher efficacy at the end of the preservice program is to reduce the noise and other possible distracting influences in such a
complex cognitive and affective process and provide a succinct and clear moment and position in mathematics teacher preparation.

1.4 Statement of the Problem

There are a number of studies being performed with in-service teachers, in efforts to improve their teaching confidence, and hence improve their classroom practice (D'Ambrosio, Boone, & Harkness, 2004; Feimen-Nemser, 2001; Ross & Bruce, 2007a, 2007b; Ross, McDougall, Hogaboam-Gray, & Lesage, 2003; Woolfolk Hoy & Spero, 2005). It seems reasonable to see if improving the initial in-faculty learning experience helps preservice teachers in their practicum classrooms. Then, it might be possible that this growth can continue through their in-service years. A firm and confident start to one’s teaching practice may affect professional growth and development and greatly decrease the time lag and discontinuity between in-service learning and classroom implementation (Erikson, 1993; Muis, 2004). As Muis (2004) noted, studies have indicated a relationship with beliefs, motivation, cognition, for teachers, and between teachers and students. Pajares (1992) and Kagan (1992a; 1992b) also suggest that teacher beliefs can inform educational practice at both the in-service, and preservice level.

In this study, I investigate the sense of teacher efficacy for secondary school preservice mathematics teachers to understand further the complex nature of preservice teacher efficacy and its perceived influences on preservice teacher classroom practice. I approach this problem by asking preservice teachers to be self-descriptive and reflective from the perspective of three specific research questions:

1. What is the teacher efficacy for secondary school preservice mathematics teachers?
2. What are some common factors and influences to preservice mathematics teacher efficacy, and what support is there for the existing theoretical constructs of teacher concern and teacher orientation?

3. How well do qualitative and quantitative teacher efficacy measures align in the preservice context?

1.5 Significance of the Study

This study is designed to offer insight into the teacher efficacy of a group of graduating mathematics preservice teachers. It is anticipated that results from this study will assist other teacher educators by understanding the factors that contribute to preservice teacher efficacy and the possible subsequent effects on classroom behaviours. In addition, teacher preparation programs may be modified to accommodate these perspectives to help teacher candidates learn to become better classroom mathematics teachers.

In Ontario, many Faculties of Education are exploring multi-year teacher education experiences in addition to the one-year consecutive program. The components of the one-year program often remain intact in these multi-year programs and are spread over a number of undergraduate years. Multi-year teacher education programs are often combined with a first undergraduate degree, meaning preservice teachers are often younger than the usual one-year consecutive, or post-undergraduate, preservice teachers. On the other hand, preservice teachers in a one-year consecutive program or a part-time program can be attempting a ‘second’ career; hence come to the program after years in another occupation, with families and children, and established roots in a community.

Through the inquiry into preservice teacher concerns and teacher orientation and preservice program contribution to teacher efficacy, it is anticipated this study will identify
maturation or history factors that influence preservice teacher efficacy. The identification of these maturation or history factors may show themselves to be influences to preservice teacher efficacy, teacher concerns, and teacher orientation. This may also suggest accommodations and adaptations that could be made to the one-year program and/or to the one-year program components so that it can be suitably delivered over a longer period of time. Hence, improvements to the one-year teacher preparation program will be a definite asset to teacher education in Ontario. In addition, it is also possible that these results may transfer to other jurisdictions.

Another significance of the study is the generation of a theoretical framework that may act as a support to, and underpin other, research and inquiry efforts into preservice teacher efficacy and preservice teacher preparation. In addition, connections to theoretical frameworks for mathematics teacher preparation, to models such as MKT (Ball & Sleep, 2007), Mathematics Knowledge for Teaching, and to the inquiry into the complexity of mathematics education may prove to be highly fruitful in longitudinal inquiries into mathematics education over the duration of a teacher’s preservice through in-service years.

1.6 Researcher: Personal Background

When I was eleven years old, growing up in a northern Ontario hockey town, a fellow player’s hockey stick broke my front tooth. It was shinny hockey on the neighbourhood outdoor rink. Every neighbourhood had an outdoor rink, some with boards, and some without. I cannot remember who looked after these rinks, but they were everywhere. However, I was not a competitive team hockey player. My skates had picks on the toes of the blades. I was a figure skater. Upon reflection of my childhood, I realize it took a lot of confidence in myself to be one of a handful of pre-competitive figure skating boys in a hockey town.
That same year, I had my first figure skating competition and placed second. The boy who achieved first place standing was exceptional; however, I know another reason why I did not have a chance at first place. As Bandura (1997) notes, self-efficacy can be increased through vicarious observation. I watched the skater, who placed first, and imagined performing all his moves and jumps myself. I replayed my own routine and all the points of interpretation and style and technique on which my coach had worked with me in training (Bandura’s (1997) self-reflective capability). Then, on centre ice as the music started, all my plans faded. I skated my routine with little or no interpretive style – no artistic arm movements, no sweeping leg swings through turns. This is an indicator of how self-efficacy got me on the ice and complete my routine, however, without the interpretive style because I faltered and could not perform as I had planned, and practiced. This alludes to a more specific efficacy, one that is contextual, in this case, skating performance on ice, possibly skating efficacy.

I have experienced other similar situations; self-efficacy to audition for the lead in a community theatre production and perform well in the practice hall singing with the female lead, but faltering again and not being able to put believable movement together on stage during the final auditions. I had a great imagination, and believed I could do anything on the stage, yet could not follow through. As a preservice teacher, I had self-efficacy to apply to a special practicum program, go to my practicum placement each week, and observe and co-teach individual lessons.

However, when the opportunity came to create a unit project on banking and personal finances I could not make those next steps to visiting the neighbourhood bank branches. In the role as a teacher from the school, I could not coordinate the students’ visiting activities and information collection without the assistance of my Associate Teacher. I felt very efficacious to
put all the logistics in order, perform cafeteria duty, and be a student-teacher in each day’s lessons, yet the act of, what I considered a ‘real’ teacher, putting the project in place showed a lack of contextual efficacy. In a specific context, a specific teaching context, I faltered.

Throughout my teaching career, I have developed my teacher efficacy. Within four years of teaching in large inner-city schools in two large urban centres I had achieved a position of added responsibility in my secondary school as the ‘Transition Years Coordinator’ responsible for the whole school implementation of the Transition Years (a grade 7, 8, 9, curriculum reform in Ontario), and leading the development of the school’s assessment plan. I became a trainer in ‘Fred Jones Positive Classroom Discipline’ and ‘Fred Jones Positive Classroom Instruction’, and facilitated workshops for the teaching staff. By my fifth year of teaching, I achieved a Department Headship responsible for one day-school mathematics department and the Board’s night school mathematics programs. Then, at a time of government funding changes for adult education requiring all full-time contract Ontario Secondary School Teachers’ Federation staff to be removed from adult education, I facilitated the Fred Jones’ Positive Classroom Management program for thirty-five of the adult-education staff, who were experiencing more than a little anxiety at moving back into adolescent school settings.

I transferred into an adolescent day school mathematics department headship, and my professional career continued simultaneously over the next ten years with remedial summer school teaching. The remedial summer school journey involved modifying and implementing and teaching a unique student-centred program for grade nine OSIS, the Transition Years, and then OSS mathematics programs. As well, during those summer school years, I became the mathematics Department Head, the Vice Principal, and then Principal of the local school board’s
remedial summer school program. The remedial summer school program consistently ran an 1800 credit program for about 1200 secondary school students.

My career path was leading me into administration, and with that goal, I started a masters’ of education degree. Nearing completion of that degree, I accepted a full Vice-Principalship. However, when a secondment opportunity to be a part of a funded mathematics centre at the local university and coordinate the concurrent mathematics education undergraduate program appeared, I removed myself from the administration track, and tackled preservice and undergraduate education.

From the time I was a Transition Years’ Coordinator to the time I was seconded to the university, I worked with preservice teachers in my secondary school classrooms as an Associate teacher. I have been continuously involved with preservice and in-service teacher professional development, and in my daily work I often found myself working with teachers tackling their own confidence issues as they dealt with challenging and ‘hard to teach’ students.

A further validating set of experiences has been the invitations, and acceptance into the First Nations’ communities, guest speaking and facilitating workshops on elementary level and secondary level mathematics learning in First Nation’s perspectives and contexts. Understanding others’ values and beliefs, and appreciating and integrating others’ learning needs in these various contexts (First Nations’ education, preservice, in-service professional development) has shown me the importance of self-efficacy itself, and in context, that is teacher efficacy, for myself and for others.

“Education is complicated, everyone agrees. More precisely it is complex, … it is a recursive open system characterized by emerging entities, the evolution of new capacities, and by developmental growth” (St. Julien, 2008, p. 101). Interestingly, it is complexity theory that I
have found provides a landscape (Connelly & Clandinin, 1995) to situate my reflection, behaviours, motivations, and understandings of mathematics education and the teacher preparation of mathematics teachers. Given a ‘landscape’ of eighteen years of secondary school classroom teaching of mathematics including seven years at the preservice education level, one might anticipate a coherent, beautifully coloured and textured set of surroundings in which to think, plan, and implement mathematics education processes. However, my landscape articulates only a brief fraction of a larger picture, the true, authentic, and holistic experience of mathematics education.

My investigation of preservice teacher efficacy comes from my work and experiences with preservice mathematics teachers. I use my memories of being a preservice teacher, and then a novice teacher, an Associate Teacher, and then my work in positions of added responsibility, to add colour and texture to the classroom life I am asking my preservice teachers to appreciate as they learn about the pedagogy of the mathematics classroom.

In my preservice secondary mathematics education course, the preservice teachers experience in-class assignments, and other assignments that require them to participate in a mathematical activity or event outside of class. One of the in-class assignments is called ‘Teaching with Technology’ and it requires preservice teachers to work in groups to learn a particular piece of technology commonly seen in secondary school mathematics classrooms, such as Geometers’ Sketchpad, and teach their preservice classmates about a particular function of that technology. A piece of the current mathematics curriculum content may be used as a vehicle for the learning. Another in-class assignment is the weekly ‘Manipulative Minute’. This requires preservice teachers to work in teams of two to teach their preservice classmates how to use an original manipulative or a mathematics manipulative commonly seen in the
intermediate/senior grades. The teams must learn how to use the manipulative, teach a particular mathematical concept from the curriculum within a short time frame, usually 10 minutes, create a homework question that requires the use of the manipulative with an appropriate assessment strategy, and then assess and evaluate their peers’ solutions and write a report on their experiences. These activities and their presentations in class, require great amounts of personal confidence, for example, a) to make groups at the beginning of a school year where people are unfamiliar with each other, b) to navigate a new computer network in the building and learn the technology, and then c) to stand up in front of peers within a month of starting the bachelor of education program and teach.

The out-side of class activities, such as creating a bulletin board display, authoring a grade 9/10 math contest to be used in the local school board’s secondary schools, observe an enrichment program run by the university mathematics department, or run a ‘problem of the week’ for Education students, also require great personal confidence as students have to negotiate team building, material organization with the help of the Media Centre, and navigate work within the Faculty building or on main campus. For example, participation in the enrichment program, which many preservice teachers select as their out-side of class activity, requires preservice teachers to find their way around campus and introduce themselves to a team of exceptionally experienced and seasoned mathematics teachers – retired and current from secondary schools and the university – who lead the enrichment activity.

I have observed preservice teachers’ self-confidence emerge against the challenges of initiative and procrastination. I have observed self-confidence develop into teaching confidence as the preservice teachers attend the enrichment program sessions for a number of months and begin to inquire into opportunities to assist. I have also observed preservice teachers’ teaching
confidence develop from facilitating a faltering and uncertain Technology presentation at the beginning of the course into being a confident and ‘reflection-in-action’ (Schon, 1983) problem solver during Manipulative Minute presentations at the end of the course.

As a teacher educator, I modify and change the course and coursework, attending to what I observe from my students’ learning in efforts to improve students’ learning opportunities. However, strategies for effective student learning appear to be a moving target. There always seems to be some invisible factor that influences and affects student learning.

I observe preservice teachers’ successes and failures throughout the year of teacher preparation and I believe I can see attitudes, character, impulses, and beliefs percolating through their actions. The contexts of their backgrounds appears to influence how they move through the teacher preparation program, what they accept or reject as good teaching practice or choose to integrate into their teaching practice. Standing in front of classes of exceptional individuals, who were trying to become secondary school mathematics teachers, has caused me to ponder my teacher efficacy that allows me to ‘teach’ mathematics education. Facilitating and leading these classes of preservice teachers, telling them how the secondary school mathematics classroom could work, causes me to reflect on the teacher efficacy I had when I first started teaching. What was I thinking about, attending to, and acknowledging in my teacher preparation learning experiences?

This inquiry into preservice teacher efficacy requires understanding preservice teachers as well as identifying their level of teacher efficacy. It becomes less important to attend to who I am, and more important to know who they are, and what they learn from the environment and community that surrounds them in this path of teacher preparation. Who I am influences the engagement, motivation of the lessons, but the pedagogy of the mathematics classroom is
commonplace in literature and many secondary school classrooms. The pedagogy of the mathematics classroom is available for learning no matter who is the instructor. I believe this is an important understanding to this study. The results are not necessarily swayed by the influence of my character, or my stories of teaching, the results are evidence of the others’ understanding of teaching mathematics

1.7 Limitations of the Study

There are three notable limitations to this study. First, the findings of this study are based on two of the largest Faculties of Education in Ontario. While these two Faculties contain two of the largest intermediate/senior mathematics teacher education programs, this sample is relatively small. Second, the timing of the data collection may be an issue when inquiring into teacher efficacy and the contributions of the preservice program as potential respondents’ memories fade over time. It was important to contact the graduating preservice teachers as soon as possible and complete the interviews before too much time had elapsed and their perceptions of their teacher efficacy and preservice program experience changed. In addition, once preservice teachers are finished their preservice program, they begin vacations, holidays, or they move back home to family and friends, or they get jobs in other jurisdictions. Their preservice program contact information may not be valid and contact becomes difficult or impossible.

Third, the data collection occurs at the end of the teacher education program experience. While a look at the trajectory of teacher efficacy over time may provide a deeper understanding of the changes in preservice teacher efficacy, this would likely be a different perspective to preservice teacher efficacy. However, as argued in the methods chapter, these findings are valid and may inform other teacher educators in similar situations.
1.8 Plan of the Thesis

This thesis is organized as follows;

Chapter Two examines teacher beliefs, teacher efficacy, and mathematics content and pedagogy in the context of preservice mathematics education. The literature review describes the relevant and pertinent background of preservice teacher beliefs, teacher efficacy, and the interplay of content knowledge, pedagogical knowledge and pedagogical content knowledge (Shulman, 1986, 1987).

Chapter Three provides a description of the methodological basis for this research and the particular method of this study. The results of a pilot study clarify, reinforce, and strengthen the methodological steps of this research study.

Chapter Four provides a detailed account of the collective and individual stories of teacher efficacy during the teacher preparation program. Participant experiences are explored through survey and interview results. The findings emerge from the convergence of quantitative and qualitative data of preservice teacher reflections.

Chapter five revisits the research questions and presents some major findings relating teacher efficacy and some contributing factors. A conceptual framework is developed and the discussion offers suggestions and considerations for preservice programs. Finally, the implications of this study on further research are presented.
Chapter 2

Literature Review

2.1 Background

The purpose of this literature review is to examine the relevant and pertinent literature for a particular subset of teacher beliefs, that is, teacher efficacy. Teachers’ beliefs form the basis for particular beliefs such as teacher efficacy, and in the context of teaching, teacher concern and teacher orientation are reviewed for their interplay in teacher efficacy. Teacher efficacy tools naturally exist in a discussion of teacher efficacy as the exploration of teacher efficacy has been integrally linked with the development of measurement tools for understanding and defining teacher efficacy. Teacher efficacy tools specific to this study are discussed.

Finally, a review of content knowledge, pedagogical knowledge, and pedagogical content knowledge is presented to provide an encompassing picture of the elements of a secondary school mathematics teachers’ professional practice. It is not an exhaustive review, but one that lays a foundation to understanding teacher efficacy and the comments made by the preservice teachers with respect to their own learning as teachers.

2.2 Introduction

In an inquiry into classroom practice, it becomes apparent that teaching is complex (Davis & Upitis, 2004), and that there are other factors to this complexity, such as teacher beliefs and teacher efficacy, teacher concerns, and the philosophic and implemented teacher orientation towards classroom practice. Mathematical content knowledge is learned in elementary school, secondary school, and as an undergraduate at university, while pedagogical knowledge is learned in a bachelor of education program and through teaching experiences prior to the education program. Teachers draw on content knowledge and pedagogical knowledge as they choose
teaching strategies in their classroom, and implement their professional practice. This literature review explores these factors beginning with teacher beliefs and teacher efficacy, and the two teacher efficacy measurement tools most pertinent to this study, then explores the constructs of teacher concern and teacher orientation, concluding with a review of mathematics content knowledge and pedagogical knowledge, and pedagogical content knowledge.

2.3 Teachers’ beliefs

“The more one reads studies of teacher belief, the more strongly one suspects that this piebald of personal knowledge lies at the very heart of teaching” (Kagan, 1992a, p. 85). Phillip et al (2007) state, “Few doubt that teachers’ mathematical content knowledge plays a critical role in their instruction, but most realize, also, that teachers need more than content knowledge to be effective. In particular, teachers’ beliefs about mathematics, teaching, and learning affect the ways they think about and teach mathematics” (p. 439). Drawing together teacher beliefs with content knowledge and pedagogical knowledge begins to create a sense of ‘who I am’ as a teacher (Peressini, Borko, Romagnano, Knuth, & Willis, 2004). Schoenfeld (2005), Fennema and Franke (1992), An, Kulm, and Wu (2004) are among some who appreciate the impact of beliefs on teachers’ acquisition of knowledge and teachers’ decision making.

Pajares (1992) posed a number of inferences and generalizations about teacher beliefs; that they are formed early and are relatively static, that belief change in adulthood may be caused by a gestalt shift or conversion from one authority to another, that they act as a filter for interpretation of new phenomenon, and for guiding thinking, information processing and defining behaviour. These inferences and generalizations can be found in others’ expressions of the nature of teaching, for example, “We teach who we are” (Palmer, 1997, p. 241).
Pajares’s (1992) review of educational research concerning the nature of beliefs explored how beliefs are not necessarily the same as knowledge. Beliefs are based on personal judgment and evaluation, and are of a subjective nature, while knowledge has more of an objective nature, based on facts. Oliveira (2004) suggests teachers’ identity develops individually, even within the same preservice program because preservice teachers have a personal interpretation of their experiences. The objective ‘facts’ or one’s experience influence the subjective ‘beliefs’. Ones’ personal interpretation is guided by one’s beliefs, and so shape classroom practice. “We teach who we are. So who is the Self that teaches? From a perspective grounded in teacher formation, that Self is the who we are ‘disposed’ to be, not the who external forces maintain we are ‘supposed’ to be” (Hare, 2007, p. 143, bold in original).

Borko et al (1992) provide examples of preservice teachers who teach in the same manner they were taught using algorithms, rote, and drill, even while being exposed to conceptual learning experiences. They conclude that preservice teachers must be situated in a continuous culture of learning as learners and teachers, and a continuous culture of learning that role models and values this conceptual kind of mathematics experience. Attitude, values, and behaviours may be very resistant to change. Dispositions, at one time identified as attitudes, has been further elaborated to suggest predictive characteristics for performance and behaviour (Freeman, 2007). Brown and Cooney (1982) explain beliefs as dispositions to action. Hare (2007) defines dispositions as the teachers’ behaviours, informed by the teachers’ thoughts and feelings, and supported by values and beliefs. It is beliefs that are a focus for this study.

Self-beliefs influence and support the sense of the individual. “Learning and a sense of identity are inseparable” (Lave & Wenger, 1991). However, when inquiring into beliefs, context (Brown & Cooney, 1982) reduces the frame of inquiry to a particular aspect. Teacher preparation
programs provide a specific set of contexts (in-class, practicum, community) to assist candidates “to become aware of and to develop their dispositions” of being a teacher in a classroom (Stooksberry, 2007, p. 226). This is an important distinction. Context illuminates the teacher beliefs within one’s self-beliefs. For example, the classroom context illuminates the teacher efficacy within one’s self-efficacy.

2.4 Teacher efficacy

Ponte and Chapman (2008) find agreement amongst many studies of the importance to build confidence in preservice teachers to facilitate professional development and knowledge production of teaching and learning. How do teachers’ beliefs impact classroom practice, or student achievement? This question of the impact and connection of teachers’ beliefs and classroom practice has become an important research focus. Teacher belief relating to classroom practice is part of what has been termed teacher efficacy.

A brief overview of the research into teacher efficacy may be helpful at this point. First, “[t]eacher efficacy has been defined as the extent to which the teacher believes he or she has the capacity to affect student performance” (Berman, McLaughlin, Bass, Pauly, & Zellman, 1977, p. 137). Teacher efficacy has been associated with many student issues such as achievement (Armor et al., 1976; Ashton & Webb, 1986; Moore & Esselman, 1992; Ross, 1992), and student motivation (Midgley, Feldlaufer, & Eccles, 1989) as well as teacher characteristics, such as enthusiasm (Allinder, 1994; Guskey, 1984), commitment (Coladarci, 1992; Evans & Tribble, 1986), and classroom practice (Ross, 1994).

Generally, teacher efficacy has been considered a global value, sometimes called teachers’ self-efficacy, or teachers’ sense of efficacy. Two psychological theories have formed a basis and foundation for inquiry into teacher efficacy. One of these, Rotter’s (1966) social
learning theory and locus of control has contributed greatly over the years to the understanding and development of measurement tools for teacher efficacy. Social learning theory suggests that teachers hold beliefs about their ability to affect and/or influence student outcomes.

Locus of control concerns the attribution of positive and negative results in a particular situation to an internal locus of control, that is, to one’s own actions and efforts, or to an external locus of control, that is, to influences and actions outside of one’s control. One of the earliest inquiries in the teachers’ context of locus of control came from a RAND study that included two particular questions relating to teacher efficacy; Rand item #1, “When it comes right down to it, a teacher really can’t do much because most of a student’s motivation and performance depends on his or her home environment”, and Rand item #2, “If I really try hard, I can get through to even the most difficult or unmotivated students.” Respondents’ levels of agreement to these two questions were added to form a single teacher efficacy value. Individually, each question aligns with a locus of control.

Rand item #1 considers factors such as the influence of the student’s home environment, the values of parents towards education, the issues of socio-economic status, race, and gender. These are considered external factors, outside the teacher’s control but which have influence on the student’s performance in school. This has become commonly known as general teaching efficacy, or GTE. Rand item #2 considers factors such as the teacher’s level of training, the teacher’s past experiences, and the teacher’s feelings of ability to overcome the external factors that may block student achievement. These are considered internal factors and have become commonly known as personal teaching efficacy, or PTE.

Subsequent measures were developed by other researchers in efforts to increase the reliability of the RAND two-item scale. For example, Rose and Medway (1981) developed the
Teacher Locus of Control, Guskey (1981) developed the Responsibility for Student Achievement survey, and Ashton et al., (1982) developed the Webb Efficacy scale. Locus of control conceptions have been seen in Mewborn’s (May 1999) results, “the decisive issue that determined whether preservice teachers were inclined to think reflectively was the locus of authority [or the locus of control] for pedagogical ideas” (p. 335).

This understanding of teacher efficacy was further enhanced with Bandura (1977; 1982; 1986) through his work with cognitive social learning theory and self-efficacy (Woolfolk Hoy, 2000; Woolfolk Hoy & Spero, 2005). Researchers considered external and internal to be ends of a continuum, rather than two separate factors that might correlate. Hence there were difficulties interpreting the results of the use of GTE and PTE in studies with factor analyses of the designed and implemented scales. “Researchers turned to Bandura’s cognitive social learning theory of self-efficacy to interpret the two factors” (Woolfolk Hoy & Spero, 2005, p. 347). Bandura conceptualized one’s judgment of his or her ability to perform a particular action as self-efficacy expectation, and one’s judgment and beliefs about the likely consequences of the particular action as outcome expectation.

Gibson and Dembo (1984) developed a more extensive and reliable measure of teacher efficacy, which has become one of the more popular and implemented teacher efficacy scales. It incorporates Rotter’s social learning theory, the results of RAND’s two-item scale, and Bandura’s conceptualizations of self-efficacy and outcome efficacy, into a formalization of personal teaching efficacy (PTE) and general teaching efficacy (GTE), as efficacy expectations and outcome expectations respectively. Results from the use and modification of this measurement showed a relationship between teacher efficacy and student achievement, attitude, and affective growth.
Subject-matter-specific modifications of the Gibson and Dembo (1984) measurement tool started to appear, e.g., for science content, classroom management, special education. As well, other methods of measuring teacher efficacy appeared such as the work by Ashton, Buhr, and Cocker (1984) who developed a series of descriptions for case study reflection and comparison. Measurement tools continued to be created comprised of combinations of these previous measurement tools.

There is a sense of efficacy that relates to one’s positive and negative anticipations and predictions of outcomes to efficacy feelings. Woolfolk and Hoy (1990) connected research evidence of teachers’ sense of efficacy with teachers’ attitudes about control in the classroom. Three aspects of control were examined by Woolfolk and Hoy (1990): pupil control ideology, motivational orientation, and bureaucratic orientation. High and low efficacy appeared to align with humanistic and custodial orientations respectively in pupil control ideology; informational purposes and controlling purposes to classroom activities in motivational orientation respectively; and internal (teacher) and external (bureaucratic) control of classroom performance in the bureaucratic orientation respectively. The results were complicated and required careful, qualified, and defined relationships between variables. Woolfolk and Hoy (1990) found some interesting results that indicated a strong sense of control issues with efficacy and the possibly confounding influence of survey item wording on the interpretation and results of the study of efficacy.

Ross, Cousins, and Gadalla (1996) also conceptualized teacher efficacy in a manner similar to ‘personal teaching efficacy’ and described the careful analysis required, and the recognition of limitations that their measurement tool had on interpretive ability for teacher efficacy. As Tschannen-Moran and Woolfolk Hoy (2001) state, “Several researchers attempted
to draw on both Rotter and Bandura, reconciling the two conceptualizations or simply ignoring the distinctions” (p. 788).

The continuing difficulties in interpreting teacher efficacy led Bandura to clarify his distinction between his conceptualization of self-efficacy and Rotter’s locus of control and social learning theory. For Bandura, perceived self-efficacy as the belief that one can produce certain actions is not the same as the conception of locus of control, the beliefs that one’s actions affect outcomes. Summarizing Bandura, Tschannen-Moran and Woolfolk Hoy (1998) state, “an individual may believe that a particular outcome is internal and controllable – that is, caused by the actions of the individual—but still have little confidence that he or she can accomplish the necessary actions” (p. 211).

In 1997, Bandura articulated his social cognitive theory and perceived self-efficacy as “beliefs in one’s capabilities to organize and execute the course of action required to produce given attainments (p. 3)” (Tschannen-Moran et al., 1998, p. 207), and developed a thirty-item efficacy measurement tool, the Teachers’ Self-efficacy Scale. Social cognitive theory suggests that teachers hold beliefs about their abilities to perform and behave in a particular manner, and beliefs about the effects of their actions on students. Sources of self-efficacy come from enactive attainment (that is mastery experiences), vicarious experience (learning from another’s actions), verbal and social persuasion, and psychological states (one’s own psychological and emotional cues) (Bandura, 1997).

Bandura’s (1997) Teachers’ Self-efficacy Scale has been used and modified to explore various other factors, such as school context effects, student or class effects, and collective efficacy effects. The Teachers’ Self-efficacy Scale contains seven subscales specific to the efficacy needed in a teaching context: efficacy to influence decision making, efficacy to
influence school resources, instructional efficacy, disciplinary efficacy, efficacy to enlist parental involvement, efficacy to enlist community involvement, and efficacy to create a positive school climate. Ross, Cousins, and Gadalla (1996) also found teacher efficacy to be a specific expectancy rather than generalized expectancy by examining three within-teacher variables: feelings of past success, feelings of being well-prepared, and student engagement. The correlation of the three within-teacher variables to teacher efficacy possibly foreshadowed Bandura’s (1997) claim of other school context factors to teacher efficacy.

Using Bandura’s social cognitive theory and Teacher Self-efficacy Scale as a foundational model, Tschannen-Moran, Woolfolk Hoy and Hoy (1998) proposed an integrated model of teacher efficacy that incorporated self-perception of teaching competence and beliefs about task requirements given specific contexts and situations. With their model, the impact of teachers’ self-efficacy was examined from the contexts of innovation implementation, with preservice and in-service teachers.

Tschannen-Moran and Woolfolk Hoy (2001) responded to teachers and teacher educators concerns that the Teachers’ Self-efficacy Scale (Bandura, 1997), while comprehensive and appearing to address the difficult issue of measuring and interpreting teacher efficacy in teaching contexts, may not be as accurate a representation of the teacher’s daily working tasks. Tschannen-Moran and Woolfolk Hoy (2001) developed a new teacher efficacy scale. Originally called the Ohio State teacher efficacy scale (OSTES), it is now called the Teachers’ Sense of Efficacy Scale (TSES). Extensively tested with preservice and in-service teachers for reliability, validity, and defining the factor structure, the TSES exists as a twenty-four question form and a twelve question form, each with three subscales of efficacy for student engagement, efficacy for instructional strategies, and efficacy for classroom management. These three subscales intend to
represent the three dimensions of efficacy and “the richness of teachers’ work lives and the requirements of good teaching” (Tschannen-Moran & Woolfolk Hoy, 2001, p. 801).

The two conceptual strands, social learning theory and social cognitive theory, have provided psychological foundations to many research programs inquiring into teacher efficacy. At times, the two conceptual strands have supported separate inquiries into efficacy within the same context, for example preservice teacher behaviours and preservice teacher preparation in social learning theory (Ashton, 1984), and in social cognitive theory (Bruce, 2005). Teacher efficacy in both of these conceptualizations have been found to be a powerful construct that appears to explain and/or predict many aspects of teaching and learning. For example, teacher efficacy is related to student achievement (Tschannen-Moran & Woolfolk Hoy, 2001, 2002), preservice teacher behaviours and preservice teacher preparation (Ashton, 1984; Bruce, 2005; Gordon & Debus, 2002; Watters & Ginns, 1995), in-service professional development effects (Ross & Bruce, 2007a), attitudes towards children and control (Woolfolk & Hoy, 1990), and mathematics reform efforts (Smith, 1996; Wheatley, 2002). This is not an exhaustive list, however it appears research into teaching and learning has benefited from the teacher efficacy perspective.

For the purposes of this study, both conceptualizations will be used. Teacher efficacy from the social learning theory perspective is used as the lens for the sense of internal and external sense of control according to the underlying principles of efficacy expectations or personal teacher efficacy (PTE), and outcome expectations or general teacher efficacy (GTE). The Internal locus of control comes from the teachers’ perceptions of personal power and influence of teachers in teaching and learning situations. The teachers attribute the success, and outcomes of students’ learning, to the teachers’ actions and behaviours. The External locus of
control attributes power and influence in the teaching and learning situation to elements outside of the classroom. The teachers perceive students’ learning as influenced by factors outside of the teachers’ control, such as particular social, demographic, and economic conditions in students’ lives. Throughout this thesis this will be called, respectively, Internal efficacy and External efficacy.

Teacher efficacy from the social cognitive theory perspective is used as the lens for the overall sense of teacher efficacy as a contextual construct. In particular, focusing on school context effects such as instructional strategy efficacy and student engagement efficacy. This overall contextual sense of teacher efficacy will be called teacher efficacy from this point onward in this thesis.

2.5 Teacher efficacy tools

The creation of measurement tools for teacher efficacy has a rich and varied history. Initially, results from two specific questions on a RAND survey in the 1970’s provided information regarding teachers’ personal teaching efficacy and general teaching efficacy, which together provided a measure of an overall teacher efficacy. There were only two efficacy questions on the survey, “When it comes right down to it, a teacher really can’t do much because most of a student’s motivation and performance depends on his or her home environment”, and “If I really try hard, I can get through to even the most difficult or unmotivated students.” Combined, these two items were defined to measure an overall sense of teacher efficacy, and individually they purported to measure general teaching efficacy, which is the power of external and/or environmental conditions to teacher efficacy, and personal teacher efficacy that is acknowledging the power of internal or ‘teacher’ conditions to teacher efficacy. Subsequent
measures were developed by other researchers in efforts to increase the reliability of the RAND two-item scale.

A popular scale by Gibson and Dembo (1984) incorporates Rotter’s (1966; 1982) social learning theory, the results of RAND’s two-item scale, and Bandura’s (1986) efficacy expectations and outcome expectations. Gibson and Dembo (1984) developed an extensive and reliable measure of teacher efficacy, and identified and formalized personal teaching efficacy (PTE) and general teaching efficacy (GTE).

Woolfolk and Hoy (1990) suggested that the influence of the wording of survey items on results and the nature of control issues appearing within personal efficacy and teacher efficacy may have a confounding effect on interpreting teacher efficacy with this measurement tool and recent modifications of this tool. Woolfolk and Hoy (1990) found many teacher efficacy items to be negatively worded, for example ‘the teacher can’t do much…’, and personal efficacy items to be positively worded, for example, ‘when I really try…’, and that this wording may have allowed these items to cluster into the two factors of personal efficacy and teacher efficacy (p. 89).

Guskey and Passaro (1994) also noted a wording consistency in the Gibson and Dembo (1984) Teacher Efficacy Scale (TES) and the Woolfolk and Hoy (1990) modification of the TES. Guskey and Passaro (1994) questioned whether the results indicated general teacher efficacy and personal efficacy factors, or were confounded with an internal and external sense of locus of control. Personal teaching efficacy items were worded positively and alluded to an internal sense of control. General teaching efficacy items were worded negatively and alluded to an external sense of control. For example, personal efficacy items all referred to “I” and were positively worded, for example, “I can”, and the teacher efficacy items all referred to “teacher” and were negatively worded, for example, “teacher cannot.”
Based on the conception that teacher efficacy is a product of internal and external loci of control, Guskey and Passaro (1994) altered the Teacher Efficacy Scale (Gibson & Dembo, 1984) and added three further Woolfolk and Hoy (1990) items. They randomly selected and reworded items to reflect an equal number of items indicating ‘can’ and ‘cannot’ and ‘I’ and ‘teacher’. Results of their work on this scale indicated that there was no distinction between personal and teacher efficacy for both the internally and externally worded items. However, the results indicated a locus of control distinction with the appearance of two factors: an Internal and an External influence, power, and impact in teaching situations.

A second conception of teacher efficacy emerged with Bandura’s (1997) clarification of social cognitive theory. Bandura’s (1997) Teachers’ Self-efficacy Scale contains seven subscales that pertain specifically to the context of a teacher’s classroom practice. Tschannen-Moran and Woolfolk Hoy (2001) have further developed this teacher efficacy scale into the Teacher Sense of Efficacy Scale (TSES), with a twenty-four item long form and a twelve item short form. Both the long form and the short form have been extensively tested for reliability and validity. “In order to be useful and generalizable, measures of teacher efficacy need to tap teachers’ assessments of their competence across the wide range of activities and tasks they are asked to perform” (Tschannen-Moran & Woolfolk Hoy, 2001, p. 795). Personal competence and an analysis of the task defined within the constraints and parameters of particular teaching contexts are two important aspects of teacher efficacy that should both be contained within the same teacher efficacy measurement tool (Tschannen-Moran et al., 1998).

The TSES was examined in three separate studies with preservice and in-service teachers. The final version was subjected to two separate factor analyses, one with preservice teachers, and one with in-service teachers. The TSES correlates well with the existing teacher efficacy
measurement tools, such as the TES (Gibson & Dembo, 1984), providing construct validity. In particular, the correlations are greater with the personal teacher efficacy (PTE) than the general teacher efficacy (GTE). However, Tschannen-Moran and Woolfolk Hoy (Tschannen-Moran & Woolfolk Hoy, 2001) feel the TSES “moves beyond previous measures to capture a wider range of teaching tasks” in its measurement of teacher efficacy (p. 801).

Three moderately correlated factors appeared from the factor analysis: efficacy in student engagement, efficacy in instructional practices and efficacy in classroom management. At times, the items that load on each factor varies slightly (Tschannen-Moran & Woolfolk Hoy, 2007). Table 1 presents the reliability details of Tschannen-Moran and Woolfolk Hoy’s administration of their scale.

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The TES (Gibson & Dembo, 1984) and the TSES (Tschannen-Moran & Woolfolk Hoy, 2001) offer well tested, reliable and valid teacher efficacy tools. Various researchers’ interpretations in numerous studies using these scales provides a wealth of analytical support for the use and implementation of these scales in the inquiry into teacher efficacy. Guskey and
Passaro’s (1994) modified TES scale for internal and external efficacy is based on research. The modifications align the TES items more closely with the original psychological construct of locus of control rather than from a blended conception of efficacy from two separate psychological lines of reasoning. These clarifications to measurement tools for locus of control and social learning theory, and self-efficacy and social cognitive theory provide two distinct perspectives with which to examine preservice teacher efficacy.

2.6 Teacher concern

Teacher concerns are the perceived problems or worries of teachers (Fuller, 1969). Teaching behaviours and classroom practices for teaching and learning mathematics arising from teachers’ beliefs may be related to teachers’ concerns. Fuller and Bown (1975) identify a set of concerns experienced by teachers and suggest that these concerns are somewhat linear, in that teachers progress through stages of concerns. Initially, preservice teachers experience concerns for ‘self’ in a focus on survival and “one’s adequacy … as a teacher, about class control, about being liked by pupils, about supervisors’ opinions, about being observed, evaluated, praised, and failed” (p. 37). Then, sometime during the preservice program but also stretching into the first years of in-service teaching, teachers’ concerns turn to ‘task’, the knowing and presenting of the mathematics content, lesson timing issues, and other instructional duties, and then to ‘impact’ and being aware of the learner and his or her needs, the evaluation of learning, fairness, etc.

Borich and Tombai (1997) developed a Teacher Concerns Checklist containing forty-five items distributed across the three teacher concerns of self, task, and impact. Teachers completing this checklist responded to the prompt, “When I think about teaching, am I concerned about this?” They responded using a scale of 1 to 5, 1 representing no concerns to 5 representing total preoccupation with the concern.
These stages are also articulated within the context of power in the classroom (Staton, 1992). This sense of power in the classroom is preservice and in-service teachers’ sense of control and being controlled, their sense of power exerted by them in the classroom and exerted on them from outside the classroom. The teachers’ sense of control is also related to their sense of teacher efficacy. Thus the dynamics of the classroom and the teaching and learning of mathematics form a complex learning system (Davis & Simmt, 2003).

Erikson (1993) suggests that there exists a continuum on which beliefs and classroom practice change at different rates, and it is possible that varying degrees of the other concerns will be evident in teachers’ expressions of beliefs and classroom practice (in Muis, 2004). “[P]reservice teachers should be expected to experience changes in their concerns about successful teaching (pedagogy, attitudes, etc.) and their effectiveness as a teacher during initial teacher preparation, as well as throughout their careers” (Beeth & Adadan, 2006, p. 106). One’s location in this nested continuum will be defined by the concern that appears more prominent.

Fuller and Bown (1975), Staton (1992), and Borich and Tombai (1997) suggest that teachers’ concerns develop sequentially, starting with the concern for ‘self’. See Figure 2 for teacher concerns over time. Berliner (1994) expressed the notion that preservice teachers may not travel very far along their learning curve within the time frame of a preservice program, in comparison to the learning curve travelled by expert teachers over the length of their professional career. The individual nature of becoming an expert teacher and one’s personal learning curve suggests teacher concern may not be a linear process from one concern to another. Preservice teachers may express elements of all three concerns, but greater professional maturity, an increasingly positive attitude, and possibly greater teacher efficacy may be reflected by an
integrated sense of these concerns, with impact as the focal point or priority to classroom practice.

![Diagram of Teacher Concerns]

*Figure 2. Teacher concern, adapted from Fuller and Bown (1975).*

Fuller and Bown (1975) and Veenman (1984) found classroom management and student motivation for attending in class, from the self concern perspective, to be preservice teachers' greatest concerns. “Thus, beliefs about how one ought to manage and motivate students as well as initial success in acting on these beliefs may be related to the development of a sense of efficacy for beginning teachers (Hoy and Woolfolk, 1989)” (Woolfolk & Hoy, 1990, p. 81).

### 2.7 Teacher orientation

Preservice teacher education involves the acquisition of knowledge, the representation of knowledge presented and learned, and the retention of knowledge. How one conceptualizes learning, knowledge acquisition, representation, and retention may provide insight into one’s orientation to teaching and learning. This study uses the teacher orientation framework as conceptualized by Feimen-Nemser (1990), with Academic, Technological, Practical, Personal, and Critical/Social orientations. A review of other conceptions of knowledge, teacher knowledge, and teacher orientation are presented to illustrate common underlying conceptions and show how Feimen-Nemser’s (1990) conception to teacher orientation is a good construct for this study.

Reynolds, Sinatra and Jetton (1996) approached one’s orientation to knowledge acquisition and retention from a historical perspective. Using historical views of knowledge,
Reynolds, Sinatra and Jetton (1996) conceptualized a continuum with endpoints, Experience-centred (EC) and Mind-centred (MC), and a middle point called Interactive. Protagorus was identified as the champion of EC with his speculation that sensation and perception are the only sources of knowledge. Plato championed the MC end of the continuum with his articulation of knowledge as a product of reason and reflection, where ideas, concepts, and deductions from reason become knowledge in one’s mind. Aristotle expresses a blend of the two endpoints, and so holds the Interactive position of the continuum. The Interactive position provides for data to be created from senses and perceptions and the mind to organize, categorize, and frame to allow for higher-order knowledge and understanding to emerge.

This conceptualization of knowledge provides a backdrop to examine and categorize five approaches to learning and knowledge acquisition: behaviourism, schema theory, social perspective theories, connectionism, and situated cognition. Reynolds, Sinatra, and Jetton (1996) selected these five particular approaches, or orientations, because they commonly appear in theoretical discussions in the academy and in practical applications in schools. Behaviourism approaches learning and knowledge acquisition from a stimulus-response with reinforcers perspective, for example Skinner’s work on behaviour modification (Reynolds et al., 1996). In a classroom context, the learner is passive and the teacher employs direct teaching techniques. Schema Theory involves flexible and interactive-processing activity based learning experiences (Reynolds et al., 1996). The students use their minds to organize and frame and create knowledge from the data their senses provide. The classroom will consist of student-centred activities designed for learning.

The Social Perspective Theories propose social constructivism and opportunities to experience socio-cultural perspectives (Reynolds et al., 1996). There is a profound influence of
social context in the construction of knowledge. The classroom environment is very important and cooperative learning strategies are commonly employed. Connectionism is the “network model of human cognition” (Reynolds et al., 1996, p. 99). Through the recognition of patterns and experiences with some ‘mind’ processes (not symbolic manipulations), learning develops by acquiring knowledge in a proceduralized manner, working towards automaticity in response.

Situated Cognition posits knowledge is created from interactions between the perceived external world, situation, or environment, and the internal representations the mind creates of these perceptions (Reynolds et al., 1996). The classroom would provide rich contexts and situations to promote and facilitate reasoning with mental models through problem-solving. See Figure 3 for the EC to MC continuum and the relative positions for the above five orientations to knowledge.

Figure 3. Social Perspective Theories (Reynolds et al., 1996, p. 102)

This historical basis for looking at knowledge offers a general world view for psychological conceptions and orientations to knowledge acquisition and retention. These psychological conceptions and orientations to knowledge form the basis for more teaching context specific orientations.

Miller and Seller (1990) say that one’s orientations come from one’s world views and models of reality, and that these orientations shape one’s beliefs. Miller (1983) described seven
orientations to curriculum: behavioural, subject/discipline, social, developmental, cognitive process, humanistic, and transpersonal. Miller and Seller (1990) describe three meta-orientations to curriculum; transmission, transaction, transformation. It is the meta-orientations of transmission, transaction, and transformation that offer the greatest illumination to teacher orientations for this study. While these are curriculum orientations, Miller and Seller (1990) also acknowledge them as teaching orientations; “[Teachers] can identify the aspects of the position [orientation] that most closely parallels their own thinking, although, certainly most teachers will find they do not subscribe to any one [orientation] in totality” (Miller & Seller, 1990, p. 11).

Transmission refers to the transmission of facts, skills, and values. It is a mechanistic view of teaching where specific instructional strategies, such as rote learning, promote mastery. The psychological underpinnings of the transmission orientation come from behavioural psychology, such as Skinner’s work on cause and effect. Transaction refers to cognitive development through the reconstruction of knowledge. Dialogue, problem solving and an academic foundation drive this orientation in classroom activities that promote democracy and contain rich social contexts. Transformation refers to two particular aspects of learning; a spiritual aspect and a personal and social change aspect. These two aspects are related within the same meta-orientation, however, from the learners perspective, are distinct conceptualizations of transformation. The spiritual dimension is often an individual experience, and the social change aspect is often a group experience. The essence of the transformation orientation is to work towards harmony with the environment, respecting and embracing diversity, and facilitating personal and social change.

From a more clearly teacher context, Pratt (1992; 1998) defined five teacher orientations: Apprenticeship, Transmission, Developmental, Nurturing, and Social Reformist. The
Apprenticeship orientation regards practice as a way of learning, and one practices after watching an expert perform the requisite task. The purpose of teaching in this orientation is the sense of passing knowledge on to the next generation, and through practice become expert practitioners gaining knowledge and wisdom. The Transmission orientation is one of the teachers telling their knowledge to the student. Crucial aspects of this orientation are the focus on timing, covering the curriculum, clearly following a syllabus, and the effective development of instructional materials for efficient knowledge acquisition. Smith (1996) also supports the existence of this orientation with research that provides evidence of teacher efficacy because the teacher practices a pedagogy of telling; a traditional, comfortable, familiar teaching practice of stating facts and demonstrating procedures.

The Developmental orientation positions the teacher as the content authority and facilitator of the mathematics to be learned. Subject matter (that is mathematics content), and thinking and finding and solving problems are the foundation to the teaching and learning experience. The Nurturing orientation requires the creation of an environment of care and trust. Teaching and learning occurs within this environment because of the continuous opportunities for teacher and student expression of feelings and emotions. The Social Reformist orientation requires personal and political action. The development of a societal vision through higher ideals fosters the environment for learning.

Fung and Chow (2002) employed these five orientations in a study of teacher beliefs and images and orientations to teaching and learning. Individual and combinations of orientations emerged in the inquiry into preservice teacher images of self and actual classroom practice. The results indicated that preservice teacher images of self do not necessarily match actual classroom practice. Preservice images emerged, in order of most prevalence to least, as Nurturing, Mixed
(most common was Nurturing and Transmission), and Developmental. Actual classroom practice showed images as Mixed (most common was Apprenticeship and Transmission), Nurturing, and Developmental. Fung and Chow (2002) identified others who have found similar results such as Bullough and Stokes (1994) and Bramald, Hardman, and Leat (1995), and some research that had found teacher images of self that do match actual classroom practice, such as McDiarmid (1990), Johnson (1994) and Doolittle, Dodds, and Placek (1993).

Simmons et al. (1999) employed a three orientation conceptualization in their inquiry into beginning teachers’ beliefs and classroom actions. A Teacher-centred orientation and a Student-centred orientation were positioned at the endpoints of the continuum with Conceptual teaching placed in the middle of the continuum. Their definitions of these orientations most closely aligned with transmission, developmental, and social reformist from Pratt’s (1992; 1998) orientations. Simmons et al (1999) found that beginning teachers self identified orientations, as being student-centred, did not match with actual classroom practice, which was teacher-centred.

Feimen-Nemser (1990) describes five orientations to preservice education: Academic, Technological, Practical, Personal, and Critical/Social. Feimen-Nemser (1990) presents these orientations as institutional conceptions of preservice education held by faculties of education that define and explain the institutional perspective behind program and instructional decisions made for the teacher preparation program. This study uses these conceptions of preservice education that are presented to preservice teachers through their teacher preparation program as a conceptual tool to interpret preservice teachers’ expressions of their own orientations to teaching. The Academic orientation positions the teacher as the subject-matter specialist and intellectual leader. It “highlights the fact that teaching is primarily concerned with the transmission of knowledge and the development of understanding” (Feimen-Nemser, 1990, p. 221). A
mathematics teacher may be of the opinion that his/her knowledge of the mathematics is more than sufficient license to know how to teach the mathematics. The Technological orientation attends to the skills of teaching. In this orientation, proficiency in the daily classroom performance and ability to follow the prescribed steps for a quality lesson is expected to guarantee student learning.

For the purposes of this study, to reduce the effect of respondent misinterpretation, that is, at this time Technological being predominantly interpreted as computer or other electronic facility, this orientation is re-named as Technical. The term ‘technical’ implies a more systematic approach, an understanding that following a set of steps for a particular teaching purpose will ensure student learning. The Practical orientation aligns with the tenets of apprenticeship learning. Classroom practice develops because the teacher is in the classroom and learning as he or she works. The elements of the art and science of teaching is attended to in the classroom, and the focus is the “primacy of experience as a course of knowledge about teaching and a means of learning to teach” (p. 222).

The Personal orientation places the teacher’s own personal development alongside the student’s development. “Learning to teach is construed as a process of learning to understand, develop, and use oneself effectively” (p. 225). In addition, “…teachers must know their students as individuals. With this knowledge they can select materials or set learning tasks that respond to individual interests, needs, and abilities” (p. 225). The Critical/Social orientation is an expression of the combination of political activism and education. The teacher models and enacts their classroom practice through a social justice lens. Critical pedagogy, emancipatory teaching, transformative experiences, and student empowerment are key elements of classroom practice.
Feimen-Nemser (1990) suggest that the orientation, or complex mix of orientations held by the preservice program faculty, influences the development and subsequent classroom practice orientation of preservice teachers. The diversity of orientations reflected as attitudes and perspectives held by preservice education faculty may influence, impact, align with, and/or conflict with, the developing preservice teachers’ sense of self and classroom instructional behavior. The combination and integration of these orientations become apparent in the focus of a preservice education course, and subsequently become apparent in preservice teachers articulation and expression of their classroom practice, e.g., classroom management, or instructional strategies.

Teacher orientation has been conceptualized in a number of ways. While not an exhaustive list of teacher orientation conceptualizations, these appear to align with Feimen-Nemser’s (1990) teacher orientations, lending support to the use of these five teacher orientations as a conceptual framework for this study. The psychological orientations are included as they appear to match particular Feimen-Nemser (1990) orientations, however, the Experience-centred (EC) – Mind-centred (MC) continuum does not translate to a teacher-centred – student-centred continuum. See Table 2 for the comparison of these conceptualizations of teacher orientation.

Three orientations or meta-orientations may be restrictive as a vehicle to describe teacher orientation to teaching and learning. Seven orientations may be too many to effectively describe distinct orientations with labels and titles that are clear and succinct. Feimen-Nemser’s (1990) terms and labels for orientations were selected because they best align with current classroom practice and teaching and learning conceptions. They employ terminology that can be clearly interpreted and appears authentically applicable to current classroom practice. They provide a workable number of orientations to consider and understand, and appear to encompass the major
tenets and conceptions of learning and knowledge and teaching orientations historically and presently acknowledged. While Feimen-Nemser (1990) defined these orientations for a

Table 2

**Conceptualizations of teacher orientation.**

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description of a faculty perspective to teaching and learning, Feimen-Nemser (1990) and Cotti and Schiro (2004) noted preservice teachers orientations may reflect the faculty orientation to beliefs about the purpose and means of teaching mathematics. Anderson (2001) noted that knowing preservice teacher orientations can help teacher educators in preservice program design. The context of this study is from a preservice teacher and preservice program perspective, not a curriculum perspective, or a strictly teacher perspective. Therefore, Feimen-Nemser’s (1990) orientations were selected as the conceptual framework for teacher orientation.

2.8 **Content knowledge**

What is the connection between attitude, belief, and content knowledge? In a study of secondary school and elementary school preservice teachers, Quinn (1997) found that
mathematics methods courses increase content knowledge and attitudes towards content for secondary school preservice teachers, and increase significantly the content knowledge and attitudes of elementary school preservice teachers. Ponte and Chapman (2008) connect work from Gellert (2000) and McDuffie (2004) to indicate a relationship between preservice teacher confidence and the development of content knowledge and pedagogical knowledge.

NCTM (2000), the National Council of Teachers of Mathematics’ Principles and Standards documents, provide an up-to-date description and list of content knowledge for North American mathematics teachers. As a framework for identifying the key mathematical concepts and skills for students to learn, it also acts as a guide for defining the content knowledge teachers should posses. Wittman (1989) suggests the development of pedagogical content knowledge comes from the knowledge of elementary mathematics, the knowledge of the subject matter. Brown and Borko (1992) find support in several studies that an increase in content knowledge is essential in the preparation of mathematics teachers. They suggest strong subject matter knowledge appears related to more effective planning, problem solving, and pedagogical thinking.

Ball (1990b) suggests that teachers must posses richly connected understandings and content knowledge in their subject matter in order to teach in a manner that provides meaningful learning opportunities for students. Frykholm and Glasson (2005) suggest that the content knowledge of preservice teachers for secondary school and elementary school classrooms is lacking. Even the participants themselves in Frykholm and Glasson’s (2005) study state “they felt their content knowledge … was insufficient” (p. 138).

Heibert, Morris, Berk, and Jansen (2007) defined two different kinds of knowledge in their study on the preparation of teachers to learn from teaching; one of which is subject matter
knowledge for teaching. This subject matter knowledge, or content knowledge, is specifically convergent on that content knowledge needed, “… to simplify the complex ideas of the subject in ways to sustain the integrity of the subject, [and], to represent [subject specific] ideas in accessible ways for students…” (p. 49).

Mingus & Grassi (1999) found that grades six to eight students are capable of creative arguments in their efforts to write mathematical proofs, but by grades ten to twelve, this ability disappears. Some of these secondary school students attend university and complete an undergraduate degree without taking any undergraduate courses that require them to further develop their ability to write mathematical proofs, and then enter a bachelor of education program to become mathematics teachers. Some of these teachers with weak content knowledge of proof are teaching secondary school students about proof. “When these deficiencies are present in preservice teachers and left uncorrected, they are amplified and passed down to future generations of students (Martin & Harel, 1989)” (Mingus & Grassi, 1999, p. 439).

Ponte and Chapman (2008) found in fifteen studies of preservice teachers’ mathematical knowledge, that there are limitations and concerns about teachers’ mathematical knowledge and their subsequent classroom practice, such as empathy for struggling students, mathematical fluency, and the ability to role model appropriate mathematical thinking. Muis (2004) found an effect of teacher knowledge on student beliefs and student achievement. In many of the thirty-three studies of students’ epistemological beliefs, students often hold ‘nonavailing’ beliefs. These are beliefs about mathematics that have no influence, or a negative influence on learning outcomes. Students holding nonavailing beliefs generally occur in classrooms where teachers approach mathematics from a perspective that it should be done quickly, that there is only one
way to solve a problem, that mathematics is memorizing and computation, and that the primary function of the teacher is to transmit knowledge.

“In contrast, constructivist-oriented approaches to teaching focus on establishing mathematics in meaningful and authentic contexts, engage students in collaboration and group activity to construct mathematical knowledge, are process oriented, and provide time for students to learn” (Muis, 2004, p. 363). Cramer (2004) also proposes a model for mathematics courses for teachers to alleviate the classroom impact of this apparent limitation of teachers’ content knowledge. The model provides further opportunities for teachers to engage in and re-learn, understand and re-construct mathematics knowledge.

Content knowledge, in particular, mathematics content knowledge is an important aspect for secondary school mathematics teachers. Mathematics content knowledge is an inherent component of particular orientations, for example, the Academic orientation (Feimen-Nemser, 1990), and has been shown to be related to teachers’ confidence levels and teacher classroom behaviours.

2.9 Pedagogical knowledge

Bachelor of education entry requirements ensures that there is a minimum of content experience in a prospective teacher’s post-secondary education but cannot ensure the quality of that experience. Understanding teachers’ attitudes towards content may provide insight into teachers’ beliefs, and hence an avenue to affect change in their classroom practice as they learn pedagogical knowledge.

One purpose of the bachelor of education program is to develop pedagogical knowledge of various structural and/or technical teaching strategies, e.g., length of lessons, cooperative learning strategies, the use of manipulatives and technology. Graeber (1999) and Hiebert and
Carpenter (1992) emphasize the relationship between teacher understanding of instructional strategies that promote remembering, and students’ memory and retention of the mathematics they were taught. Graeber (1999) states teaching for understanding requires preservice programs give preservice teachers experiences with a variety of instructional practices so that a traditional and common ‘teach by telling’ is less likely to be repeated.

However, it is not as simple as just locating teachers’ beliefs on a continuum of beliefs and giving them the appropriate preservice experiences or professional development. The relationship between teacher beliefs and pedagogical practice in a classroom is a complex construct, as discovered in Erikson’s (1993) study of two middle school teachers, both of whom experienced the same 15-month staff development project designed to assist in the implementation of the NCTM 1989 Curriculum and Evaluation Standards for School mathematics and the 1991 Professional Standards for School Mathematics. Growth and change in mathematics beliefs occurred for both teachers by the end of the project, yet classroom practice did not change for one of the teachers. Interpretation of the findings suggest that, while Teacher A’s beliefs changed, by the end of the project the beliefs were just aligning with Teacher B’s beliefs from the beginning of the project. Classroom practice for Teacher A would likely not change to be more like that of Teacher B until more time was available to work on implementing the curriculum standards.

Preservice teachers often dismiss or reduce the importance of learning pedagogy since they come to teaching preparation programs with decades of their own classroom experience. Preservice teachers believe they have extensive knowledge of teaching mathematics based primarily on their experiences (Jaworski & Gellert, 2003). Preservice teachers believe they have watched teaching in practice while they were students, and attribute their personal academic
achievement to their teachers’ instructional abilities. Teaching for student success appears simple, and the apparent ease with which these teachers taught translates into preservice teachers’ beliefs that they are already prepared to teach as they enter the preservice program (Britzman, 2003).

Pedagogical knowledge involves the knowledge of teaching strategies, and classroom strategies such as classroom management actions. These relate directly to teacher concerns of survival, classroom management, student motivation, lesson preparation, and the assessment of student achievement. The perception of pedagogical knowledge and its acquisition and retention is also influenced by one’s orientation to teaching and learning.

2.10 Pedagogical content knowledge

Shulman’s (1986) pedagogical content knowledge is a synthesis of content knowledge and pedagogical knowledge. Frykholm and Glasson (2005) call this synthesis the ‘mathematics for teaching’, and Ball and Sleep (2007) call this ‘mathematical knowledge for teaching’. Weak content knowledge makes the development of mathematics for teaching, or pedagogical content knowledge challenging (Ball & Sleep, 2007; Frykholm & Glasson, 2005; Muis, 2004; Shulman, 1986). This is an important challenge in teacher preparation and in particular, mathematics education courses.

Preservice teachers may recognize and be able to describe instructional practices when experiencing content such as NCTM (2000) standards and reform-based instructional practices, however cannot implement this apparent knowledge into classroom practice (Frykholm, 1999). Lappan and Theule-Lubienski (1994) identify three domains of knowledge that preservice teachers need, and hence that teacher preparation programs need to clearly define: mathematics or content knowledge, pedagogy of mathematics, and knowledge of students. Lappan and
Theule-Lubienski (1994) suggest it is the integration of these three domains that increases the effectiveness of teachers’ instructional programs in the classroom.

Hill, Rowan, & Ball (2005) found that “knowledgeable teachers can positively and substantially affect students’ learning of mathematics” (p. 396), meaning “teachers’ mathematical knowledge for teaching positively predicted student gains in mathematics achievement…” (p. 399) where mathematical knowledge for teaching refers to subject specific pedagogical content knowledge. Frykholm and Glasson (2005) attempted to provide contextual learning in a mathematics pedagogy course, and Shulman’s (1986) work has supported and articulated the position that it is what the teacher does with the content that is important.

Many preservice teachers have not experienced integrated, collaborative, and contextual learning environments (Frykholm & Glasson, 2005). “[T]hrough engagement in active learning opportunities in which authentic contexts provide fertile ground for understanding…. by focusing on pedagogical context knowledge, the potential problems inherent in the student teachers’ deficiencies in content knowledge dissipated …” (p. 138). Preservice teachers in Frykholm and Glasson’s (2005) study stated they learned more when taught in a contextual manner. “One must attend also to how it is learned, for it is this ‘how’ that significantly influences the way in which mathematics eventually gets taught” (Cooney, 1994, p. 611).

Bromme (1994) extended Shulman’s (1986; 1987) pedagogical content knowledge into subject-matter-specific pedagogical knowledge. Researchers have furthered the inquiry into content knowledge, and its relationship to classroom practice, or pedagogical knowledge. Most notable is an AERA symposium presentation in March of 2008, focusing on a collaboration of research studies in an effort to more deeply articulate and understand the mathematics that mathematics teachers need to know and how it combines with pedagogical knowledge into
‘mathematical knowledge for teaching’ (Ball & Hill, 2008; Bass, 2008; Goffney & Ball, 2008; Hill, Hoover Thames, Sleep, & Blunk, 2008; Lewis, Phelps, Hoover Thames, Bass, & Ball, 2008; Sleep, Suzuka, & Zopf, 2008).

A possible link between teacher efficacy and pedagogical content knowledge emerges as “researchers have demonstrated that the educational beliefs … of in-service and preservice teachers may play an important role in their acquisition and interpretation of knowledge and subsequent teaching behaviours and practices (Ashton & Webb, 1986; Czerniak & Schriver, 1994; Tracz & Gibson, 1986)” (in Gerges, 2001, p. 84). Researchers have inquired into the amount of influence efficacy has on the variety of instructional methods in preservice teachers’ classroom practice (Gerges, 2001). While Gerges (2001) found no quantitative support, there was some indication of qualitative support to the influence of preservice methods courses on the variety of instructional methods used by preservice teachers in their classroom practice.

It appears there are benefits of mathematics education courses in bachelor of education programs. Amongst the many benefits, in particular the participation in mathematics education courses may have three results; the development of pedagogical content knowledge, improved content knowledge, and changes in beliefs. This poses an interesting and necessary question as to the nature of teacher belief, and how beliefs appear to be related to classroom practice and one’s understanding of the learning of mathematics. Perhaps it is necessary to inquire into the initial opportunities teachers have to formally articulate and shape their beliefs.

2.11 Summary

While Guskey and Passaro (1994) may speculate that the personal efficacy and general teacher efficacy distinction is not as robust an explanation for teacher efficacy as the internal and external classification, the combination of personal efficacy, general teacher efficacy, and
internal and external locus within the conceptions of teacher concern and teacher orientation are clearly complex. These relationships may provide insight into the nature of teacher efficacy in the context of the mathematics classroom. Midgley, Feldlaufer, and Eccles (1989), using their teacher efficacy measurement tool, classified an internal locus of control with high efficacy and an external locus of control with low efficacy. The OSU (Woolfolk Hoy & Spero, 2005) was developed from Bandura’s (1997) Teacher Self-Efficacy Scale conceptualization, and Tschannen-Moran and Woolfolk Hoy (2001) and Woolfolk Hoy and Spero (2005) have found valuable correlations amongst PTE, GTE, OSTES, and the OSU Teaching Confidence Scale.

Tschannen-Moran and Woolfolk Hoy (2001) also state that Guskey and Passaro’s (1994) refinement of items for internal and external efficacy “… provokes further reflection on the meaning of the two factors that have often been found in measures of teacher efficacy. These findings invite us to question once again the nature of teacher efficacy and how it can best be measured” (p. 794). Guskey and Passaro (1994) suggest that researchers consider a variety of explanations when interpreting teacher efficacy. Ross (1994) suggests that various teacher efficacy measures have been collecting information on different dimensions of teacher efficacy, and that teacher efficacy may be better conceptualized as multi-dimensional. It may be helpful to consider incorporating two distinct dimensions into one inquiry of teacher efficacy.

The complexity of the preservice teacher education landscape (Ponte & Chapman, 2008) requires careful navigation, and attention, to the various factors that may influence preservice teachers’ efficacy. Pajares (1992) suggests a connection to preservice teachers’ perceptions of the contributions toward their teacher efficacy; “Beliefs strongly influence perception, but they can be an unreliable guide to the nature of reality” (p. 326). Simmons et al (1999) found that beginning teachers may express a “wobbling” teaching style amongst teacher-centred,
conceptual, and student-centred teaching styles. In addition, Fung and Chow (2002) suggested preservice teachers’ pedagogical images of themselves, that is, their beliefs and orientations, may not align with their actual classroom practices.

Therefore, the contribution identified by one preservice teacher’s teacher efficacy may be suspect, but contributions expressed by many preservice teachers may show common themes. As Schunk and Pajares (in press) encourage, “[e]ducators should continue to explore how teacher self-efficacy develops, what factors contribute to strong and positive teaching self-efficacy in varied domains, and how teacher education programs can help pre-service teachers develop high efficacy” (p. 29).

These generalizations illuminate connections to teacher concerns, teacher orientations, and the impact of a teacher preparation program, and the learning that occurs during a teacher preparation program. Teacher preparation programs attempt to improve the pedagogical content knowledge of preservice teachers. During this learning period, preservice teachers’ beliefs are subjected to learning experiences that suggest change and adaptation. Preservice teachers’ images of themselves may not match their classroom practice even though their beliefs and orientations change (Fung & Chow, 2002). Changes in preservice teachers’ beliefs may be reflected as increases in overall teacher efficacy and hence may also reflect an increase in teacher efficacy with respect to instructional strategies (Lappan & Theule-Lubienski, 1994; Tschannen-Moran & Woolfolk Hoy, 2001). Changes in teacher efficacy may contribute to changes in pedagogical content knowledge, or more specifically, increases in teacher efficacy may contribute to improved pedagogical content knowledge.

Research on these individual issues has been fruitful; however, there are many calls for more combined inquiry into the nature of teacher efficacy and its related factors and influences.
“We know very little about how teacher efficacy relates to phases in teachers’ careers (such as the stages described by Fuller, 1969; Kagan, 1992; Oja, 1989)” (Ross, 1994, p. 27). Woolfolk Hoy and Spero (2005) also add voice to further inquiry into program and school and personal contributions that “make a difference in the formation of efficacy beliefs” (2005, p. 354). The impact of the initial teacher preparation experiences, the preservice teacher program, on teachers’ professional practice over their careers is an issue that should not be ignored (Tschannen-Moran & Woolfolk Hoy, 2001).

Studies of the contributions to teacher efficacy have been largely from an elementary preservice teacher perspective, and not from a preservice secondary school mathematics teacher perspective. Goulding, Rowland, and Barber (2002) found a link between weak subject matter knowledge and elementary preservice teacher emotions, and the relationship between the teachers’ emotions and their levels of confidence in their classroom practice. They also identify the inseparability of emotions from the situatedness, the context, of the elementary school classroom environment. Labone’s (2004) inquiry found vicarious experiences, a source of self-efficacy (Bandura, 1997), influential to the development of elementary preservice teacher efficacy. The situatedness, or context of the elementary preservice education classroom or preservice practicum classroom, has been shown to be an important element to the development and change in teacher efficacy. Elementary preservice teachers’ may hold well articulated beliefs about teaching that might be challenged or changed by practica (Tillema, 2000), or by a combination of preservice education coursework and practica (Clark, 2005; Lowery, Feb 2002). Considering preservice education coursework on its own, it could provide opportunities in which preservice teachers understand students’ learning issues better and hence re-direct pedagogical beliefs and practices rather than directly change beliefs (Ambrose, 2004). Wilkins and Brand
(2004) found elementary methods coursework increased the alignment of teacher belief with current curriculum reform efforts.

In a similar manner to this study, Charalambous, Philippou, and Kyriakides (2008) inquires into teacher efficacy with elementary school preservice teachers. The TSES (Tschannen-Moran & Woolfolk Hoy, 2001) was used to explore preservice teacher beliefs and explore the possibility that the TSES could be adapted to measure teacher efficacy from subject matter context. While Charalambous, Philippou and Kyriakides (2008) concurred that teachers’ beliefs are generally hard to change, the influences of practical experiences in school classrooms and the interactions with Associate or mentor teachers did have an effect. The effect did not involve a uniform change in teachers’ beliefs, such as teacher efficacy, and they suggested more research be performed to find more factors that increase or decrease teacher efficacy.

Sloan, Daane, and Geisen (2002) inquired into the nature of elementary preservice teacher learning styles and its relationship to mathematics anxiety. While Sloan, Daane, and Geisen (2002) suggest teachers’ learning styles are related to teachers’ concerns about content knowledge, they suggest other variables “such as instructional methods, mathematics achievement levels, confidence in doing mathematics…may account for more variance” (p. 86). Ball (1990b) focused on content knowledge for elementary school and secondary school preservice teachers, and found majoring in mathematics at the undergraduate level was found to ensure subject matter knowledge and be an important component to preservice teacher mathematics teaching success (Ball, 1990a). However, it was also found that elementary preservice teachers see mathematics in a different way than secondary preservice teachers. Elementary preservice teachers see mathematics as a set of procedures and rules while secondary preservice teachers see it otherwise and hold greater confidence in their content knowledge.
Many studies have focused on particular elements of Ponte and Chapman’s (2008) landscape of preservice mathematics teacher education. Teacher concerns, teachers’ orientations to teaching and learning, teachers’ beliefs and teacher efficacy, mathematics content knowledge and pedagogical knowledge have been particular focal points for inquiry. However, few have connected these constructs together. Many studies have also focused on elementary mathematics preservice teachers more than secondary mathematics preservice teachers, or studies have combined the two groups of teachers. Ball (1990a) identifies differences between elementary preservice teachers and secondary preservice teachers in the area of feelings and content knowledge, and wonders about other social and individual influences. This is the opening to the gap in the research that the study for this thesis intends to fill.

There is a gap in the research concerning a multi-faceted sense of secondary school preservice teacher efficacy. What is the sense of teacher efficacy for secondary school preservice mathematics teachers and what are some common factors and influences to secondary school mathematics teacher efficacy in mathematics teacher preparation programs? These are the research questions that appear as important issues to investigate and that I have attempted to address in this study.
Chapter 3

Method

3.1 Introduction

A number of interesting questions arise in the previous chapters that illuminate the various facets of teacher efficacy. This study converges to one particular question encompassing the preservice teachers’ perceptions of their teacher efficacy in a teacher preparation program. This chapter explores the underlying philosophy to this research, which is important to understand the nature of the method and research design. The results of a pilot study that informed and improved the logistical sense of the study, the data collection, analysis, and inference processes are documented.

3.2 Research design

Phenomenologically, teacher, classroom, and school, in essence create a nested, complex, system (Davis & Sumara, 2002; 2006). Objects, such as school, classroom, and teacher that are nested will overlap each other to varying degrees. The nature of nested implies an integrated and interconnected relationship amongst objects. Hence an inquiry into one such object, the teacher, and in particular the preservice teachers’ teacher efficacy illuminates a “continuum of overlapping objects of varying degrees of complexity – not objects which are forced to accommodate absolute distinctions between general and primary kinds” (McGuire, 2007, p. 189).

There are many overlapping objects in the complex system of a teacher, such as teacher efficacy, teacher concern, and teacher orientation. These objects of inquiry require attention to various perspectives and lenses acknowledging the multi-faceted nature of the preservice teachers’ emotional and cognitive development, and one quickly arrives at the realization that
there are various conceptions of teacher efficacy inspired and motivated by one’s perspectives and values and worldviews. In a sense, this research is an inquiry into the ‘world views’ of the preservice mathematics teacher, into the paradigms that shape and have shaped preservice teachers, and their potential professional practice as secondary school mathematics teachers.

McGuire (2007) describes the ontology of complexity theory as ‘patterns’. “The very foundation of complexity theory lies in the task of explaining how elements as diverse as molecules, plants, or economic actors act collectively to produce complex patterns of behaviours” (p. 197) The study of teacher efficacy inquires into behaviours, specifically the behaviours of teachers, and consists of many physical, emotional, and cognitive elements that create a complex pattern. Within an educational jurisdiction such as a provincial ministry of education whose mandate is to manage and coordinate an educational program for all learners across a large geographical area, these patterns of teacher behaviour are often quite individual and unique for each teacher. From these patterns emerge differences as well as similarities and parallels because of the nested context of the teacher within a school of other teachers, within a school board of other schools, within a larger educational organization.

Adami (2002) introduced physical complexity which refers to the amount of information stored in an organism about its environment that can be used to make predictions about the environment. In the context of this study of teacher efficacy, the ‘organism’ is teacher efficacy and the information stored within it are the constructs of teacher concern, teacher orientation, Internal and External efficacy, pedagogical content knowledge, etc. Adami (2002) assigns low complexity to both ordered and random systems and high complexity to those in between. As an application to teacher efficacy and its related constructs of teacher concern, teacher orientation and Internal and External efficacy, the level of complexity of the related constructs may translate
well to understanding teacher efficacy. Relationships and patterns amongst related constructs such as teacher concern and teacher orientation and Internal and External efficacy may provide a predictive opportunity for teacher efficacy about the classroom environment.

Zeidan and Fonseca (2007) and McGuire (2007) caution against too quickly transposing a set of metaphors from one discipline onto another. McGuire (2007) uses biological and economic contexts, Adami (2002) uses physical contexts, and this study inquires into preservice teacher efficacy. Therefore issues of complexity, relevance, and mathematics education require careful examination and articulation of the paradigm that acts as a foundational base to this research to appreciate fully what the preservice mathematics teachers say about their teacher efficacy, to what they notice, and to what they attend in their experiences that make them who they are as secondary school mathematics teachers.

Patterns as an ontological understanding for complexity theory may provide a familiar and definable space in which to explore teacher efficacy. The definable space of patterns draws upon existing resources of levels of clarity with algorithmic and invariance notions. “This category of ‘pattern’ … not only sits very neatly with fundamental conceptions in complexity theory – specifically a definition of complexity itself, it also offers a certain kind of objectivity in apprehending what can be considered to be ‘ordered’ and what is not” (McGuire, 2007, p. 196). Patterns provide a grounding for a universal capacity to distinguish between ordered and less- or non-ordered phenomena, where the multiplicity of patterns permits “a plurality of explanatory levels and processes” as they “subsume many traditional metaphysical categories” (McGuire, 2007, p. 198).

With reference to mathematics education and mathematics teacher behaviours specifically, Davis and Sumara (2006) emphasise the importance of patterns. The search for
patterns in the social context of this study may be paralleled with another context, from the physical complexity perspective, “simplification is at the same time the greatest strength of simulated evolution experiments since it allows us to find and see the forest (general principles of evolution), not just the trees” (Jedlicka, 2007, p. 225).

Complexity theory (Waldrop, 1992) as a world view provides a springboard from which paradigms, methodologies, and systems (such as an educational system, or a research field like mathematics education) come together and emerge in models that reflect our lived experiences. Complexity theory is also a sense of patterns of nestedness, and may illuminate the nested understandings and actions of research and practice in a field, or system, such as mathematics education. Davis and Sumara (2002; 2006) and Davis and Simmt (2003) suggest the complexity theory lens shows the interconnected and nested behaviour of mathematics education and associated research. Mainzer (2007) emphasizes that understanding complex dynamics may be more important than trying to find a definite solution when considering practical behaviour.

“Rather than search for truth, complexity thinking suggests that the best that a knowing agent can do is to take a pragmatic stance toward the representation made. How useful are they? What do they do? What do they entail? What do they foreground and what do they defer?” (Davis & Sumara, 2006, p. 34). The pragmatic stance for this study comes from a paradigmatic position or ‘worldview’ of complexity theory to converge the inquiry onto one conception of preservice teacher beliefs, that is teacher efficacy and its contributing factors. Complexity theory is used as a means to express clearly, the interconnectedness and possible relationships and influences amongst the conceptions of teacher efficacy, teacher concern, teacher orientation, and mathematics content knowledge, and teacher preparation, and research into such issues.
Mathematics education research might then employ related and interconnected methods or research approaches “… mixed in ways that offer the best opportunities for answering important research questions” (Johnson & Onwuegbuzie, 2004, p. 16). Morgan (2007) suggests that a paradigm or approach to research does not necessarily have to focus on epistemological, ontological, or just methodological fronts. “In contrast, a pragmatic approach would treat issues related to research itself as the principal ‘line of action’ that methodologists should study, with equal attention to both the epistemological and technical ‘warrants’ that influence how we conduct our research” (p. 68).

Johnson and Onwuegbuzie (2004) state that the time for mixed methods research has arrived, and that pragmatism is its philosophic partner. Mixed methods or mixed model research does not subjugate the ‘question’ for the paradigm, or the method for the question. “The great strength of this pragmatic approach to social science research methodology is its emphasis on the connection between epistemological concerns about the nature of the knowledge that we produce and technical concerns about the methods that we use to generate that knowledge” (Morgan, 2007, p. 73).

Mixed methods, complexity theory, and mathematics and mathematics education share similar language and worldviews – emerging order, and nested structure – and as such illuminate a natural propensity for supporting and reinforcing each other. The literature review has shown complexity theory emerging in mathematics education contexts. The language and understanding of complexity theory has illuminated a relationship to research contexts, in particular a pragmatic approach of a mixed methods paradigm. It is from this interrelatedness of conceptions that mixed methods research is the necessary backdrop to the design and implementation of this study. In
this study, I am using a pragmatic lens to mixed methods research in order to focus on the importance of the questions and the appropriateness of the research method.

3.3 Design overview

Due to the ‘snapshot in time’ nature of this study with the data collected from preservice teachers upon their completion of a preservice program, and the nature of the data collected, there were two phases to the design. This mixed-method study employed a two-phase sequential (Creswell & Plano Clark, 2007) design. The first phase involved collecting quantitative data with the “Teacher Efficacy Scale” (TES) (Guskey & Passaro, 1994) and the “Teachers’ Sense of Efficacy Scale” (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001), and qualitative data with two short answer questions. The second phase involved collecting qualitative data from selected preservice teachers through interviews designed to gain more insight into their understanding of their sense of self as a teacher. The selection of the participants for the second phase was dependent upon the results of the TSES in the first phase.

There was a parallel and simultaneous collection of preservice program data consisting of program structure, components, philosophy, etc. from available public sources and course instructors. This data collection happened concurrently with the first stage. When the quantitative and qualitative methods were implemented simultaneously and interactively, interpretability was enhanced as the results from the quantitative data were used to complement the results of the qualitative data and vice versa (Greene, Caracelli, & Graham, 1989).

The quantitative and qualitative methods enhanced and clarified the contexts of preservice teachers’ efficacy within the data collection, analysis, and inference processes. The results of the teacher efficacy scales strengthened the interpretations of preservice teachers’ perceptions of influential program contexts expressed in the qualitative data, and likewise, the
preservice teachers’ perceptions provided added value to the numerical values of teacher efficacy. Specifically, the TSES results provided a ranking and level of teacher efficacy and the TES results provided information relevant to the teachers’ sense of control, their teacher concern, and teacher orientation. The mix of qualitative and quantitative data occurred in the data collection, analysis, and results stages.

A mixed-method design was warranted for various reasons, but primarily because of the complexity of the influences on teaching, classroom practice, beliefs, and efficacy (Ball & Sleep, 2007; Davis & Upitis, 2004; Frykholm & Glasson, 2005; Fuller & Bown, 1975; Tschannen-Moran et al., 1998; Watters & Ginns, 1995). Another reason was the change in the efficacy measurement tools to reflect the growing sense that there is more to teacher efficacy than one’s personal beliefs. The development of measurement scales for teacher efficacy has progressed from initially identifying overall teacher efficacy, to personal and general attitudes, to internal and external factors, and through specific contexts (for example, science classes). In addition, “researchers must look beyond composite scores to identify samples of high and low efficacy teachers if a multidimensional measure of efficacy is used” (Woolfolk & Hoy, 1990, p. 89). Educational contexts are socially, psychologically, and pedagogically complex, and hence it was necessary to employ as many methods as reasonable to find and articulate the contextual influences of a teacher’s sense of teacher efficacy.

3.4 Pilot study

A pilot study with a class of intermediate/senior preservice mathematics teachers was performed in May 2007, to test the web-based survey tool, and test the analysis process. The setting, procedure, and results of the pilot study are outlined in this section.
3.4.1 Setting

A pilot study was performed with a class of intermediate/senior preservice mathematics teachers at a Faculty of Education in an Ontario university. Approximately fifty students were invited to complete a teacher efficacy survey and to volunteer for a subsequent interview. The students were sent an email after their preservice program had ended, and they were invited to participate by accessing the web-based survey.

3.4.2 Procedure

The email inviting the recently graduated class of intermediate/senior mathematics teachers to participate also contained the letter of information. The prospective participants were informed that they would be giving consent for this pilot study by accessing the web-based survey. A summary of the information letter and consent reminder was placed on the opening page of the web-based survey tool as well. A time frame of three weeks was available to complete the survey. A reminder email was sent at the end of the second week to encourage as many as possible to complete the survey. Once the survey period ended, the data was downloaded for analysis.

The survey consisted of the twelve questions from the short form of the Teacher Sense of Efficacy Scale (Tschannen-Moran & Woolfolk Hoy, 2001), the Teacher Efficacy Scale (Guskey & Passaro, 1994), and two short answer questions, “Describe one thing that is a concern for you with regard to teaching”, and “Describe one thing from the preservice program that you feel contributed to your level of confidence.” A third set of fields appeared at the bottom of the survey; “Contact Information. If you agree to participate in a one hour interview, please provide your contact information: Name, email address, phone number, address.” Approximately half of the participants provided their contact information for a possible interview.
3.4.3 Results

A problem was discovered with the performance of the web-based survey tool. The efficacy scale questions use a five point and nine point Likert scale. The Guskey and Passaro (1994) scale contains labels for each Likert scale value. The Tschannen-Moran and Woolfolk Hoy (2001) scale contains labels for every second Likert scale value. The web-based survey tool was implemented to imitate the paper format, therefore, when the data was retrieved from the web, participants’ selections of those values without a label was not saved. The data for the Tschannen-Moran and Woolfolk Hoy (2001) scale was unusable.

The teacher efficacy score from the Tschannen-Moran and Woolfolk Hoy (2001) scale was to be used to rank the preservice teachers in order according to score value. This ranking would generate the first selection pass of the extreme cases, high efficacy and low efficacy. The Guskey and Passaro (1994) values are to be used to delve deeper into the nature of teacher efficacy, in particular the internal and external efficacy factors. In a second selection pass, this data would add context to the nature of the extreme high and low efficacy scores. This information may mean a change in who was selected for the interview phase.

During the interview phase, the Guskey and Passaro (1994) results would also provide direction and flow to the inquiry into the nature and context of the preservice teachers’ efficacy. Since the Tschannen-Moran and Woolfolk Hoy (2001) data was not available, it was not possible to initially select the extreme high and extreme low efficacy cases to interview. The Guskey and Passaro (1994) results matrix did not allow for extreme case selection.

Since the data set was incomplete, it was not possible to combine the results of the two scales or identify participants for interviews. However, the Guskey and Passaro (1994) scale data was available to analyse for internal and external efficacy information. The process for this data
analysis was refined and a two by two matrix developed for inference purposes. Internal and external efficacy are the two columns and personal efficacy and teacher efficacy are the rows. It is interesting to note that sorting the quantitative results for the four possible combinations identified similarities and patterns in the order of low efficacy to high efficacy across the four possible combinations of internal, external, personal efficacy, and teacher efficacy elements. Participants appeared to be grouped in high and low efficacy ranges across each of the four combinations. This gave evidence to the notion that the results of the two scales would support each other, and provide possible triangulation effect in the effort to articulate preservice teacher efficacy. A second calculation was performed by subtracting the external efficacy score from the internal efficacy score to give a single score, labeled the I/E Difference value, that would be used to rank respondents from high internal efficacy to high external efficacy.

It was also appreciated that some further demographic information would be necessary in order to more completely discuss and make authentic inferences, for example, the number of undergraduate mathematics courses, the name of one’s university, the undergraduate degree (major and minor), the last year of attendance in post-secondary education, the other teaching subject, and gender. Modifications to the web-based survey tool included the addition of labels for all Likert scale values and the addition of demographic questions.

3.5 Method for the main study

3.5.1 Sampling

The participants were intermediate/senior preservice mathematics teachers from two universities in Ontario who had just completed their bachelor of education. The populations at the two universities consisted of approximately one-hundred and eighty preservice teachers. Preservice teachers were informed of this study via email by the investigator directly or through
the instructor of the course. A letter of information and details of consent were attached and included in the email and on the web-based questionnaire. For the students at one university, I was the preservice teachers’ mathematics education course instructor, but this relationship ended upon the completion of the preservice program.

There were three types of sampling used for data collection in this study. Initially universities were selected based upon the size of the intermediate/senior preservice mathematics education program in the province of Ontario. The first phase of data collection involved a cluster sampling of the whole population of graduating intermediate/senior preservice mathematics students within each of these universities. In the second phase of data collection, the order for participant interviews were purposively selected based upon their results from the teacher efficacy scales. This is based on advice from Kemper, Stringfield and Teddlie (2003), “[i]n sequential mixed models studies, information from the first sample … is often required to draw the second sample…” (p. 89). All eleven participants who indicated they would participate in an interview were contacted. In pairs, two with high teacher efficacy (TSES) scores and two with low teacher efficacy (TSES) scores were contacted. Further selections in pairs for interviewing, according to TSES scores, were made until all potential participants who were still available were interviewed.

Four of the eleven interviewed preservice teachers became the subset for case study. These four were selected according to TSES scores and the I/E Difference value calculation. Two preservice teachers who achieved high TSES scores with high Internal efficacy scores were selected, and two preservice teachers who achieved low TSES scores with high External efficacy scores were selected.
3.5.2 Data collection

In phase one, data was collected with an online web-based questionnaire consisting of thirty-three Likert type scaled items, two short answer questions, and some demographic questions. The Likert type scaled items consist of the “Teacher Efficacy Scale” (TES) (Guskey & Passaro, 1994) and the “Teachers’ Sense of Efficacy Scale” (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001) which is the short form modified for context with the inclusion of the word ‘math’. The TSES measures the level of overall teacher efficacy with a numerical value, and the level of teacher efficacy for three subscales, student engagement, classroom management, and instructional strategies, with a numerical value. The TES describes the nature of the Internal efficacy and External efficacy, also with numerical values. The TES scale is not being used in an attempt at finding a definition for teacher efficacy, but at further clarifying the nature of the factors of teacher efficacy, especially useful in the context of teacher preparation program contributions, teacher concern, and teacher orientation.

The internal factor appears to represent teacher perceptions of personal influence. The external factor appears to represent teacher perceptions of influence from outside the classroom. This alludes to issues of power and control (Staton, 1992) and their ultimate impact on teaching and learning. Teacher concern, of self, task, and impact, closely aligns with this notion of power and control in the classroom. Relevant and related is the preservice teachers’ changing sense of concern, possibly connected with a changing sense of teacher efficacy.

The short answer question section asked the respondents to 1. “Describe concerns you have with respect to being a secondary school mathematics teacher,” and 2. “Describe those things from the preservice program that you feel contributed to your level of confidence.”

Demographic data of university attended, second teaching subject, the last year of attendance in
post-secondary education before the bachelor of education, undergraduate degree major, and
minor where applicable, number of full year mathematics undergraduate courses and gender was
collected.

An information and invitation to participate in the study email was written and included
the Letter of Information and Consent information. At the end of the preservice school year,
which is the end of April for one university and the end of May for the other university, an email
was sent to all graduates of the preservice programs from the two universities. This email was
sent directly by me through the university email system using university student email addresses.
The email was sent to the three instructors at the other university. One instructor also emailed her
students directly with a copy, and the other two instructors posted the email on a preservice
webmail bulletin board to which preservice mathematics students had access. The web-based
survey did not log identifying information, however I was able to tell how many respondents had
completed the web-based survey. In the middle of June, I sent out a reminder email encouraging
graduate preservice students to participate. Again, I and one instructor from the other university
directly emailed our students, and it was posted on the preservice webmail bulletin board by the
other two instructors.

By the end of June, few students from the other university had responded, although a
couple had emailed me personally after reading my information letter and inquired into the
length of time the survey would be available online. At this time, I received class lists from the
other university and proceeded to send a third encouragement email to each student individually.

At this time, program information was collected from each university through
conversations with instructors and information available from the university websites. A course
outline and course information was available from my records, and I received course outlines
from two of the instructors from the other university. I also had a conversation with one of the other university’s instructors about the mathematics education program and particular course components.

In phase two, preliminary data analysis was performed to determine TSES and its subscales values, and Internal and External efficacy values, and a preliminary analysis of the short answer responses inquiring into orientation and teacher concern issues. Respondents were ranked by TSES score. Starting with the highest and the lowest TSES overall teacher efficacy scores, I emailed and/or phoned each respondent that indicated he or she would be willing to participate in an interview. Some respondents did not return the email or phone call regarding the possibility of an interview. For the eleven people that did respond, due to vacations and various employment situations, these interviews occurred over the months of July, August, and into the first week of September. The summer and employment related attrition meant that all the preservice teachers that indicated interest on the web-based survey by providing their email or phone contact information were interviewed.

A semi-structured interview was completed by phone and at a time that was most convenient for the participant. The interview involved reading and responding to teacher concern prompts and teacher orientation prompts in the form of descriptive paragraphs. The interview was audio taped, and transcribed for analysis purposes and I took notes during the interview to note points that respondents emphasized during the interview. Once an interview was accepted and acknowledged, respondents were sent an email with an attached document containing the set of three teacher concern paragraphs and the set of five teacher orientation paragraphs. See Appendix E for teacher concern and teacher orientation descriptive paragraphs.
The teacher concern cases were created for three reasons. First, to provide a descriptive narrative to which participants could respond that might prompt more complete reflection. Second to attempt to reduce misinterpretation or selection of a particular teacher concern based on a popular understanding of possible meanings of the titles. Third, the cases were used instead of the Teacher Concern Checklist (Borich & Tombai, 1997) because the statements for each teacher concern used in the Borich and Tombai (1997) checklist appeared to contain inconsistencies. For example; a) task items were generally negatively worded and this negative tone may resonate unduly with a possible low teacher efficacy in an individual and hence may skew the results, b) self concern items dealt with peers much more than the individual him or herself and therefore is not as pertinent for preservice teachers, c) preservice teachers may be conceptually confused by some items because of their close alignment with the terminology of the Ontario Secondary School (OSS) curriculum’s assessment Achievement Categories (Knowledge and Understanding, Thinking, Application, and Communication) and therefore not be considered a teacher concern since it is a curriculum assessment expectation, and d) the placement of self, task and impact items generally occurred at the start, middle and end of the checklist, respectively.

The teacher orientation cases were created for two reasons. First, to provide a descriptive narrative to which participants could respond that might prompt more complete reflection, and second, to attempt to reduce misinterpretation or selection of a particular teacher orientation based on a popular understanding of possible meanings of the titles.

Interview questions numbered 1 and 3 were designed to have the preservice teachers articulate their sense of selves as teachers given the case paragraphs on teacher concern and teacher orientation. Interview questions numbered 2 and 4 were designed to provide the
preservice teachers with a context for conversation. These questions were also designed to provide the researcher with data for comparison and analysis of what the preservice teachers self-identified with what appeared in the text of their natural conversation. Interview question 6 was designed to provide an opportunity to clarify any apparent difference between what the preservice teacher said in the survey and what the preservice teacher said in the interview. Interview question 7 was designed to give another context for conversation in order to further inquire into and clarify the preservice teachers’ teacher concern(s) and teacher orientation(s). See Appendix D for the interview protocol.

Each interview lasted between thirty and forty-five minutes in length. All interviewed respondents expressed pleasure at being a part of the study and appreciated an opportunity to talk about their experiences. Some expressed an appreciation of the reflective opportunities the interview offered and for some, they said the interview provided a sense of closure to their teacher preparation experience.

3.5.3 Data analysis

The analysis began with the data from phase one immediately after the web-based survey closed. Unweighted means were calculated with the overall TSES scale (Tschannen-Moran & Woolfolk Hoy, 2001) for teacher efficacy and the three subscales of student engagement (SE), instructional strategies (IS), and classroom management (CM). The overall TSES score results for teacher efficacy allowed for ranking and creating three categories of preservice sense of teacher efficacy: low, middle, and high. Respondents were selected based on high and low overall TSES scores. A trial ranking using the TSES subscale scores of IS, SE, CM, were used as key values to see if any obvious and clearly visual pattern appeared in the data. No patterns appeared, and so the TSES subscale scores, SE, IS, and CM, were only used to inform and guide
the interviews. The score results for the TSES subscales were also used in further statistical analysis described below, and, for integration with all the data in the process of making inferences and conclusions.

Three numerical results were then tabulated using the TES (Guskey & Passaro, 1994) data. An Internal efficacy score, External efficacy score, and the value from the Internal efficacy score minus the External efficacy score (I/E Difference) was calculated. The External efficacy factor items have low scores for greater External efficacy. These scores were reversed in order to conform to high scores indicating high efficacy across all items in the efficacy scales to aid in the calculation of the I/E Difference efficacy calculation. This Internal efficacy minus the reversed External efficacy calculation is labeled I/E Difference. The I/E Difference values indicated the amount of difference between the Internal efficacy score and the External efficacy score, and were used as one of the considerations in the process of selecting case studies during the analysis phase. The External efficacy values were returned to their original values for further analysis.

The qualitative data from the short answer questions were quantitized to aid in the identification of, and analysis of the a priori themes of teacher concern and teacher orientation. Caracelli and Greene (1993) suggest this process is a kind of integrated analytic strategy, and Li, Marquart, and Zercher (2000) articulate the value of moving back and forth between qualitative and quantitative data as a form of cross-track analysis that improves the quality of the analysis.

SPSS 16 was used to statistically analyse the quantitative data and the quantitized data. Reliability statistics and tests for normality were determined for the TSES items and the items for the TSES subscales of student engagement, classroom management, and instructional strategies. TSES and subscale means were calculated and paired sampled t-tests were performed looking into the possible significant differences between means. Correlations were performed
with the TSES mean and subscale means. Reliability statistics and tests for normality were
determined for the TES items and the items for Internal efficacy and External efficacy. Internal
efficacy means, External efficacy means, and a correlation and paired sample t-tests were
performed with the means for TSES, TSES subscales, and the Internal efficacy and External
efficacy values. The calculation of I/E Difference were determined. The I/E Difference
calculation provided a value that indicates a predominance of one locus of control over another.
It is possible a preservice teacher would score high Internal efficacy and External efficacy,
hence, from a qualitative perspective, the difference in locus of control may be an important
piece of information.

After the second phase of data collection, the qualitative results from the interviews were
transcribed electronically and analysed using Atlas.ti for common themes. A particular focus was
the extreme cases of high and low teacher efficacy. It was expected that the extreme cases would
identify particularly strong or weak influences, particular internal or external influences, specific
teacher concerns and orientations, and/or unique components of the preservice program that have
affected the preservice teachers’ levels of teacher efficacy. The information of the two short
answer questions from the interviewed participants was compared to the information collected
from the rest of the preservice teachers. SPSS 16 was used in an investigative role to calculate
the Spearmans’ rho between the quantitized teacher concern values, made into ordinal values,
and the TSES and TSES subscale values, and the Internal efficacy, External efficacy, and I/E
Difference values.

The preservice mathematics education course interview and document data were
examined. In particular, two aspects were investigated: the nature of the preservice mathematics
education course, and the structure of the practica in the program in relation to the mathematics
education course. The structural integration of the preservice mathematics coursework with practica was explored and compared between the two universities, and the course outlines and conversation with instructors about their instructional purposes for the course, assignments used, and the order of topics and respective reasons were examined.

Conclusions and inferences emerged through the recursive combining of demographic data, quantitative data, qualitative data, and transformed data. This integration of qualitative and quantitative results and the continuation of the cross track analysis strategy moving between the quantitative and qualitative data and transformed data, from phase one and phase two, clarified, described, and explained possible interpretations and findings.

3.5.4 Issues of validity and reliability

In quantitative research, there is the issue of validity. In qualitative research, the concept of validity may be called trustworthiness, credibility, plausibility, and/or dependability. In mixed methods research, combining the quantitative and qualitative methodologies requires a word that might be acceptable to both the quantitative and qualitative paradigms and researchers. Onwuegbuzie and Johnson (2006) suggest ‘legitimation’ which is “consistent with its use in the Onwuegbuzie (2003) Quantitative Legitimation Model and the Onwuegbuzie and Leech (in press-a) Qualitative Legitimation Model” (Onwuegbuzie & Johnson, 2006, p. 55).

Various legitimation issues are reduced with this study design. First, considering the multiple validities issue, the efficacy scales are proven measurement tools validated with previous researchers’ factor analyses. Reliability statistics were performed with the data in this study and the efficacy scales were determined to be of high reliability. Second, sample integration issues were reduced, even though there were unique variations, it was anticipated that there would be common components to each preservice program, i.e., practicums, methods
courses, electives, Associate Teachers, etc. Therefore, to increase the descriptive validity, more than one university was sampled. Third, sample integration issues were also reduced as it was anticipated there would be a minimal non-response rate due to the timing of the questionnaire and the personally connected nature of the inquiry with the students’ program of study. The relationship of the researcher to the respondents who had been his students appeared to have little or no impact on the nature of, and content of respondents’ answers. The inherent objectivity of the web-based survey scales removed the researcher’s voice and potential influence to respondent answers. In addition, the range of teacher efficacy values indicates respondents did not attempt to provide answers they anticipated the researcher wanted to receive. For example, high teacher efficacy and locus of control values were not uniformly selected across the respondents. It appears respondents provided an authentic and honest appraisal of their teacher efficacy and locus of control.

During the interview, researcher influence was minimal as respondents did not hesitate to identify practicum as more important to their teacher efficacy than the mathematics education course the researcher taught. Respondents also freely discussed and critiqued the valuable contributions of other courses in the preservice program, with and without comparison to the mathematics education courses. This phenomenon was true for respondents from both universities. In general, as expressed by the respondents, and understood and interpreted by the researcher, respondents from both universities comfortably accepted and appreciated the researcher as a fellow secondary school mathematics teacher with which they were having a conversation about the teaching and learning of mathematics within the context of teacher efficacy.
Fourth, considering *weakness minimizing*, even though the sampled population was small for the collection of qualitative data from the survey in phase one and the qualitative interview data in phase two; the combination of quantitative and qualitative data from each phase would provide support and a sense of complementarity. While small sample sizes impact the generalizability of results in a quantitative study, the small sample size in this study has less of an effect as the inference quality (Teddlie & Tashakkori, 2003) remains high because of the mix of quantitative and qualitative data and the mixed methods design. Fifth, considering *commensurability*, the cross-track analysis of phase one and phase two data, and quantitative, qualitative, and quantitized data, would also increase the data validity and influence trustworthiness (Johnson & Turner, 2003).

The legitimation issue of *inside-outside* was reduced with an inter-rater reliability check. An inter-rater reliability check was performed for the teacher concern codes and the teacher orientation codes. The inter-rater reliability check served to clarify the interpretations of teacher concerns, self, task, and impact, and of teacher orientations, Academic, Technical, Practical, Personal, Critical Social.

The responses for the survey question regarding teaching concerns were examined and coded with the three teacher concerns by Dr. Sibbald. Dr. Sibbald is a secondary school mathematics teacher with an equivalent amount of experience in the secondary school classroom as a teacher, and as an Associate teacher with preservice teachers. Dr. Sibbald’s research interests lie in the area of teacher self-efficacy, and hence these similarities imply a reasonable expectation that the coding probabilities between Dr. Sibbald and myself could be assumed equal (Scott, 1955). These codes were compared with my codes and discrepancies either resolved to a code of mutual agreement, or left as different codes. The same process was used on the responses
for the survey question regarding contributions to teacher efficacy. Dr. Sibbald’s codes were compared with my codes and discrepancies resolved to a code of mutual agreement, or left as different codes. The inter-rater reliability values for teacher concern were determined to be 0.88 for a direct calculation of agreement, and 0.81 for the Pi calculation. The inter-rater reliability values for teacher orientation were determined to be 0.81 for a direct calculation of agreement, and 0.76 for the Pi calculation. The Pi statistic compensates and corrects for chance errors by the two raters. The errors due to chance are assumed to be the same for both raters.

Also considering the multiple validities issue and conversion issue, the quantitative methods of the TSES and TES scales, and the quantitizing of qualitative data from short answer questions on the survey provide reliable teacher efficacy values for approaching the first research question, ‘what is the teacher efficacy?’ and the third research question, ‘how well do the quantitative and qualitative teacher efficacy measures align?’ The ability to rank and order, and match this ranking and ordering and sense of teacher efficacy to the sense of teacher efficacy that emerges from the qualitative data is necessary to understand the nature, sense, and relative size of teacher efficacy with preservice teachers in the sample. It also provides opportunities to compare results from this study to results from other studies, and to compare results of this study to other studies that use the same quantitative measures.

The qualitative methods of the short answer questions from the survey and the interviews provide opportunities to understand the emerging teacher efficacy and its contributing factors in a narrative and storied manner. Common factors, contributions, and influences to preservice teacher efficacy, as self-reported by preservice teachers can be interpreted and appreciated holistically, as the rich and textured expressions and texts of lived experience. This provides data to answer research question two, ‘what are some common factors and influences to preservice
teacher efficacy?’ Finally, both the quantitative and qualitative methods offer information and perspectives from which to answer research question three, ‘how well do qualitative and quantitative teacher efficacy measures align?’ The qualitative sense of teacher efficacy is mixed with the quantitative sense from statistical results to provide as complete a picture as possible of preservice teacher efficacy.

3.6 Ethical Considerations

Prior to data collection, approval for this study was granted by the Research Ethics Board of the University of Toronto via expedited review. The web-based survey was designed with an anonymous login procedure. Participants were asked to enter a pseudonym consisting of their mother’s first name, the respondent’s birth month as a two-digit number, and the respondent’s year of birth as a two-digit number. For example, if the respondent’s mother’s name was Heather, and the respondent was born in July of 1965, then the pseudonym would be Heather0765. This pseudonym was not used for any other purpose than for data integrity on the part of the researcher. Since the web-based login was anonymous, in the event a respondent experienced internet troubles and multiple copies of their survey existed, or they attempted to complete the survey more than once, then the researcher would have a better chance at identifying duplicate or redundant data sets.

All potential participants were given the Letter of Information and Consent information in the sent email. Potential participants were informed that consent would be assumed if they started the web-based survey. This information was also displayed on the opening page of the web-based survey, and participants were required to press a ‘continue’ button on the opening page before the survey moved to the first item. At any time, participants could exit the survey and effectively terminate their participation. Incomplete surveys were deleted.
At the end of the web-based survey, another consent note was displayed with the request that participants enter contact information if they would agree to a possible interview at a later date. The initial contact for the interview always began with a verbal confirmation of consent and that the respondent could terminate the interview and withdraw from the study at any time.

The first invitation was emailed and posted to graduating preservice teachers after their preservice program had ended. For those preservice students that had been in the university where I had been an instructor, that teacher-student relationship had ended. In addition, all email communication was performed through the official university email addresses. No personal email addresses were used.

New pseudonyms were used to organize and manage the various pieces of data. Pseudonyms were created with the code “PT?##” where the ? identified the respondent as either “M”ale or “F”emale, and the ## represented a two digit number that correlated with a relative TSES overall value, high efficacy starting with 1 and reducing as the numbers increased.

For the duration of the study, data collection and data analysis, and writing, all identifying information was changed to pseudonyms and electronically stored on the secure university network. All data in paper form is stored and locked in a cabinet and will be destroyed within four years of publication of any report in thesis or journal form. See Appendix C for approved review protocol.
Chapter Four

Findings and Results

4.1 Introduction

This chapter provides the results from the online web-based survey completed by the participating preservice teachers, and the results from the interviews completed by participating preservice teachers. The general demographic details of the respondents to the survey and to the interviews are described to provide context to the quantitative and qualitative results. In this chapter, I will describe the quantitative results of two surveys: the Teacher Efficacy Scale (Guskey & Passaro, 1994) exploring the nature of internal efficacy and external efficacy, and the Teachers’ Sense of Efficacy Scale (Tschannen-Moran & Woolfolk Hoy, 2001). The results of the two short answer questions from the survey regarding teacher concern and teacher orientation will be included in the discussion, and in a deeper inquiry into preservice teacher efficacy using the results of the interviews.

4.2 Demographics

The online web-based survey was completed by thirteen preservice teachers from one university and twenty-three preservice teachers from another university. This is a response rate of approximately twenty percent. Both universities are in Ontario, and the respondents are all preservice teachers in their respective university’s Faculty of Education. Of these thirty-six respondents, fourteen are male and twenty-two are female. One respondent did not provide any demographic information other than gender.

The relative ages of the respondents can be helpful in providing more context for appreciating the other influences to teacher efficacy, such as teacher concern and teacher orientation, as will be seen in the interview analysis. Nineteen respondents were in a university
program one year prior to the preservice year, six respondents were in a university program two
two years prior, seven respondents were in a university program between three and eight years prior,
and five respondents were in a university program nine or more years prior to the preservice
year. This translates to 71% of the respondents being in university within the previous two years,
and 29% of respondents having taken a break of some kind between their last university program
and the bachelor of education program.

In Ontario, Canada, Intermediate/Senior preservice teachers become certified to teach in
two school subjects. A minimum of two full credits in undergraduate mathematics with one or
more full undergraduate credits in a related course are required for entry to a Faculty of
Education as a secondary school mathematics teacher. For these thirty-six preservice teacher
respondents, the number of undergraduate mathematics courses ranges from 2 to 24, with a mean
of 8, and a standard deviation of 5.74. The median number of undergraduate mathematics
courses is 5 and the mode is 4. Eleven preservice teachers hold a degree major in mathematics,
seven hold a sciences degree major, four hold a computer science degree major, four hold an
engineering degree major, and ten hold some other degree major. Degree minors are less
common for this sample of respondents, with eighteen stating that they do not have a minor, ten
said they have a mathematics minor, two have a computer science minor, and five have a minor
in another academic area. This translates into certifications in a second teaching subject across a
range of subject areas.

In summary, twelve respondents have computer science as a second teaching subject,
twelve respondents have a science (general science, biology, chemistry, physics) as a second
teaching subject, and eleven respondents have another subject area as a second teaching subject
(for example, music, geography, history, English). A wide range in academic preparation and life
preparation underscores the nature of the mathematics knowledge-base and personal perspectives for secondary school mathematics preservice teachers in a faculty of education program.

4.3 Review of the Intermediate/Senior mathematics education courses and practicum

The Intermediate/Senior mathematics education courses at both of these universities are implemented from similar teaching and learning philosophies for mathematics teacher preparation. Both universities state that their courses focus on developing expertise in teaching secondary school mathematics, issues of assessment, and professional growth within the preservice program and afterwards as an in-service teacher. The course descriptions and stated objectives for the two universities follow. For each university, if there were more than one instructor, the most common treatment is presented. The following are excerpts from the two universities’ course outlines:

University A

Course Description, Aims, Goals, Objectives, Outcomes

This course introduces students to the theory and practice of teaching mathematics in the Intermediate/Senior grades. Integrating relevant ideas and content from psychology, sociology and mathematics education the course provides students with the background to critically appraise curriculum documents; examine issues in mathematics education reform; and, develop expertise in teaching.

The course is designed to introduce prospective teachers to the teaching and learning of mathematics in the Intermediate/Senior grades; to enable them to use a variety of teaching strategies and assessment tools; and to familiarize them with the curriculum content.
Note: The Standards of Practice developed by the Ontario College of Teachers are woven throughout the course.

The scope of the course is the teaching of mathematics from Grades 7 to 12. The Ontario Ministry of Education (ME) initiatives with respect to mathematics teaching and the appropriate integration of technology into the mathematics classroom will be thoroughly discussed. The experience that participants bring with them is valued and all students will be expected to share this expertise by taking an active part in all discussions.
Upon completion of the course candidates should:
Demonstrate a thorough knowledge of the characteristics of the Intermediate/Senior mathematics learner;
Demonstrate a thorough knowledge of the policies and guidelines of the ME as they apply to the Intermediate/Senior school teacher;
Demonstrate a thorough knowledge of the content and pedagogy of Intermediate/Senior mathematics;
Demonstrate an awareness of how their evolving practice exemplifies the Standards of Practice;
Develop an awareness of and familiarity with supporting resources;
Demonstrate an ability to critique curriculum resource material in the light of the most recent research in mathematics education.

The course is organized around a number of themes that will be studied in the context of a developmental model of Preservice teacher learning. That is, various pieces of each theme may be discussed at different times of the course as the students develop more expertise in particular areas.

For University A, course strands and general topics are described under the headings, Integrating Technology in Teaching and Learning Mathematics, The Role of Assessment and Evaluation in Mathematics Education, The Secondary School Mathematics Curriculum, Teaching Practice, and Orientation to Intermediate/Senior School Mathematics. The details of each strand were listed and three Ontario College of Teachers Standards of Practice were listed for each strand.

University B

Objectives of the course

Intermediate/Senior Mathematics is designed

(a) to prepare the candidate to teach mathematics in the Intermediate and Senior Division (grades 7-12)
(b) to qualify a candidate for a Bachelor of Education Degree at the University of Toronto
(c) to qualify a candidate, in part, for the Ontario Teacher’s Certificate, Intermediate/Senior, awarded by the Ministry of Education for the Province of Ontario
(d) to provide the candidate with the confidence and background knowledge to have positive experiences within a classroom setting and to provide a foundation for future professional development.
To achieve these objectives

(a) effective classroom teaching methods are examined. These include:
(i) methods for encouraging maximum student participation
(ii) methods for dealing with different learning styles in the classroom
(iii) methods for motivating and engaging students in the mathematics classroom
(iv) the identification and effective use of learning aids including technological aids and other resources
(v) methods of diagnosis and remediation

(b) techniques for effective classroom management are considered

(c) various strands of the mathematics curriculum are explored in detail

(d) criteria and techniques for self-evaluation of teachers and for evaluation of student achievement are explored

Both programs work to develop a sense of teacher practice and teacher reflection in the preservice teachers. Mathematical content is not taught as a topic, but used as a vehicle for pedagogical issues, such as creativity in the creation and design of activities, the interconnectedness of the content, content-context connections, secondary student motivation, the use of manipulatives and technology in the mathematics curriculum and classroom, and assessment of student achievement. Other issues, such as teacher reflection (Schon, 1983), critical thinking of teaching and learning strategy choices, and learning theories such as constructivism are also common between the two programs.

While particular topics and assignments vary, the intent of these assignments is the same. The assignments for each university follow, and identifying characteristics have been removed:

University A

1. 25% - Due 24 September, 2008. Learning with Technology. In teams, learn a particular function of a piece of technology commonly used in the I/S mathematics classroom, and teach this to your teacher candidate colleagues in an in-class presentation. A mathematics curriculum topic may be used as a context with the creation of a classroom ready example. Evaluation will be determined from the in-class presentation and presentation handouts. Materials will be saved [electronically] for sharing with colleagues.
2. 25% - Due 17 November, 2008. Lesson Plan with assessment strategies. Individually, create a lesson plan for a current curriculum mathematics concept or algorithm, and include your assessment strategies of student learning. Lesson Plans will be posted [electronically] for sharing with colleagues.

3. 30% - Due 20 February, 2009. Planning. A group project to create either, i. a unit plan, or ii. a course plan, or iii. a three day summative activity and assessment plan. Each of these options will be assessed and evaluated on the same criteria: Application (the integration and connection of the OSS curriculum content), Thinking (the flow and transitions), Knowledge and Application (the integration of the assessment strategies), and Communication (overall presentation, clarity, ease of use, ability for the reader to follow the plan). The Planning projects will be saved (electronically) for sharing with colleagues.

4. 20% - Ongoing. Contribution & Professionalism. This part of the course evaluation plan deals with your contribution to the course, to the classroom practice of teaching and learning, to your colleagues’ learning, and to the profession, as well as the professional manner with which you contribute (as outlined in the Ontario College of Teachers’ Standards of Professional Practice).

Along with ‘classroom and professional contribution’, included are two other components specifically related to the OCT Standard “Leadership in Learning Communities”; first, learning with manipulatives (in teams of two, pick a week, and teach your colleagues how to use a manipulative and learn a mathematical concept/skill with the manipulative), and second, participation (in one ‘outside-of-class’ event/activity).

University B

(a) Miscellaneous Assignments
Weighting: 30%
Due Date: On-going throughout the course

(b) Lesson Plan Assignments
Part 1
You will plan a lesson around a topic and create a teaching and learning sequence that will include the following components: name of topic; required materials; Ministry expectations being met; teaching notes that describe what you and your students will be doing throughout the class from the beginning to the end. The start of your lesson should demonstrate an understanding of the need to motivate students to want to learn the topic at hand by arousing their curiosity with an interesting question, problem or application. You should also include sample questions for students that you will pose during the lesson. Please limit your lesson plan to three pages.
Part 2
You will submit a lesson plan that you developed and used during the first practicum. You will also be asked to write a critique of how it went and to outline the changes you would make if you had to teach the lesson again. This plan should be at least three pages long. Please post an electronic copy of your lesson plan to our class conference or give your Instructor a copy on a CD labeled with your name and the title of your Lesson Plan.

Weighting: 10%
Due Date: November 23, 2007

(c) The Mathematical Lens Assignment
The purpose of this assignment is to provide you with an opportunity to put on a pair of mathematical glasses and to view the world through a mathematical lens. To meet this goal, you will begin by selecting newspaper or magazine articles; advertisements; photographs; clips from radio or television shows such as NUMB3RS or the Simpson's; movies such as Proof, Copenhagen or Arcadia, and excerpts from books such as The Curious Incident of the Dog in the Night Time or The Pleasure of My Company. Ten items are to be selected. You will then create a set of mathematical questions or an activity related to each item that can be used in a mathematics course in Ontario. Answers are to be included along with the names of the mathematics courses where these items can be used plus a listing of the Ministry expectations that would be met. Please post an electronic copy of your assignment to our class conference or give your Instructor a copy on a CD labeled with your name.

Weighting: 20%
Due Date: To be announced

(d) Math Trail Project
You will take part in a Math Trail by following a guided math walk set in downtown Toronto. You will be asked to answer a set of questions that will be provided as part of the Trail and to write a report on the benefits of taking students on a math field trip of this nature.

Weighting: 20%
Due Date: October 19, 2007

(e) Professionalism and participation
Weighting: 10%
Both universities stated their expectations of preservice teacher participation and contribution to the preservice program. University A identified these expectations through the Ontario College of Teachers Standards of Practice that were woven throughout the course strands and topics, integrated in the assignments (for example, the Contribution and Professionalism assignment) and Policy Statements section of the course outline where Attendance, Language proficiency, Late penalties, and Statement on Academic Offenses are presented. University B identified these expectations in on section titled, Candidate Expectations: Professionalism and Active Participation. This section described the expectations through the sections on Attendance and punctuality, Completion of assignments on time, Consideration for others, and Use of [the university computer network]. These expectations were similar and had a common goal of setting the tone for academic and professional integrity.

Another commonality between the two programs involved the instructors’ expectations of the preservice teachers’ sense of self. The instructors anticipated and appreciated that preservice teachers coming to the preservice program with a previous mathematics degree, or enough university level mathematics courses to teach secondary school math, may feel very confident that they already know how to teach mathematics. Instructors within both programs faced this preservice teacher perspective and collaborated on common course outlines with opportunities for slight variations motivated by their individual perspectives and approach, such as small variations on the assignment weightings and in the case of University B, choice of assignments within the Miscellaneous Assignments component.

Similarities also exist across both universities in the progression of course topics. Program topics initially started with lesson planning, technology in the classroom, learning strategy issues, then moved into assessment issues, unit planning, critical social issues,
mathematical communication, and teaching particular student populations, such as English as second language learners.

The mathematics education program at these two universities is taught by instructors with a range of experience in the field and in the university. Experience varies from a couple of years to over thirty years in secondary school classrooms. One instructor has a PhD in mathematics education with limited secondary school classroom experience, one instructor is “ABD” in a PhD in mathematics education with ten years secondary school classroom experience and eight years experience teaching in a faculty of education, one instructor is a current secondary school mathematics teacher who has been teaching at the university for over ten years, and one instructor is a retired secondary school math teacher. All have varying emphases on theory and theoretical connections to research and classroom practice.

In both programs, the mathematics education courses and a practicum component runs throughout the year. Block practica and an internship or alternative practicum are evident in both programs. The practicum in University A consists of three weeks in October, three weeks in December, and four weeks over March and April. The two teaching subjects are placed randomly within these three practica, with two practicum blocks in one teaching subject and one practicum block in the other teaching subject.

The practicum in University B consists of four weeks from the end of October and four weeks from the beginning of March. The two teaching subjects are placed one in each practicum block. The alternative practica at the end of the program provide opportunities for the preservice teachers to explore and experience an educational, teaching and learning experience, locally, or outside of the usual Ontario secondary school setting. For example, one set of preservice teachers in University A traveled to a Central American country to work with on a community
development project, and one student in University B traveled to Australia to spend time in Australian secondary schools and their mathematics and science classes.

4.4 Quantitative results

4.4.1 Internal and External efficacy

The nature of Internal efficacy and External efficacy is explored using the Teacher Efficacy Scale modified by Guskey and Passaro (1994). While this scale is not designed to identify teacher efficacy as a global value, it does provide the opportunity to understand the nature of teacher efficacy from the perspective of an internal sense of control and an external sense of control.

For the Internal efficacy scale, item analyses were conducted on the 10 items hypothesized to assess Internal efficacy. Initially, each of the 10 items was correlated with the total score for Internal efficacy. All the correlations were greater than .30 except for two items: “If a student did not remember information I gave in a previous lesson, I would know how to increase his/her retention in the next lesson” ($r = .19$) and “If a student couldn’t do a class assignment, most teachers would be able to accurately assess whether the assignment was at the correct level of difficulty” ($r = .21$). These items were retained to maintain the complete scale as designed by Guskey and Passaro (1994), and because their content reflect important pedagogical discernment issues, possibly challenging for preservice teachers with little classroom experience and warrant further investigation with other data collected in this study. Coefficient alpha for the Internal efficacy items was .78.

For the External efficacy scale, item analyses were conducted on the 11 items hypothesized to assess External efficacy. Initially, each of the 11 items was correlated with the total score for External efficacy. All the correlations were greater than .30 except for one item: “I
have not been trained to deal with many of the learning problems my students have” ($r = .24$). This item was retained to maintain the complete scale as designed by Guskey and Passaro (1994), and because its content reflects important pedagogical discernment issues, possibly challenging for preservice teachers with little classroom experience, and who may or may not have taken a special education course in the preservice program, and warrants further investigation with other data collected in this study. Coefficient alpha for the External efficacy items was .83.

Internal efficacy means and External efficacy means were calculated. The normality assumption was explored with descriptive statistics of skewness and kurtosis. For both the Internal efficacy means and External efficacy means, the skewness and kurtosis values were not greater than twice the standard error. The histograms of each set of means also appeared to match the shape of a normal distribution.

A correlation for the means revealed that Internal efficacy and External efficacy means were significantly negatively related, $r = -.56$, $n = 36$, $p < .001$, two tails. The nature of the TES scale means that larger scores will be calculated for greater Internal Efficacy and smaller scores will be calculated for greater External Efficacy. The coefficient of determination is 31%. This indicates that a greater efficacy value for one variable, for example Internal efficacy is a moderate indicator of a greater efficacy value for the other variable, External efficacy, and vice versa. It is possible to feel that one’s teacher efficacy has both internal and external influences. Of particular note will be the examination of the individual preservice teachers’ differences between the values of the Internal efficacy and External efficacy, the I/E Difference calculation, and which value was greater.
The scores for the External efficacy items were reversed in order for higher scores to indicate greater efficacy. A paired-samples t-test was conducted to evaluate whether the means of the Internal efficacy items and the External efficacy items were similar. The results indicated that the Internal efficacy mean \((M = 4.50, SD = 0.58)\) was significantly greater than the External efficacy mean \((M = 3.14, SD = 0.85)\). The standardized effect size index, \(d\), was 1.06, with very little overlap in the distributions for the 6-point Likert ratings of Internal efficacy and External efficacy. As shown in Figure 4, the 95% confidence interval for the mean difference between the two ratings was .92 to 1.78. The box plots show the means and standard deviation for the Internal efficacy and External efficacy values. There are three outliers in the Internal Efficacy scores, for respondents 3, 21, and 23. The scores for External efficacy were returned to their original values for further analysis.

![Box plots of Internal efficacy and External efficacy means](image)

**Figure 4.** Box plots of Internal efficacy and External efficacy means

### 4.4.2 Teacher Sense of Efficacy and three subscales.

The teachers’ sense of efficacy was determined using the TSES (Tschannen-Moran & Woolfolk Hoy, 2001). For the TSES, item analyses were conducted on the 12 items hypothesized
to assess teachers’ sense of efficacy. Initially, each of the 12 items was correlated with the total score for TSES. All the correlations were greater than .30 (see Table 3). Coefficient alpha for the TSES items was .92.

| Table 3 |
|---|---|---|---|---|---|---|
| Item | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
| TSES1_CM | 67.22 | 122.121 | .817 | .847 | .90 |
| TSES2_SE | 67.81 | 128.447 | .648 | .711 | .91 |
| TSES3_SE | 67.33 | 128.057 | .761 | .771 | .90 |
| TSES4_SE | 67.56 | 128.711 | .624 | .678 | .91 |
| TSES5_IS | 67.53 | 115.456 | .745 | .750 | .91 |
| TSES6_CM | 67.11 | 127.816 | .649 | .802 | .91 |
| TSES7_CM | 67.53 | 126.142 | .629 | .782 | .91 |
| TSES8_CM | 67.25 | 125.050 | .801 | .835 | .90 |
| TSES9_IS | 67.56 | 135.111 | .407 | .517 | .92 |
| TSES10_IS | 67.06 | 126.397 | .688 | .741 | .91 |
| TSES11_SE | 68.00 | 129.429 | .506 | .462 | .91 |
| TSES12_IS | 67.78 | 120.063 | .796 | .848 | .90 |

For the TSES subscale, Classroom management (CM), item analyses were conducted on the four items hypothesized to assess classroom management efficacy. Initially, each of the four items was correlated with the total score for classroom management efficacy. All the correlations were greater than .30. Coefficient alpha for the classroom management efficacy items was .93.

For the TSES subscale, Student Engagement (SE), item analyses were conducted on the four items hypothesized to assess classroom management efficacy. Initially, each of the four
items was correlated with the total score for classroom management efficacy. All the correlations were greater than .30. Coefficient alpha for the student engagement efficacy items was .79.

For the TSES subscale, Instructional Strategies (IS), item analyses were conducted on the four items hypothesized to assess classroom management efficacy. Initially, each of the four items was correlated with the total score for classroom management efficacy. All the correlations were greater than .30. Coefficient alpha for the instructional strategies efficacy items was .83.

TSES and TSES subscale efficacy means were calculated. The normality assumption was explored with descriptive statistics of skewness and kurtosis. For the TSES and Classroom management and Student Engagement subscale efficacy means, the skewness and kurtosis values were not greater than twice the standard error. For the Instructional Strategies subscale means, the skewness value was not greater than twice the standard error, however the kurtosis value was approximately three times the standard error. This is still within acceptable limits and, since the histograms of each set of means also appeared to match the shape of a normal distribution, it can be concluded that these means fit the normal distribution.

A correlation for the means revealed that all pairings of the TSES and its subscale means were significantly related. For the TSES and Classroom management pair, \( r = +.84, n = 36, p < .001 \), two tails. For the TSES and Student Engagement pair, \( r = +.87, n = 36, p < .001 \), two tails. For the TSES and Instructional Strategies, \( r = +.88, n = 36, p < .001 \), two tails. All the other pair combinations for the TSES subscales were significantly related, \( p < .001 \). All were moderate correlations. This indicates that it is likely a high value for the TSES mean corresponds with a high value for a subscale mean. This is an expected result given that TSES is a measure of total teacher efficacy, which includes the three subscales. The moderate correlations between subscale means indicates that a high mean for one of the subscales may correspond with a high mean for
another subscale. This is also an expected result since an efficacy subscale may have its own sense separate from the other subscales for any particular TSES value, and that other factors, such as an Internal sense of control may be influences to such subscale constructs as instructional strategies, and an External sense of control to classroom management and student engagement.

Paired-samples t-tests were conducted to evaluate whether the means of the TSES and TSES subscales were similar. The results indicated no significant difference between these four means.

4.4.3 TSES and Internal Efficacy and External Efficacy values

A Pearson correlation was performed between the means of TSES and TSES subscales, and the Internal efficacy and External efficacy. Internal efficacy was significantly correlated to the TSES and its three subscales of classroom management (CM), student engagement (SE), and instructional strategies (IS), \( p < .001 \). The student engagement (SE) subscale had a large effect size while the instructional strategies (IS) and classroom management (CM) subscales had moderate effect sizes. External efficacy was significantly negatively correlated to the TSES and its three subscales, \( p < .001 \) for overall TSES and instructional strategies (IS), and \( p < .01 \) for student engagement (SE) and classroom management (CM). The correlation with CM and SE had small effect sizes. The correlation with SE and the overall TSES had moderate effect sizes. See Table 4 for the correlations.
### Table 4

*Pearson correlations (N = 36)*

<table>
<thead>
<tr>
<th></th>
<th>Internal efficacy</th>
<th>External efficacy</th>
<th>TSES – Classroom management</th>
<th>TSES – Student engagement</th>
<th>TSES – Instructional strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal efficacy</td>
<td></td>
<td>-0.56*</td>
<td>0.72*</td>
<td>0.59*</td>
<td>0.72*</td>
</tr>
<tr>
<td>External efficacy</td>
<td></td>
<td></td>
<td>-0.56*</td>
<td>-0.42**</td>
<td>-0.49**</td>
</tr>
</tbody>
</table>

* p < .001 (2-tailed)  
** p < .01  (2-tailed)

Of note then, for the purposes of this research, is the nature of the Internal efficacy and External efficacy and its possible contextual application to understanding teacher concern and teacher orientation and teacher efficacy as a whole. (See Appendix A for a table of values).

The interviewed preservice teacher with the highest sense of Internal efficacy was also the only preservice teacher to identify the mathematics education instructor specifically as a contribution to her teacher efficacy, PTF1. She said:

> I found going to the math class specifically where we talked about actual issues that we were going to face, I felt like in [my instructor’s] math class the instructor had taught a math class before. [The instructor’s] specific examples from classes and different things that [he] had tried, seeing things that [he] had done that [he] wasn’t happy with anymore and/or had failed at. (interview, PTF1)

This preservice teacher also had one of the highest TSES scores of all surveyed preservice teachers.

The three participants with the smallest I/E Difference efficacy scores, all in the External efficacy range (-1.15 for PTM34, -1.21 for PTF36, and -1.81 for PTM33), all identified practicum and course material as significant contributions to their teacher efficacy. Specifically, the course material was applicable, and practical, and practicum was the place to try learned...
skills and techniques. Skills and techniques were acquired in the coursework, and practicum was the place to see if these skills and techniques were successful. The preservice teachers apparently could not appreciate the value of their learning without the success felt in a secondary school classroom situation. External validation of their teaching success was required. In addition, the theories of learning and mathematical thinking provided in the coursework were not mentioned by these preservice teachers. They did not internalize the knowledge of learning, and of learners’ needs, before the preservice teachers attempted to teach. This indicates a sense that something external has control over their behaviours and hence over their teacher efficacy.

4.5 Qualitative and quantitative results from survey

Two short answer questions were posed in the online survey. Designed to provide supporting data for the quantitative results, they were also designed to provide a reliability check when the results for the interviews are analysed. First, the quantitative nature of the results of these two questions is presented, supported, and textured by respondents’ words in explanation. Then a summary in the form of an appreciation of the role of context in understanding these results is presented.

4.5.1 Teacher concerns

The teacher concerns of self, task, and impact (Fuller & Bown, 1975) comprise the conceptual basis for interpreting preservice teachers’ responses. A self concern is characterized by the sense of survival in the classroom. A teacher could be concerned about knowing the mathematics content, classroom management – especially with respect to behavioural issues and respect from student to teacher, time management, and relations with peers. Task concerns are characterized by concerns about the task of teaching itself, implementing teaching methodologies correctly, identifying and using resources appropriately, and concerns about timing – in
particular the timing in lesson plans and lesson plan implementation. Impact concerns revolve around the issues of learning, in particular the values associated with the social and emotional needs of students, appropriate and authentic assessment of student achievement for the purposes of learning, and motivation factors.

The question posed was, “Describe concerns you have with respect to being a secondary school mathematics teacher.” Table 5 presents the number of preservice teachers who expressed a sense of a teacher concern as gleaned from what they said in response to the posed question.

Table 5

<table>
<thead>
<tr>
<th>Teacher Concerns evident in responses to question 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>13</td>
</tr>
</tbody>
</table>

Preservice teacher responses, due to the nature of an online, short answer question, were relatively short. This brevity of response, while at times providing an interpretation challenge, likely provided the most clear and concise expression with respondents getting immediately to the point. Typical self concern responses were: “I think setting up the first day will be the hardest” (survey, PTF23) and “Being able to control the classroom…” (survey, PTF13). Self concerns are clearly identified in terms of surviving the first few days, the logistics and actions of setting up a classroom, and the concerns about classroom management and control of student behaviour.

Combinations of teacher concerns are evident in responses that combine self and task concerns, such as, “The workload and time management is of concern with the amount of marking associated with teaching any subject, and especially math” (survey, PTF10). Workload
and time management are self concerns, and the worry about the amount of marking is a task concern. Some preservice teachers combined self and impact concerns. PTM15 writes, “Not knowing all the content. Interesting kids in math as it is important not because of number crunching but developing logical thinking.” The concern for knowing the content is an expression of self concerns and the importance of the development of logical thinking rather than number crunching is an expression of impact concerns.

Typical task concerns appear as expressions about the task of teaching, using and finding resources, such as “Most of my concerns with respect to being a secondary school mathematics teacher are centred around resources. Will I have the necessary resources to deliver the curriculum in a way that I want?” (survey, PTM17). Task concern combined with impact concern is expressed by PTM3 who is concerned about student engagement, creating interesting projects and activities, and making sure students and himself, knows the ‘why’ of using mathematics. Typical impact concerns are best evident in the response by PTM8, “My main concern is getting unmotivated students to start working and understand how math is important in their lives.” PTM8 expressed impact concerns through the knowledge of the external motivation efforts required of the teacher to overcome the internal lack of motivation in students, and the value of getting them to appreciate the importance of mathematics to them personally.

The teacher concern codes were translated into numerical values, self = 1, self/task = 2, task = 3, impact/self = 4, task/impact = 5, impact = 6. A Spearman correlation (1-tail) was performed between the TSES and its three subscales, and the ordinal values for teacher concerns. They were not significantly correlated. A Spearman correlation was performed between the ordinal numerical values for teacher concern and the I/E Difference values. This was a one-tail computation accounting for the directionality of teacher concern moving from self to task to
impact, and the relationship to the holistic sense of locus of control that the I/E Difference value provides. The teacher concern and I/E Difference comparison was significantly related, $r = .32$, $n = 36$, $p < .05$, one tail. This offers a marginal opportunity for using Guskey and Passaro’s (1994) internal vs. external efficacy measure as an influencing factor for teacher efficacy; the greater the internal efficacy, the more chance teachers experience impact concern.

4.5.2 Teacher orientation

The teacher orientations of Academic, Practical, Personal, Technical, and Critical/Social (Feimen-Nemser, 1990) form the conceptual basis for interpreting preservice teacher responses. Each orientation has a distinct perspective on teaching and learning. To summarize Feimen-Nemser’s (1990) conceptualizations of these orientations, consider the sentence, “I am a good teacher because …” being completed according to a particular teacher orientation. A teacher with an Academic orientation might say, “… I know my mathematics. Knowing the math is all that is needed to be a good math teacher.” A teacher with a Practical orientation might say, “…I am the teacher in the classroom with students and it is being in the situation that makes me a good teacher.” A teacher with a Personal orientation might say, “… my own, and my students, personal and emotional growth, and learning and knowing this of my students makes me a good teacher.” A teacher with a Technical orientation might say, “…there are a defined set of steps and procedures to follow, and following them will ensure my teaching success.” A teacher with a Critical/Social orientation might say, “…we work to enhance a social justice perspective, and the principles of democracy and equity and social activism are what make good teaching and learning.”

The teachers’ orientation may be evident from the examples and illustrations they use to support or describe their concerns. The sense of the preservice teachers’ written words and
intent, the meaning and relevance of the thoughts and concerns they connected together in the response are compared with the conceptual definition of Feimen-Nemser’s (1990) orientations, and compared with the descriptive paragraph for the orientation (see Appendix E). The interpretation process requires reading each response many times and trying to understand what the preservice teacher is trying to say. The language used to describe the concerns and the nature of the concerns provides insight into the nature of the preservice teachers’ orientation. For example, preservice teachers who state they are concerned about not knowing all the math they are sure they will need for teaching grade nine, are expressing an Academic orientation. Preservice teachers who state a concern for not knowing techniques for dealing with discipline issues in class may be expressing a Technical orientation. It was anticipated that preservice teachers would respond more succinctly in a written survey than they would in an interview, therefore, the most important concerns would be stated.

Figure 5 is a visual graphic that represents the nature of the teacher orientations that emerged from what they said in response to the question about concerns. Each vertex of the pentagon represents one of the teacher orientations (Feimen-Nemser, 1990). Some preservice teachers’ writing of what they were concerned about provided insight into one particular orientation. For example, seven preservice teachers’ responses were interpreted to be an expression of an Academic orientation. The lines connecting the orientations positioned at the vertices represent a preservice teacher whose written concerns appeared to be an expression of two orientations. The numbers at each vertex and with each set of lines connecting the vertices represent the number of preservice teachers for each of these individual orientations (e.g., Academic (7)), or combinations of teacher orientations (e.g., Academic-Personal (2)). Emphasis is evident with the Academic, Technical and Practical orientations.
Responses can clearly show a particular teacher orientation or combination of teacher orientations. For example, the Academic orientation appears for eighteen of the thirty-six preservice teachers; Academic (7), Academic-Practical (1), Academic-Personal (2), Academic-Technical (7), and Academic-Critical Social (1). The Academic orientation is evident in this response:

Presently I have several concerns. First, is always knowing the right answer. While I am confident in my abilities, I am admittedly rusty on a few mathematical concepts. I am worried that I won’t always have the right answers for them at my fingertips. (survey, PTF11)

Her concern illustrates an orientation towards the predominance of the knowing of the mathematics itself, rather than, say, the knowledge of pedagogical questioning strategies to deal with student questions about the mathematics.

Five preservice teachers expressed a Technical-Practical orientation. A Technical-Practical orientation is shown in the words from one preservice teacher as she worries about task issues, and the related resources, and steps and processes that are required in being a teacher:

“One of my concerns is not to have appropriate teaching materials available for the classroom (graphing calculators, text books, etc.). Another concern is the paper work needed for the
classroom (report cards, interim reports, progress reports, etc.)” (survey, PTF25). A combination of Academic and Technical orientations is expressed by another preservice teacher who worries about “Being up-to-speed with the content of the curriculum, especially at the higher grade levels e.g., calculus. … [And] not having too much of an arsenal of [instructional] techniques to use in teaching math” (survey, PTM33). The self concern about having the adequate knowledge of mathematics coincides with the academic orientation, and the technical orientation as he must have a large number of teaching strategies or ‘techniques’ to manage the teaching of all of the mathematical concepts and skills.

An example of the Personal orientation appears within the task concerns expressed by a preservice teacher. PTF6 states, “I am concerned about covering all the curriculum in a way that addresses the various learning needs of the students.” The task concerns for PTF6 come from the focus on covering the curriculum and the teaching strategies and skills required so that individual student needs are met. To meet individual student needs, one must know the students, hence the Personal orientation. The Personal-Technical orientation is stated by a preservice student within an expression of a concern for self. He states, “I want to be able to relate math as much to their personal experiences so that they, at least, don’t hate math class… but this is easier said than done” (survey, PTM7). These preservice teachers describe an orientation towards students as individuals with needs and feelings, and approach the learning of mathematics for the growth and benefit of the students rather than the teaching of math as a practice performed by the teacher.

Teacher orientation may also be interpreted from the written responses to the question about preservice program contributions to teacher efficacy. The following question was posed, “Describe those things from your preservice program that you feel contributed to your level of
confidence (your teachers’ sense of efficacy).” The context of preservice program contribution is
different from the context of teacher concerns, and the context of a survey question influences
what preservice teachers remember. The preservice teachers’ orientations will be interpreted
from what they identify as the element that contributed most to their teacher efficacy, and how
they describe it. The preservice teachers’ orientations provide the lens from which they observe,
experience, and remember the elements of the preservice program that aligns with their
perspectives on teaching.

Figure 6 presents a visual graphic that represents the nature of the teacher orientations
that emerged from what they said in response to the question about contributions. Again, the
lines represent a preservice teacher whose words expressed two orientations, and the numbers
represent the number of preservice teachers for each individual or combination of teacher
orientations. This graphic illustrates an emphasis in the Technical and Practical orientations.

![Figure 6. Teacher orientation graphic about contributions.](image)

The responses in the context of program contributions to teacher efficacy clearly illustrate
a prevalence of a particular teacher orientation or combination of teacher orientations. Twenty-
three preservice teachers in this study expressed a Practical orientation, the perspective that
learning how to teach comes from being in the classroom. This orientation will be used as a starting point in the following two examples. One preservice teacher, from a Practical orientation stated, that “Just getting the chance to get up there and experience it was the most helpful” (survey PTF23). Another preservice teacher expressing a Technical orientation in combination with the Practical orientation states “Practicum placements where I was actually in the classroom. Having teachers give examples of methods they have used that I could implement in the classroom…” (survey, PTF13). The importance of being in the secondary school classroom indicates a Practical orientation, and receiving the methods or step-by-step plans from another teacher that can be implemented without further planning indicates a Technical orientation.

For an example of a combination of a Personal orientation with the Critical Social orientation, PTF31 expresses that the personal growth of the teacher is key to her successful learning, and the particular elements, such as environment, indicates a critical social perspective: “I think more than anything, the preservice program provided me with an environment where I felt safe and comfortable to step outside my comfort zones and see what I was capable of.”

4.6 Qualitative results from interviews

The next section uses results from interviews to explore further the contrast of what preservice teachers selected as their teacher concern and teacher orientation with their subsequent conversation, and illuminate the emerging complex sense of perceived and expressed teacher concern and teacher orientation. All the interviews are used to examine the contrast of what preservice teachers selected and what emerged in conversation. A selection of four preservice teachers comprises a set of case studies to further explore the complex nature of teacher efficacy.
4.6.1 Teacher concerns

From the short answer question in the survey, the dominant concern identified by preservice teachers is a combination of self and task. The interviews themselves provide an opportunity for the participants to explain their thinking about teaching concerns. Initially, when presented with descriptive paragraphs, respondents’ selected teaching concerns were a mix of all three concerns; self, task, and impact, with only one combination of self and task. Subsequently, during interview conversations, preservice teachers revealed a complex mix of combinations of teacher concerns. Only one preservice teacher presented an inconsistency between her image of her own teacher concern and the evident teacher concern from her expression of her classroom experiences. PTF35 selected task concerns but gave examples of impact concern in conversation of her classroom experiences.

Self and task concerns are predominant, and impact concerns appear in conversation for some of the preservice teachers. Impact concerns are identified and expressed in conversation by preservice teachers with higher teacher efficacy scores. Again, the one anomaly is PTF35.

For each respondent, R, see Table 6 for a summary of the teacher concerns that emerged from the survey responses, TC-Survey, and the teacher concerns respondents selected in the interview, TC-Interview selected, and the teacher concerns that emerged upon analysis of the interview conversations, TC-Interview. The parentheses, ( ), indicates the teacher concern was expressed indirectly, but was still evident in the interpreted intent of their conversation. The order of the concern in a combination indicates frequency and a predominant sense of the teacher concern in conversation, from greatest to least.
Table 6

*Teacher concerns from surveys and interviews.*

<table>
<thead>
<tr>
<th>R</th>
<th>TC-Survey</th>
<th>TC-Interview Selected</th>
<th>TC-Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTF1</td>
<td>Self</td>
<td>Impact</td>
<td>Impact/Task/(Self)</td>
</tr>
<tr>
<td>PTF4</td>
<td>Task</td>
<td>Self</td>
<td>Task/Self</td>
</tr>
<tr>
<td>PTF6</td>
<td>Task</td>
<td>Impact</td>
<td>Impact/Task</td>
</tr>
<tr>
<td>PTM7</td>
<td>Self</td>
<td>Self</td>
<td>Self/Impact</td>
</tr>
<tr>
<td>PTM17</td>
<td>Task</td>
<td>Impact</td>
<td>Task/Self/Impact</td>
</tr>
<tr>
<td>PTF25</td>
<td>Self/Task</td>
<td>Task</td>
<td>Impact/(Task)</td>
</tr>
<tr>
<td>PTF27</td>
<td>Self/Task</td>
<td>Self</td>
<td>Self/Task</td>
</tr>
<tr>
<td>PTM28</td>
<td>Task</td>
<td>Self</td>
<td>Self/Task</td>
</tr>
<tr>
<td>PTF32</td>
<td>Self/Task</td>
<td>Task</td>
<td>Task/(Self)/(Impact)</td>
</tr>
<tr>
<td>PTM33</td>
<td>Self/Task</td>
<td>Self &amp; Task</td>
<td>Task/(Self)</td>
</tr>
<tr>
<td>PTF35</td>
<td>Self</td>
<td>Task</td>
<td>Impact</td>
</tr>
</tbody>
</table>

### 4.6.2 Teacher orientations

When responding to a survey question regarding what they are concerned about (*TO-s1* in Table 7), preservice teachers mostly express Academic and Technical orientations. Some preservice teachers’ responses of concerns show a Practical orientation and only two express a Personal orientation. The Academic and Technical orientations appear as the major perspective, as a focus on the mathematics itself and teaching techniques. When responding to a survey question about contributions to their teacher efficacy (*TO-s2*), preservice teachers predominantly express Technical and Practical orientations. The Academic and Personal orientations do not appear in *TO-s2* as they did for *TO-s1*. During the interview, preservice teachers most often selected (*TO-Interview selected*) the Personal orientation and the Practical orientation as descriptive paragraphs that most closely resonated with their sense of self as a teacher. Then, in conversation during the interview, (*TO-Interview*), the preservice teachers expressed a combination of orientations that had appeared in the two survey short answer responses and the
teacher orientation paragraph selection during the interview. The exception is PTM28, who expressed a new orientation, Academic, during the interview conversation.

The dominant orientation expressed in conversation matched the orientation paragraph selected by PTF1, PTF4, PTF27, PTF32, PTM33, and PTF35. Their images more closely matched their perception of actual classroom experience. For the rest, the match was less direct but still showed some consistency of orientation with the exception of PTM28 who selected the Practical orientation paragraph and expressed an Academic and Technical orientation combination.

The orientation predominantly expressed in conversation and elaborated with examples and explanations is the Personal orientation. However, it is often combined with many other orientations. For example, one preservice teacher states that:

I think it was just knowing that I could master the skills of teaching, both in math and science, getting that initial confidence about ‘I am the teacher’ and I can create different lesson plans to convey the expectations. As that confidence developed, I was able to focus my attention on getting to know the students more, rather than trying to master the little skills and steps that are involved in teaching. (interview, PTF27)

This is a combination of Personal, Technical, and Academic orientations. The Personal orientation is clearly dominant. This preservice teacher approached each practicum with an icebreaker activity, talking about herself as a ‘hockey-mom’ when she asks students about their extra-curricular activities, end of unit surveys about the learning experience, and making sure she pronounced their names correctly. She stated, “I like that relationship building opportunity … and I find that my number one rule across the board is always respect and I want to respect the student.”

Table 7 is a summary of teacher orientations that emerged from the responses to the survey question about concerns, TO-s1, orientations that emerged from the responses to the
survey question about program contributions to teacher efficacy, TO-s2, orientations descriptive paragraphs the preservice teachers selected in the interview, TO-Interview selected, and orientations that emerged from the interview conversation, TO-Interview. Other codes in the table are, A = Academic, T = Technical, P = Personal, Prac = Practical, CS = Critical Social. The parenthesis, ( ), means the teacher orientation was expressed indirectly, but was still evident in the interpreted intent of their conversation. The order of the orientation in a combination indicates frequency and a predominant sense of the teacher orientation in conversation, from greatest to least.

Table 7

*Teacher orientation from surveys and interviews.*

<table>
<thead>
<tr>
<th>R</th>
<th>TO-s1</th>
<th>TO-s2</th>
<th>TO-Interview Selected</th>
<th>TO-Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTF1</td>
<td>T-A</td>
<td>T-Prac</td>
<td>P</td>
<td>P-(Prac)-(CS)</td>
</tr>
<tr>
<td>PTF4</td>
<td>Prac</td>
<td>T-Prac</td>
<td>Prac</td>
<td>Prac-(P)-(T)</td>
</tr>
<tr>
<td>PTF6</td>
<td>P</td>
<td>Prac-T</td>
<td>P</td>
<td>T-P-(Prac)</td>
</tr>
<tr>
<td>PTM7</td>
<td>P-T</td>
<td>T-Prac</td>
<td>P</td>
<td>A-P-(Prac)</td>
</tr>
<tr>
<td>PTM17</td>
<td>Prac-T</td>
<td>Prac-T</td>
<td>P-Prac</td>
<td>Prac-T-(A)</td>
</tr>
<tr>
<td>PTF25</td>
<td>T-Prac</td>
<td>T</td>
<td>A-P</td>
<td>P-(Prac)</td>
</tr>
<tr>
<td>PTF27</td>
<td>A-T</td>
<td>A-T</td>
<td>P</td>
<td>P-T-A</td>
</tr>
<tr>
<td>PTM28</td>
<td>T-Prac</td>
<td>T</td>
<td>Prac</td>
<td>A-T</td>
</tr>
<tr>
<td>PTF32</td>
<td>A-T</td>
<td>Prac</td>
<td>Prac</td>
<td>Prac-A-(T)</td>
</tr>
<tr>
<td>PTM33</td>
<td>A-T</td>
<td>T</td>
<td>T</td>
<td>T-A</td>
</tr>
<tr>
<td>PTF35</td>
<td>A</td>
<td>Prac</td>
<td>P</td>
<td>P-Prac-(A)</td>
</tr>
</tbody>
</table>

4.6.3 Program contributions

When talking about contributions to teacher efficacy in an interview, preservice teachers predominantly identified the Practicum as the greatest contributing element, “the practicum sessions by far contributed the most to my level of confidence as a teacher” (PTF4, survey). Their orientation focused on being in the environment and acquiring a particular set of skills as the greatest way to learn to be a teacher. “Had you not had a chance to practice it along the way,
I don’t think that, well, it’s hard to retain everything that you learned” without the opportunity to practice (PTF1, interview). The practicum was noted as an important program element in the development of their teacher efficacy by nine of the eleven preservice teachers. Among those nine, six respondents stated that the practicum was the sole and most important program element in the development of their teacher efficacy. The other two respondents of the eleven, (PTM28, PTM33), stated coursework was the most important program element in the development of teacher efficacy, however, they clarified this by stating that it was the applicability and practical use of the coursework that contributed to their teacher efficacy.

Three preservice teachers stated the combination of coursework and practicum contributed to their teacher efficacy. Two preservice teachers, PTF1 and PTF32, stated coursework, although they clarified their claim that coursework was only a place to get ideas, “specifically, we talked about actual issues that we were going to face” (PTF1, interview). One respondent specifically stated that the Practicum was necessary as the place to try things out and really get a sense of teaching. One preservice teacher, PTF25, identified practicum and coursework as equivalent, although she said the mathematics education course work provided the greatest increase to her teacher efficacy.

Some preservice teachers discussed the sense of professionalism they felt as a teacher on practicum and the nature of professional learning as they moved between faculty coursework and practicum:

The different feelings of where other people are coming from and what they think and realizing that it’s ok that we all have these different views. And that that’s all right. Ultimately, you can only ever have your own. You really have to come to terms with that, that no two teachers are ever going to be alike and you just have to do what’s best for students. (PTF4, interview)

Seeing things that [the instructor] had done that [the instructor] was not happy with anymore and had failed at. Sort of gave me a sense that this is a process…. I think that
gave me confidence in knowing that you’re not going to necessarily feel the same way now about how you are going to have to learn and things are going to develop and change. (PTF1, interview)

A few preservice teachers expressed the benefits of reflection opportunities, and collaboration and confirmation opportunities with peers, aiding them to move from one stage of learning and teacher practice to another:

I feel that our practicums were spaced out, so you kind of learn something with your first one, then we come back and we get to regroup and talk to other people about what they went through. Then you get to go out into the classroom again. (PTF27, interview)

For other preservice teachers the benefits of moving back and forth between faculty coursework and practicum involved the reduction of anxiety and nervousness of being in front of a class as a teacher:

We had to do a micro lesson. We were taped by our instructor. We taught a ten-minute lesson on a topic to some of our colleagues and we were taped and critiqued by our instructor. I think that helped a lot…. I was very nervous about being in front of a class because I hadn’t been in a classroom since I had graduated from high school, from a long time ago, so that helped to calm some fears. (PTM33, interview)

Definitely [the preservice mathematics course] and [the instructor’s] classroom management style. When I have issues arising in the class, I try to remember what the instructor’s advice was….It was very important for me to be prepared from the bachelor of education program to know what to expect, how to react, and it was also very useful to see those methods applied to the classes I had. (PTF25, interview)

Moreover, in response to an interview prompt that the order of preservice coursework and practicum be changed, PTF25 exclaimed:

Oh no, no! Please don’t change the order….I really needed something to know before I go to class…. In my opinion it is better to know what to expect first, and how to react first than go and react. (interview)

While the practicum may be identified as the greatest contribution to teacher efficacy, preservice teachers appreciate the positives and negatives that exist in such an experience.

Preservice teachers are teaching in a secondary school classroom, but always with Associate
teacher observation and evaluation. PTF35 clarifies the possible consequences of the dichotomy of collaboration and mentoring with evaluation, as a preservice teacher sharing a classroom with an existing teacher. The Associate teacher:

was super supportive, a really strong mentor and knew when to kind of step back and knew when to push. With another Associate of mine, I was not as fortunate to have as strong a mentor, and [the practicum experience] did push me, but it was more my own sort of thing. When you are put in that situation, you kind of find the strength to push forward in other means. I do think that given my character and how I handle specific situations, I think that the Associates can certainly be a very integral part of the learning process. (interview, PTF35)

Table 8 presents the relationships of program contribution to teacher orientation from the survey questions and the interview. Particular codes in Table 8 are used for brevity and visual clarity. A = Academic, T = Technical, P = Personal, Prac = Practical, CS = Critical Social, and the parenthesis, ( ), means the teacher orientation was expressed indirectly, but was still evident in the interpreted intent of their conversation. The order of the orientation in a combination indicates frequency and a predominant sense of the teacher orientation in conversation, from greatest to least.

Table 8

<table>
<thead>
<tr>
<th>Teacher orientation and contributing component.</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>PTF1</td>
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<tr>
<td>PTF4</td>
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<tr>
<td>PTF6</td>
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<tr>
<td>PTF7</td>
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<tr>
<td>PTM17</td>
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<tr>
<td>PTF25</td>
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<td>PTF27</td>
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<tr>
<td>PTM28</td>
</tr>
<tr>
<td>PTF32</td>
</tr>
<tr>
<td>PTM33</td>
</tr>
<tr>
<td>PTF35</td>
</tr>
</tbody>
</table>
PTM33 and PTM28 are the only two preservice teachers to identify coursework as the sole contribution to their teacher efficacy. The Practical orientation does not appear in PTM33’s written responses or his interview conversation. The Practical orientation only appears in PTM28’s survey response to teacher concern, and then, only as a minor sense within a dominant Technical orientation.

The Practical orientation appears in the other nine cases corresponding to the preservice teachers’ identification of the practicum being the greatest contributor to their teacher efficacy. A common expression comes from one preservice teacher:

The one that was the biggest indicator was the practicums. That’s the most realistic scenario of what we are going to expect when we become full time teachers. When we get to have our own class, I don’t know, the theoretical aspect, the classes themselves, I’m not too sure. I’d rather be the doing aspect as opposed to the learning aspect of teaching. (PTM17)

Another preservice teacher said; “I can say that I don’t think that anything within my math program helped me or guided me or anything, towards my understanding of teaching, towards my teaching pedagogy or my confidence as a teacher” (PTF35).

These are important results. The complexity of the influence of context in ones’ response appears in the different expressions of orientation. A single orientation or combination of orientations may change depending upon the context of the question, for example, about concerns, or about contributions to teacher efficacy, and between a survey response and an interview response. This complexity requires further exploration, hence the need for an exploration of four selected interviews.

4.6.4 Four case studies

Four preservice teachers are examined as case studies in the following section. They represent four very different expressions of teacher efficacy and related constructs and
instructional behaviours. They were selected based on extreme values for the TSES and the I/E Difference calculation. Of the four interviewed preservice teachers clustered at the top with high TSES values, the top two were selected because they also scored higher I/E Difference values. Of the six interviewed preservice teachers clustered at the bottom with low TSES scores, there was a mix of high and low, positive and negative I/E Difference values. The preservice teachers with the lowest and highest I/E Difference values were selected, PTM33 with -1.81 and PTF25 with 1.66. Additionally, it can be seen that the I/E difference scores are relatively the same distance from zero, where the Internal efficacy value would equal the External efficacy value, but one is on the negative side and one is on the positive side of zero. These four case studies provide a rich cross section of personal context that appears to influence their teacher orientation, teacher efficacy, and sense of internal and/or external sense of efficacy.

**Preservice teacher PTF1**

Preservice teacher PTF1 scored the highest overall TSES value of all the respondents in this study, and the highest Internal efficacy score. Her External efficacy score was the lowest in comparison to the rest of the respondents. Preservice teacher PTF1 is female, and graduated from her undergraduate mathematics major degree the year before she entered the preservice program. PTF1 completed the required undergraduate credits so that Geography was her second teaching subject. PTF1 was from University A.

PTF1 also scored the highest values possible for all three TSES subscales of student engagement, instructional strategies, and classroom management. As she says of herself, “I came into preservice pretty cocky. I really wasn’t concerned about anything specific.” PTF1’s strong sense of self efficacy easily transferred into a strong teacher efficacy. Her comments about the mathematics education course are indicative of this connection: “The instructor’s examples from
classes and different things that had been tried… seeing things that had been done that he wasn’t happy with anymore and had failed at. Sort of gave me a sense that this is a process.” This contrasts with her undergraduate experience. PTF1 remembered feeling very ineffectual with her undergraduate mathematics courses. “I went into every single course that I took in undergrad thinking I am going to fail this class. I mean, I never failed, but I always had that mentality.”

PTF1 appreciated the difference between completing a mathematics degree and completing an education degree. The mathematics degree was another step along her path of life with no particular end state, whereas, the education degree provided a concrete goal and concrete end state – a mathematics teacher in a secondary school.

PTF1 appreciated the value of the mathematics education coursework, and she anticipated a high teacher efficacy outcome from her participation in the preservice program. She stated: “I didn’t really know how to assess correctly yet, but I’ll figure that out. I didn’t really know how to do classroom control but I was really confident that I could figure that out.” PTF1’s expression of high teacher efficacy also speaks to an Internal sense of efficacy. There is a clear sense of herself as a teacher, that her success as a teacher comes from within. She is confident in her ability to succeed in the classroom, which is to facilitate increased student achievement: “To see that if I can do things this way, and then if I realize it’s not the best, then I can change it and I can grow and I can develop.” There is a strong sense of “I” in these sentiments. This is a very strong expression of the Personal orientation, the sense that personal growth is integral and necessary to a successful teaching practice.

The Internal efficacy held by PTF1 carried her through the practica that were not a good experience, and, her teacher efficacy did not waver. In the second and third practica:

I was with a different teacher for every single class that I taught. I felt like all I did was jump through hoops the entire practicum trying to please all these teachers. Everyone’s
style was different. I walked into classrooms where I thought their classroom management was atrocious. And so I started to try to have some sort of routine and structure with the class, it was like pulling teeth for the first week or two weeks. Not that it made me less confident, I still know that I could do it. (interview)

She recognizes that the success of the first practicum made a difference in being able to get through the challenge of the next practica, and she appreciates that there is the possibility of external control factors on her efficacy:

It’s scary how much your Associate Teacher can affect everything about it… and even affect who you become! It is almost scary how little control [from the Preservice Office] is put on that and how much of an impact they have on preservice teachers. (interview)

In the survey, PTF1 identifies the practicum component as having the greatest impact on her confidence as a teacher. She also contextualizes her answer and adds, from the context of the in-faculty course work, such as the mathematics education course, the topics of assessment and evaluation greatly increased her confidence as a mathematics teacher.

In the interview, this understanding of the various purposes to preservice program components in her development and learning to be a teacher is also evident. Practicum is important, but it may be the sense of classroom practice that she is trying to say is the important component. PTF1 talks about the value of the field experience her mathematics instructor brought to the mathematics education course and the value of the instructor’s ability to facilitate classroom activities, conversation, and professional learning from those field experiences. She clearly contrasted this with her other teaching subject course, “I felt like he’d never taught a class in his life. Which is not true. I am sure he is a phenomenal teacher but he couldn’t really portray that to us as preservice students.”

The opportunities to talk about “actual issues that we are going to face” in the mathematics classroom, and learn about the teaching and learning of mathematics was the most important contributor to her teacher efficacy. Practicum, as teaching opportunities for herself,
had the greatest impact on her level of confidence. However, it was only as a place to try out what she learned in the preservice program courses.

PTF1 consistently expressed an impact concern. In the survey, she clearly and explicitly stated a self concern, getting a job. However, from a classroom teaching context, she added that she had no concerns about classroom management, content knowledge, or “making math exciting for students of all levels.” These are all identifiable self and task concerns. In the interview, PTF1 selected impact as her concern, and her conversation throughout the interview consistently supported that concern. She predominantly attended to student needs, and her classroom practice was implemented to maximize the information she could gain and the benefit she could realize when utilizing this information for student learning. PTF1 states the importance of “paying attention to the individual.” She said: “You need to do what will appeal to the students.” There is a little sense of task concern, of “finding an appropriate way of working with the students…” because she looked through some of the course outlines and thought, “‘oh, I am bored’. If someone gave me this on the first day of school, I would want to gouge my eyes out.” The expression of the engagement and attention she would feel towards the teaching strategies suggested for a particular course indicate task concern.

Impact concerns also appeared in her statements about lesson planning and unit planning: “If you are trying to do backward design then you can’t think about assessment and the appropriate teaching method separately,” because good instructional strategies are also good assessment strategies and hence good learning strategies. She appears to understand that these thoughts and concerns of “finding the assessments that best equip the student to excel and to demonstrate their knowledge” changes the nature of the task concern into impact concern.
PTF1 maintains a strong Personal orientation throughout her preservice program experience and all her practica. In the interview, PTF1 self-identified a Personal orientation, and throughout her conversation, remained true to that sense of self. She appreciates the possibilities that other orientations are at play: “I would have to say that the idea of having social justice incorporated into the classroom as well as having that practice and more experience teaching, probably makes you more successful.” However, she states: “I think that my passion for students and finding their success is what makes me want to do those other things.” PTF1 has a strong sense of attending to student needs; that her purpose as a teacher is to meet student needs. For example, with a particular high-needs student in one of her practicum classes: “All the other teachers were saying, ‘isn’t that annoying, like she bugs you all the time?’ But I mean, I was so thrilled that she was trying so hard."

Attention to individual needs and students’ emotional and academic wellbeing underlies her classroom practice, and instructional decisions, “that best equip the student to excel and to demonstrate their knowledge” (interview, PTF1). Identifying another of her student’s particular needs with respect to test anxiety, PTF1 describes her intervention:

I brought in a security blanket and I stuck it underneath her chair for the test and she got 90 something percent on the test and did phenomenally. I think that by seeing what it was that she needed, she needed somebody who was giving her that positive feedback and being able to do that in a non-direct way was huge for her. (interview)

PTF1 expresses humility when reflecting on her teaching practice: “I don’t necessarily think that I did anything exceptional. I really don’t think of making a point of standing in the hall and greeting the students as they come in really is anything that is exceptional” (interview). For any student in her class, PTF1 finds the details that influence her actions and help her connect her teaching with her students’ learning:
I would go to any sort of event that I knew the kids were involved in. And even if that meant I was really busy with marking and prepping, sometimes I would take marking to volleyball games and between halves I would mark, and sort of find a way to accommodate that sort of thing. (interview)

The Personal orientation also extends to peers and colleagues. When the interpersonal sense coalesces and common ground is found between peers, in the case between herself as a preservice teacher and her colleague as the Associate Teacher, “my confidence went through the roof.” She says: “There wasn’t much transition from her style to my style. How we interacted with the class was pretty similar.” The school and classroom contexts do underlie a sense of the Practical orientation, but for PTF1, only when the practicum and classroom experience are a place to practice what she is learning from the education courses.

This integration of impact concern, Personal orientation, and internal sense of efficacy with high overall TSES, blends into one complex, and comprehensive, image of being a teacher for PTF1. Most, if not all of the conversation in the interview seamlessly moved through and around these conceptions.

**Preservice teacher PTF4**

PTF4 scored one of the highest overall on the TSES. The TSES subscales of classroom management, student engagement, and instructional strategies, were consistently high, with values similar to the overall TSES. PTF4 scored relatively high on the I/E Difference calculation, indicating a strong sense of Internal efficacy. PTF4 is female, studied at University A, and completed an undergraduate degree in English with a minor in mathematics in the June before she started her preservice program in September. PTF4 had unique preservice practicum experiences being placed as a preservice teacher in the secondary school in which she had been a student. This appeared to be an important influence to her sense of Internal and External efficacy.
A greater External efficacy for PTF4 came from an external factor, her Associate teacher on her practicum placement. In this case, PTF4 felt the need to prove herself to her Associate Teacher as well as negotiate the responses and communication coming from an Associate teacher. She was placed on a practicum in the secondary school she attended as a student. She felt pressure:

It was added pressure because I felt that these were my teachers and I have to prove to them that I know the math, and that I have chosen the right career, and all that, and do them proud. (interview)

Even in a school of familiar and known teachers, she appreciates the effect some Associate teachers can have on one’s teacher efficacy. This preservice teacher identified positive outcomes after each of the first two practica, and recognized that her teacher efficacy increased each time:

“I felt that ‘ok I can go in there now, and I feel like a teacher…I do know that I am a teacher’. I did have that sense of teacherness in myself.” However, she said that the:

third practicum was really hard for me. I think my scores might have been lower after that one, than the first two. My main Associate, he was a very standoffish kind of guy. So I didn’t hear a lot of positive reinforcement from him. … I was pretty tired and felt a little beat down by the end, but when it was done, … and after I got my report and reference letters, I thought, ‘ok, my Associate does like me. That’s good’. (interview)

In the survey, PTF4 stated that several preservice courses helped prepare her for teaching, “However, the practicum sessions by far contributed the most to my level of confidence as a teacher” (survey). This is paralleled in her interview response to the question about the preservice program component that most contributed to her teacher efficacy, “The practicum. All three of them whether it was English or Math” (survey). The practicum was identified as the greatest contributor to her teacher efficacy: “The practice of just trying it on, being the actual teacher and doing it. And just feeling it. Yeah, just the experiences of it made me feel more confident, that I could do it” (interview).
While practicum was deemed important, and certain teaching specific experiences were desired, such as wanting to have been in a secondary school classroom on the first day of school, PTF4 moved back and forth between appreciating practicum and appreciating the preservice course work as contributions to her teacher efficacy. Notably, this preservice teacher identifies the relevance of the preservice program course work, such as the pedagogical knowledge gained, as important influences to the success of the practicum. She realizes she could transfer many of the skills of teaching English into teaching mathematics. She makes it clear that it is the practicality of the coursework experienced that is important. Watching videos of teachers and students in secondary school classrooms, discussing the relevant and classroom specific issues that came up in coursework, and listening to the personal stories from classroom teachers and hearing of their problem solving strategies provided some of the practical element of preservice coursework.

PTF4 expresses a sense of Internal efficacy to her teacher efficacy. The textbook for the educating exceptional students’ course, the discussions in the mathematics education course, and the understanding gained from other course work, all come together and form an internalized understanding and appreciation of being a teacher as she reflects upon her own learning in the preservice program:

the different feelings of where other people are coming from and what they think and realizing that it’s ok that we all have these different views. And that that’s all right, and ultimately you can only ever have your own, you have to kind of come to terms with that, that no two teachers are ever going to be alike, and you kind of just have to do what’s best for students, as [the instructor] said. I love that line. (interview)

This is in contrast to her initial thoughts of what being a teacher was all about. At the start of the preservice program, PTF4 held an image of the teacher that was a “mirage of equality and equity and everyone does the same thing, and there’s these guidelines and there’s these rules.” At the
beginning of the preservice program, she held a distinct external sense of locus of control. By the end of the preservice program, she expresses a blend of Internal and External efficacy to her teaching.

In the interview, PTF4 identifies with the self concerns paragraph, however expresses task concerns in conversation. “Absolutely number two! [self concerns]. All through my practicum number two. How to, do, even the simplest, I know how to do exponents, I know how to use exponents. Do I know how to teach exponents? That’s another question.” PTF4 misinterprets the self concerns paragraph selection because she misinterprets what mathematical knowledge is in the context of being a mathematics teacher. She feels she has content knowledge concerns, when in fact, she has pedagogical content knowledge issues. She appreciates that her mathematics background is less than many of her teacher colleagues:

I just did a math minor, so I hadn’t done that much math… ever. In high school I had two maths at once in OAC and I remember feeling like that was a lot of math. But just doing it all day was so, is was so different. Kind of shocking, a little bit. (interview)

It was the task focus of being in the classroom that alleviated this concern.

PTF4 identified self and task concerns, but the self concerns were less about classroom management and mathematics content knowledge, and more related to the feelings of being judged and observed by peers and her Associate teacher. Her underlying task concerns emerge in her expression of nervousness about others’ judgment of her teaching, the teaching strategies she employs, and not about herself as an individual: “I am a very, kind of nervous person when it comes to people watching me do things. I was always aware of that on practicum.” The task concerns are more important to her feelings of being a mathematics teacher.

This also relates to her strong Practical orientation. It is through the Practical orientation that she has an understanding that she can become a better teacher when she is teaching in a
classroom and that her concern about her math background diminishes. PTF4 describes the sense of doing a lot of math as a student, and feeling somewhat nervous about being a math teacher for a whole day of classes, yet, once she is in the classroom she moves confidently and easily through the day, which, she finds surprising that this would feel so easy. This sense of the Practical orientation and task concern is connected with an increase in teacher efficacy. She stated: “I am feeling better now. I am teaching summer school, just the classroom management stuff, and just having my own class I am feeling more confident about that.”

During the last practicum, PTF4 was feeling that her teacher efficacy was continuously decreasing. However, she acknowledges that she needed to be in the classroom, to push through her fears and worries. This alludes to the self-reflective capability Bandura (1986) identifies as a teacher efficacy foundation in his social cognitive theory. PTF4 reflected on her present situation and feelings to anticipate greater efficacy in the future:

I think right until the very end, I felt definitely lower, and then after it was done… I was feeling good that I was scared about doing math, so it was good that I was doing the math and getting through the days and knowing that I can do it. (interview)

The Practical orientation appears to be a key element to her sense of teacher efficacy. While practicum was identified as the greatest preservice program contributor to her teacher efficacy, preservice course work also had an influence although only as much as it was practical and provided her with opportunities to transfer learning directly into the development of her classroom practice knowledge. In one class, she had sessions on computer software, such as Dragon Naturally Speaking. She enjoyed learning about the technology:

I found that really useful just to have a taste of all that, and you know what’s out there. By no means do I know how to use it too much, but I know it’s out there and I know what it does. So I found that useful. Besides that, I don’t know how practical the other classes were. (interview)
Other classes that did not have this Practical orientation and did not offer answers and techniques that could transfer directly into the classroom were not as helpful. For example, in the education psychology course, her main concern for taking that class was: “what happens when a kid comes up to me and says ‘I am going to commit suicide’. What do I do in that situation?” Similarly in another preservice course, the instructor “spent a lot of time on social justice in the classroom, while I think it is important, to me isn’t teaching me how to teach English.” A sense of the Technical orientation appears to underlie her thoughts about teaching. This appears in her initial thoughts, before the preservice program, that as a teacher “everyone does the same thing, that there’s these guidelines and there’s these rules”, and continues in her thoughts at the end of the preservice program. She wants to know what to say in a particular situation, with a particular student issue, how to use a particular piece of technology like Dragon Naturally Speaking that is used only for an intervention with very special learning disabilities and not in the general classroom environment.

The Practical orientation and the Technical orientation is evident in her demand that preservice coursework be practical to classroom teaching, that the skills and knowledge she acquires in the coursework be directly implementable in a classroom, and that she is given the procedures and steps and actions to know what to do in a classroom. Her English education instructor had not taught in a secondary school, and his focus on social justice issues, “on the whole I think is important, to me isn’t teaching me how to teach English.” “What do I do in that situation? That was my main reason for taking that class, and at the end of that class I still don’t know how to deal with that situation.” Answers to these questions and situations and concerns were to come from the course instructor, and so, field experience is considered vital to PTF4 in order for course work to be practical and useful.
Understanding PTF4’s high overall teaching efficacy, the TSES, may be aided by the stronger Internal efficacy she feels about learning about teaching and getting into the classroom to try it out, and also by the External efficacy of being validated by her former secondary school teachers who are now teacher peers. Even though PTF4’s Technical orientation helps her feel that there was a lack of teaching techniques and skills acquired from the preservice program, her Practical orientation helps her feel increased teacher efficacy because of the opportunities to be in the secondary school classroom and be the teacher in the room. This sense of orientation and Internal and External efficacy appears to align effectively with a current task concern.

**Preservice teacher PTF25**

Preservice teacher PTF25 scored a lower 5.6 out of a possible 8 on the overall TSES. The three subscales were relatively low, although showed small fluctuations around the overall TSES. For example, Instructional strategies received the highest value at 6.5. PTF25 also scored a higher External efficacy scale value, 4.36, and received a positive difference between the Internal efficacy and External efficacy values in this study. The I/E Difference value was 1.66 indicating a slight emphasis in Internal efficacy. PTF25 is female and has a double major undergraduate degree in mathematics and computer science. She is from University A. This undergraduate degree was achieved outside of Canada in June 2000. PTF25 was employed in an office setting for three years before she moved to Canada and worked again in an office setting until she started her preservice program.

For this preservice teacher, the External efficacy element comes from being an adult immigrant to Canada, as she was:

not a student at any level in Canada, so everything I had done was in a totally different style… I think the whole view of teaching is totally different from my country. I was never really afraid of not knowing the curriculum, it was more the ‘how you do things’ here in Canada in the high schools and everything. (interview)
She stated that she completed school in another country: “All my schooling was done back home. I had a chance to work back home for almost three years, and then I changed it and I came to Canada, and my whole life came upside down.” PTF25 has no personal history with elementary school and secondary school education in Canada. As well, PTF25 moved to Canada after completing an undergraduate degree and after working for a few years in her home country.

Growing up in another culture as an adolescent with her lived behaviours, expectations, and ‘pop-culture’, “everything [she] had done was in a totally different style.” Now as an adult, and becoming a teacher, she felt the whole view of teaching was very different from her experiences from the country and culture in which she grew up. She states, “I was never really afraid of not knowing the curriculum, the academic curriculum, it was more the ‘how you do things here in Canada in the highschools’ and everything.”

The impact of this sense of being in an unknown culture, and soon to be a role model, a teacher who would be immersed in the adolescence of a new culture was an important factor to her sense of External efficacy. This created questions of herself about her own teaching efficacy. This undoubtedly is a factor for her strong task concern. She is looking for those teaching strategies and steps that are cultural norms compared to the teaching strategies in which she is familiar:

Every time I went into a new class, the first thing I did was to give the class a questionnaire to see what their interests are, how much they liked math, how much they don’t like math, and if there was anything they would replace it with. Because that gave me an idea of how to orient the math I wanted to teach them towards their interests. (interview, PTF25)
However, upon deeper examination, this apparent task concern is really a superficial interpretation of another concern. Her apparent expression of task concerns comes from a deep impact concern:

I worry about finding the appropriate teaching method. I think that’s the most important one. And it’s not because I don’t feel prepared, it’s because I want the students to leave class with the most knowledge, be the best, whatever level they are. But I want them to be sure of what they know and what they learn. I care a lot about them. (interview)

Every time PTF25 went into a new class, the first thing she did was to have the students complete a questionnaire to see what their interests were, how much they liked math, how much they didn’t like math, and if there was anything they would replace it with in their school day. This is an astute line of questioning, asking questions that increase the likelihood that she learns something important about their interests and attitudes towards mathematics by asking first what their interests are, but then, asking what other course or activity they would replace the math class with. She used the information she received from her students to “try to find things related to teach but still be teaching them the math that was required of the curriculum.” The Academic orientation underlies this line of reasoning, however, it is not through self concern. PTF25 has great confidence in her content knowledge; it is her impact concern that moves her to express a task concern and Technical orientation.

Many elements of her background experiences gave her great confidence. For example, her computer science background and being an adult; “Because I had this background in computers, it was a little bit easier for me to figure out and understand all these things and how they function and how I can use it. So yes, definitely, it helped me a lot.” This is in reference to the use of technology in the mathematics classroom. PTF25 self-identified an Academic orientation and a Personal orientation in the interview, however, her conversation clearly showed
expressions of the Personal orientation and the Academic orientation was underlying her task and impact concerns.

Her External efficacy value may need to be contextualized to the nature of being an immigrant to Canada. By being sensitive to that factor, her Internal efficacy appears very strong, aligned with her Academic and Personal orientations and task and impact concerns. PTF25 related an experience from teaching a four-week summer school course immediately after graduating from the preservice program. There were no textbooks, students were being added and dropped from the course for the first week, and technology was unavailable – there were no graphing calculators, computer lab, or smartboard. However, PTF25 became inventive with what was available in the classroom – paper, overhead projector, handouts, the one computer with Geometers’ Sketchpad in the classroom, “I tried to make things easier for the students to visualize, and to focus not necessarily on graphing the quadratic equations but to see how a, h, or k changes the graph by using GSP as a demonstration.”

One of the important contributions to her low teacher efficacy is the lack of control she feels as a preservice teacher in the classroom: “As a student, you are not in control of anything. If the Associate teacher decides at the last minute that he or she doesn’t like you then your report doesn’t come the way you truly are.” At some point, these interactions, and the resulting situations in classroom teaching where students did not respond to her, had an effect on her teacher efficacy, “at some point it did. Because I was wondering why those things happened. I was trying to look back into my knowledge and into myself as a person and see if I really did things wrong.”

In an effort to gain some control of the classroom, of teaching, and the impact she felt she should have as a teacher, she looked for ways to connect with students outside of the
mathematics classroom. PTF25 appreciated that her interests outside of mathematics might not match the students’ interests, she liked playing chess, and not many students liked playing chess. However, PTF25 joined the Environment Club, the Equestrian Club, and in the four weeks of time on practicum, she was able to experience the role of a teacher to a student who was a problem in class, but was not misbehaving in the Environmental Club.

This preservice teacher understood the situational dynamics of having her own class versus being a preservice teacher in another’s class too. Once she had her own class to teach in summer school, and had a modicum of autonomy, she experienced the success she had expected when she started the bachelor of education program. She stated:

The impact was that I found myself for the first time into a class with students according to the ages I should teach, and I didn’t have problems. I knew how to control the problems. I knew how to be in control of the class, and also make students feel comfortable and learn and ask questions and provide the knowledge that was required. I really loved it. (interview)

This statement is also an indicator of a strong impact concern. She needed to connect personally with the students so she could learn and understand the educational sense, perspective, student needs in Canadian secondary schools. She focused on student achievement and student understanding “because that gave me an idea of how to orient the math I wanted to teach them, towards their interests.” As a preservice teacher on her practicum, PTF25 understood the nature of the external locus of control that comes from working with an Associate teacher. “If the Associate teacher decides at the last minute that he or she doesn’t like you then your report doesn’t come the way you truly are.” Reflecting upon one particular negative practicum situation, PTF25 appreciates the influence this uncertainty in a relationship and the possible evaluative impact has on one’s teacher efficacy, “I was wondering why those things happened. I was trying to look back into my knowledge and into myself as a person and see if I really did
things wrong.” “You have to take that knowledge and that confidence further and sometimes it can hurt you a lot.”

As with task concerns being manifestations of impact concerns, the Practical orientation appears to be only an expression and manifestation of the Personal orientation. Practical orientations appear clearly, however, in the context of a secondary school classroom, the Practical orientation is not based in the pure sense that she will become a quality teacher from being in the classroom. Her sense of teacher practice is based on a complex blend of mathematics, the learning from the mathematics education course, and being in the classroom with a purpose of finding a way to ensure student learning. Her practicum experiences in various schools gave her opportunities to experience the effects of social and economic problems, for example, students working full time while in grade 9, “That really opened my eyes a lot in terms of what type of students you can have in the class.” It is the lived experience in the classroom that may have a greater impact than just listening to these stories from instructors in a faculty classroom.

This subtlety of one orientation over another is also evident in the context of the preservice program coursework. The Practical orientation appears within expressions of the Personal orientation, specifically, her own personal growth and learning that occurs from experience with classroom environments and discussion of classroom issues. The mathematics education course and the psychology of education course provided PTF25 with advice and strategies with which gave her “another perspective of the student.” When she had issues arise while teaching in her secondary school mathematics classes, she would try to remember the preservice course instructor’s advice and implement it. “Not all of them but some of them and I noticed they were working.”
PTF25 identified both the preservice program coursework and the practicum as important, and equal, contributing components to her teacher efficacy:

Both of them had equal contributions. It was very important for me to be prepared from the bachelor of education program to know how to expect, how to react, and it was also very useful to see those methods applied to the classes I had [to teach]. (interview)

She wanted to be prepared to teach: “I really needed something to know before I go to class. In my opinion, it is way better to know what to expect first, and how to react first, and then go and react” in the classroom.

Another example of context to illuminate the underlying influences to her expressed concerns and orientation and apparent External efficacy comes from her survey response to the question about teacher concerns. In the context of someone who has no experience with Canadian education and organizational structures and bureaucracy, her concerns have a different sense:

One of my concerns is not to have appropriate teaching materials available for the classroom (graphing calculators, textbooks, etc.). Another concern is the paper work needed for the classroom (report cards, interim reports, progress reports, etc.). One more concern is the possibility of having drug dealers and gun traffickers as students in my class. (survey)

This response could be seen as obvious self concerns from a purely Technical orientation unless one has knowledge of her personal context of being a new Canadian, i.e., what was the bureaucracy, politics, societal violence, and educational system like back home.

This indicates how low TSES scores may be explained with knowledge of the nature of the preservice teachers’ Internal and External efficacy and the context of their experiences.

Hence, while a preservice teacher has low teacher efficacy, it may be important to inquire into the subtle elements of that efficacy. PTF25 has low teacher efficacy scores on both the classroom management and student engagement subscale scores, compared with the overall TSES score,
however, has a higher instructional strategies subscale score. The mathematics content, pedagogy, ability to learn, and use of learning tools are positive contributors to her efficacy, and imply the ability to understand, relate to, and make the curriculum relevant to learners are indicators of impact concern.

Preservice teacher PTM33

Preservice teacher PTM33 scored one of the lowest overall TSES with a total score of 4.67 out of a possible 8.0. The TSES subscales of classroom management, instructional strategies, and student engagement were of similar value. PTM33 also achieved the greatest negative difference between the Internal and External efficacy scores, -1.81. PTM33 is male and completed an electrical engineering degree three years prior to starting the preservice program. His second teaching subject is Physics. PTM33 is from University B.

PTM33 stated that his confidence did not change through all his experiences, but that his attitude and responses changed. While he was not able to identify any particular reasons or experiences for his low teacher efficacy, his conversation illuminated the salient impact of his greater External efficacy values, and self concern, and his reliance on a Technical and Academic orientation.

PTM33 expresses a strong External efficacy in his explanations for problems that occurred in his teaching and his students’ learning. He was challenged with the way classes existed with such a mix of students. For example, a grade ten applied class posed a challenge because of inconsistent student motivation, “It’s doubly hard, because they have already failed the regular applied class and you want to get them motivated, so it’s a bit challenging. Some of them are motivated and some are not.” Classes are created randomly from the school or school board scheduling software, therefore a situation that is out of his control. In addition, he
expressed incredulity at the wide range of student personalities and attitudes within the same class, “it’s such a varying thing, different levels all over the place” with students who could do the math but wouldn’t in the same class with students who couldn’t do the math, all mixed in with the attitude of not wanting to be in school in the first place. In his experience, the success of the lesson “depended upon the make up of the students in the class… they were a chatty bunch, … or they knew I wasn’t really in charge.” In addition, other external factors such as the Associate teacher influenced his success in the classroom:

The other thing that happened was that my Associate introduced me as a student teacher, and I know that a number of Associates refused to identify student teachers as a student teacher, they identified them as a colleague or as a teacher, and I think that makes a little bit of a difference.

During the summer, PTM33 taught a summer school class. He felt that there would be greater success in this class because “obviously now I am the teacher in charge in the school, and they can see me as a teacher. I am the authority figure.” PTM33 firmly believes in the power given by others, in the formal and traditionally recognized status and positioning of the teacher in the school. This external, societally determined influence is the foundation to his External efficacy. As he says, “there is only so much you can really do as a student teacher in terms of classroom management.”

He tended to blame others for his inability to engage students, improve their achievement, and apply and improve his teaching strategies. He said that the students were the problem and the reason why things did not work out. “I tried teaching the same lesson, …and it worked wonderfully in one class and it just completely bomb shelled in the other class. I think it’s the class. … I think it was the make up of the students in the class.” He felt that there was a different feeling in one of his classes:
Because I guess it was just a different vibe, like when I was entering the fourth period class. It totally changed. In some ways it was detrimental towards... you know it was sort of like a positive feedback effect, right? So they were sending me the wrong vibes, and I am getting these vibes and I am thinking 'man, I don’t want to teach these guys this because they’re not even going to bother listening to what I have to say.’ So I found myself being extra motivated in my fourth period class... where with the period 1 class I would think, forget it, these guys aren’t worth the trouble. (interview)

PTM33 also maintains a relatively strong Internal efficacy. At one point on a practicum placement, he had the same grade in two different periods of the school day. If the first period didn’t go well, “it didn’t affect [my confidence] at all. I didn’t really have time to think about it to be honest, you just have to get into the lesson and teach them. So it didn’t faze me at all.” He has enough Internal efficacy to change his teaching style from one situation to the next:

Actually I tried that in my first practicum with the applied class last session. I tried doing ice breakers and stuff like that. And they went okay. I am experimenting a different way this session so I am going in completely business-like. I am going to keep it that way and I am going to start off really hard. And then maybe towards the end of this week I am going to slack off a little bit. (interview)

In addition, was his desire and concern for students to be successful, whether he was teaching a grade eleven English class or a grade eleven math class, “I don’t care. I just want to change your attitude towards math. I think I might have done that for a couple of students.” This sense of Internal efficacy also appears in a story of how he taught a particular topic that interested him, even though his Associate said there was no time in the course. “I pulled a fast one on him basically. At that point, I had had enough you know. I wanted to try something really interesting in the class.”

There is a distinct mix of External and Internal efficacy in these comments. At times, he appears unsure of himself, expressing a low self-efficacy, and deferring to others for validation and assurance that the problems were not of his doing and out of his control. At other times, he
expresses Internal efficacy by changing teaching styles even though the first one was successful, and teaching a topic of interest outside of the curriculum after he felt he had covered everything in the course his Associate had scheduled for him.

PTM33 has a clear and distinct Technical orientation combined with an Academic orientation. Academic preparation is vital for PTM33, however, he also recognizes his own personal academic background of engineering “might not be applicable to grade 10 applied or grade 9 applied courses.” The technical skills and steps of a methodological approach to mathematics and to teaching are more important to him. “I think there is definitely a method to teaching and I think that overrides everything else.” Not only does PTM33 believe there are specific steps and procedures to teaching mathematics, but they are grade and level specific too. “In grade 9 and grade ten, you need different techniques to teach an academic class. You need different techniques to teach an applied class.”

There is a sense of the Practical orientation as well. He states his teacher efficacy increases when he is in the classroom situations, “you need to be immersed in it as a teacher.” In particular, he feels confident that his teacher efficacy will increase once he has a class of his own after he completes the preservice program. It was the practicum experiences and working with Associate teachers where he felt he gained the most knowledge about teaching mathematics. Sets of steps to make lesson plans and teach particular topics came from his practicum more than from his preservice mathematics education instructor.

PTM33 also believes the knowledge of these steps to teaching will resolve classroom management issues. “If you can facilitate proper discussions or get the class motivated by finding the appropriate teaching method it sort of takes care of some of the problems.” The conviction in the Technical orientation is clear in his choice of words; discussions need to be
facilitated in a ‘proper’ manner. When PTM33 describes his problem solving strategy when a class lesson did not go well in a morning period, “I tried the same methods, it was exactly the same method that I tried in the afternoon class.” This was important to PTM33 because he “wanted to keep both classes at the same pace, same level, exactly the same.”

PTM33 believes that mathematics is very important to students’ success in life, and so they need to do well in secondary school mathematics in order to have a better life. His role as a mathematics teacher is to “improve your ability in mathematics and go on to bigger and better things, whatever that may be.” PTM33 also believes that the kind of mathematics he uses in his classes will also improve the classroom experience, such as, reduce classroom management issues. He feels that the mathematics itself will solve the students’ attention problems. He stated that:

the homeroom class was, for some reason, just chatty, like really talked a bit. I put up a problem dealing with the golden triangle, so, you know, they were supposed to find all the angles, 36 degrees, 72 degrees, and then they would find the golden ratio using properties of similar triangles. (interview)

There is an expectation that ‘good’ math will naturally and automatically engage students, however, there is no mention of how this problem connected with the curriculum, nor what instructional strategies he used in the class to engage students in this task.

Student motivation will also improve with mathematics, especially if he can find the appropriate mathematics, and the Academic orientation appears to be a foundation to PTM33’s conception of being a mathematics teacher. “Something that’s always in the back of my mind is how do you get these kids motivated by math and want to do math and want to pursue math?” This is also an indication of high External efficacy. It is the mathematics, not himself as the teacher, which will create positive classroom management, a positive classroom environment, and provide motivation to students to attend and learn the course content. PTM33 identifies
many mathematics topics he felt would influence student attention and behaviour, such as ratios of similar triangles, the golden ration, and digital roots.

The material he remembers and enjoys most, and that he feels increased his teacher efficacy from the preservice mathematics education course was the time spent on “activities that we were doing that were not necessarily a part of the curriculum. Like stuff to do with the golden ratio, digital roots.” In addition, PTM33 feels he would like to have more experience and learning opportunities with the mathematics itself:

Maybe more exposure to the different grade levels. I told you we had to do a lesson plan, for one lesson. It was strictly grade ten academic, to do with binomial expansion – how would you teach this lesson, are you teaching them about simplifying binomial expressions. Maybe more exposure to topics within the different grade levels would have been more useful. I feel I hadn’t benefited because as part of the curriculum [in the preservice program] I never had the opportunity to study the grade eleven or grade twelve portions of math in high school. (interview)

PTM33 states that, as his teacher efficacy increases, he changed from self concerns to task concerns. At the beginning of his practicum experiences, he was very concerned about “being super organized on the first day,” and about classroom management, even more than about the mathematics content he was to teach. He worried about students being bored and then causing problems in the classroom. He expresses a clear and definite self concern, demanding respect from students:

I think it was more that they didn’t respect me the same way that they respected their real teacher. I was more like a surrogate teacher in the first period class. But my other three classes were totally different. They respect me as a teacher. (interview)

He also stated that classroom management was one of his concerns. He is teaching a summer school class at the time of the interview, after completing the preservice program. He said:
I wasn’t able to enforce things like classroom discipline and class management in my practicum the same way that I am able to now. Because obviously now I am the teacher in charge in the school and they see me as the teacher. I am the authority figure. (interview)

While his self concerns continued, with respect to peer interactions with his Associate teacher, recognition from school administration, and receiving respect from his students because he is the teacher in the classroom, they decreased and were of much smaller importance compared to his task concerns. His task concerns are contextualized by his teacher orientations and sense of External efficacy. The Technical orientation and the Practical orientation provide the perspective of appreciating the technical and step-by-step manner of teaching and the increased learning that comes from the classroom context. His dominant concerns revolved around the questions, how to teach a particular topic, how to teach a particular topic for an advanced level class or an applied level class, and his experience and training with the technology of the mathematics classroom, such as Geometers’ Sketchpad and the graphing calculators.

However, PTM33 could prioritize these technical and practical aspects to his teacher training as well, “I think the Sketchpad would be less important than the micro teaching.” In his preservice mathematics education course, he expected to be trained on the use of these tools of the mathematics classroom, and given opportunities to practice ‘teaching’ in micro teaching lessons experiences.

PTM33 has low teacher efficacy characterized and explained by his high External efficacy. Others rather than himself the teacher, have control over the productivity and student achievement in his classroom. It appeared that many people had a great influence on his teaching practice, such as Associate teacher, peers, students, and school Vice Principals. Influence was even afforded to me, the researcher, as he deferred to me for validation and encouragement by
saying “I don’t know” and “right?” at the end of many statements. PTM33 has a sense of Internal
efficacy, however, this appears to be more self-efficacy than teacher efficacy. He will stand up
for his beliefs as a person, however the connection to teaching and being a teacher is minor. The
two dominant teacher orientations are contextualized as a teacher orientation and a personal
orientation.

PTM33 has a strong mathematics background, and this is an aspect to his personal
perspective on teaching style and his personality. A sense of the Practical orientation places him
firmly in the classroom and in classroom situations for his teacher training, and his teacher
orientation appeared firmly as Technical. His lack of self and teacher efficacy is illuminated by a
randomness to his teaching style by trying different approaches whether one has worked for him
or not. The Technical and Academic orientations are clearly paralleled in his teacher concerns.
Task concerns and the Technical orientation align. PTM33 feel he needs to ‘find’ the appropriate
‘teaching method’. The acquisition of procedural knowledge that provides efficient and
structured teaching by telling, and not the teaching through cooperative learning or with
manipulatives or with real life data is a priority.

Self concerns and the Academic orientation also align. His sense of mathematics is a
traditional content-process dichotomy, that is there is a right answer and marks are given for
process, rather than a sense that real-world mathematics can be ‘messy’ and that mathematics is
action and performance (Harvard, 1995), that data collected through experiments and
investigations require interpretation and multiple solutions can be expressed. He expresses
mostly self and task concerns, and his teacher orientation is inconsistent, indicating a chaotic
sense of orientation in his classroom practice.
4.6.5 Summary

To summarize the information acquired from exploring these four case studies, the following chart, Figure 7, organizes the key themes of teacher efficacy from the quantitative and qualitative perspectives.
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<td>Self then Task</td>
<td>Task (Self)</td>
<td>Practical elements of coursework</td>
<td></td>
</tr>
</tbody>
</table>

The Practica was a more important contribution to teacher efficacy, but only as it was a place to try out what was learned in the Faculty of Education. The preservice course instructor needed field experience. Teaching and learning as; empowering, an ongoing process, a profession. Impact concerns are dominant, teaching and learning is all about ‘people’.

Some External efficacy due to Associate Teacher influences. The Practicum is the greatest contributor to teacher efficacy. Coursework is important as opportunities for technical skill development. Will learn math in the classroom as a teacher. Self concerns are dominant, feels she has to prove herself to Associate Teacher, relationships important to success, often nervous.

External efficacy influences due to cultural acclimatization. Learns from on mathematics coursework (increase in teacher efficacy) and experiences decreases in teacher efficacy from Associate teacher interactions. Practicum & Course-work equivalent contributors. Impact concerns dominant -- attention to resources with purpose of student learning.

The Practical elements of coursework. Wants the steps to successful classroom teaching and classroom management. Tries to enact Impact concerns but has strong Task concerns. Idealizes a Personal Orientation but cannot visualize his own orientation and success in the classroom, hence fluctuates from one orientation to another.
Chapter Five

Discussion and Interpretation of Findings

5.1 Introduction

This chapter presents the answers to the research questions. The research questions will form the framework for a cross case analysis to present a multifaceted conception of preservice teacher preparation, and combine, where appropriate, the quantitative and qualitative results of the other interviews and web-based data of the study. The discussion and findings are linked to the literature. Discussion of the implications for secondary school mathematics preservice teacher preparation arising from this study is presented and includes suggestions and considerations for preservice teacher preparation. Finally, future research will be presented.

5.2 Research questions

This study was motivated by a desire to understand more deeply the nature of teacher efficacy with secondary school mathematics preservice teachers at the end of their bachelor of education program. The following questions formed the basis for the focus of this study as outlined in Chapter One:

1. What is the teacher efficacy for secondary school preservice mathematics teachers?
2. What are some common factors and influences to preservice mathematics teacher efficacy, and what support is there for the existing theoretical constructs of teacher concern and teacher orientation?
3. How well do qualitative and quantitative teacher efficacy measures align in the preservice context?
5.2.1 Research question one

1. What is the teacher efficacy for secondary school preservice mathematics teachers?

All interviewed preservice teachers claimed their teacher efficacy increased by the completion of the preservice program. Preservice teachers stated that their teacher efficacy continued to increase in subsequent teaching experiences, such as teaching summer school. Data for this study was collected at the end of the preservice program, and so it can be speculated that teacher efficacy values were generally lower earlier in the program. This self-reported increase is interesting, however, the research questions remain situated at the end of the preservice program.

At this point in time, at the end of the preservice program in the preservice teachers’ professional development, preservice teacher efficacy can be encapsulated as follows. Statistical analysis with Pearson and Spearman correlations found no significant results based on gender. Teacher efficacy is a wide range of values. This range of values may be understood and appreciated by looking at some contributing influences and factors. For example, teacher efficacy has an Internal efficacy or internal locus of control, and an External efficacy or external locus of control. Teacher efficacy has a teacher orientation, and a teacher concern sense to it. Teacher efficacy is not self-efficacy.

The following provides elaboration of these general characteristics of preservice teacher efficacy. It is with the case study data that elaboration to these characteristics are presented.

TSES appears to be a measurement of teacher efficacy, preservice teachers’ feelings and beliefs of themselves as teachers, and not necessarily self-efficacy, feelings and beliefs about themselves as people. For example, PTF1 and PTF4 are two preservice teachers who expressed high self-efficacy and scored high on the TSES. PTF1 expresses great confidence in herself as a person, and as a student starting a new university program. She also has high TSES scores, the
highest of the preservice teachers sampled in this study. PTF4 has a high TSES score and expresses positive confidence in herself as an individual with the purposeful choice of the Department Head of her practicum school to be her Associate teacher. Of all the people in the school department, the Department Head would be the one with the most curriculum, teaching and learning knowledge and expertise, and who would likely have great professional awareness. It might have been easier to choose another teacher who might be less aware of teaching and learning issues, might be easier to impress, have fewer expectations, and hence provide for an easier practicum experience.

In contrast, PTF25 and PTM33 are the other two preservice teachers who expressed high self-efficacy and low TSES. PTF25 demonstrates great personal confidence as an adult immigrant to a new country, learning a different language and culture, and initiates a career that places her in a position as a role model responsible for the emotional and cognitive growth of children. However, on the TSES scale, she scores one of the lowest values of the preservice teachers sampled in this study. PTM33 expresses great confidence in himself as a person, knowing his mathematics and being an expert in his field such as engineering, trying different teaching styles, and ‘pulling a fast one’ on his Associate teacher by doing something he was told not to do, while scoring one of the lowest TSES values in the sample of preservice teachers in this study.

Exploring teacher efficacy for the four case study preservice teachers from the perspective of Internal and External efficacy another result emerges. For the two preservice teachers with large differences between Internal and External efficacy scores, PTF1 and PTF4, their teacher orientations show differences across survey questions and across interview questions. PTF1 expresses a Technical-Academic orientation combination then a Technical-
Practical orientation combination in the survey ‘concern’ and ‘contribution’ questions respectively. In the interview, she selects the Personal orientation paragraph and through her interview conversation expresses a Personal-Practical-Critical/Social orientation combination. Eventually, PTF1 has expressed all five orientations. PTF4 expresses a Practical orientation and then a Technical-Practical orientation in the responses to the survey questions on ‘concerns’ and ‘contributions’, then selects the Practical orientation paragraph and expresses a Practical-Personal-Technical orientation in conversation.

For the two preservice teachers with relatively similar Internal efficacy and External efficacy scores, PTF25 and PTM33, teacher orientations appear more stable. PTF25 expresses a Technical-Practical orientation combination, then a Technical orientation in the survey ‘concern’ and ‘contribution’ questions respectively. In the interview, she selects an Academic-Personal orientation and through her interview conversation expresses a Personal-Practical orientation combination. The Technical and Practical orientations thread through her expressions. PTM33 expresses an Academic-Technical and then a Technical orientation in the responses to the survey questions on ‘concerns’ and ‘contributions’, then selects the Technical orientation paragraph and expresses a Technical-Academic orientation in conversation. Teacher orientations are clearly more stable across all data collections methods with the two preservice teachers who had similar Internal and External efficacy scores. An extreme example of the stability occurs with the preservice teacher who has a negative difference, and a greater External efficacy.

Overall, TSES scores appear higher with higher Internal efficacy scores and TSES scores appear lower with higher External efficacy scores. With relatively equal Internal and External efficacies, teacher orientations appear relatively stable across contexts. With unequal Internal and External efficacies, teacher orientations appear more variable. In addition to respondents’
self-reports that their teacher efficacy increases over the duration of the preservice program, there is a wide range of teacher efficacy values. Teacher efficacy appears to respond with context factors.

5.2.2 Research question two

2. What are some common factors and influences to preservice mathematics teacher efficacy and what support is there for the existing theoretical constructs of teacher concern and teacher orientation?

The quantitative and qualitative data collected in this study from all the respondents provides evidence that teacher efficacy appears to be clearly defined by the underlying constructs of Internal and External efficacy, teacher concern, teacher orientation, and preservice program. The practicum is the predominant preservice program contribution that preservice teachers feel increase their confidence for teaching in their classrooms. Twenty-six preservice teachers identified the practicum or a combination of practicum and coursework as the greatest contributing factor to their teacher efficacy. Mathematics education coursework was identified on condition that it be practical, applicable, and easily or quickly transferable into the teachers’ classrooms. Ten preservice teachers identified coursework alone as the important factor to their teacher efficacy.

Preservice teachers who felt coursework was most important most often expressed a higher internal sense of efficacy. They appeared to internalize the learning from preservice program courses, and they felt they had more control over their teaching. Hence achieving higher teacher efficacy as these preservice teachers set higher goals for themselves and appeared more willing to take risks. They felt that they had more control over classroom management, motivating and engaging students in class, and using a variety of instructional strategies. From a
locus of control perspective, this refers to their personal impact, power and influence in teaching
and learning situations (Guskey & Passaro, 1994).

Preservice teachers who felt practicum was a more important contribution to their teacher
efficacy often expressed greater External efficacy. They internalized the course learning less and
attributed their teaching success to factors outside their control, such as the social conditions of
the practica relationships and situations, and the demographic or economic conditions in the
practicum school. These external elements may have a positive influence on student learning,
however, the results of this study imply a negative impact on teachers and therefore a lower
sense of teacher efficacy.

This result enhances the existing literature discussing popularity of practicum, effects of
Associate teachers on pedagogical strategies attempted, and teacher orientation to classroom
management (Beeth & Adadan, 2006; Hoy & Woolfolk, 1990; McIntyre, Byrd, & Foxx, 1996).
The preservice teachers’ explanations, the emerging orientations and concerns, and expressions
of teacher efficacy suggest a connection between field experiences and the preservice program,
and the theoretical constructs of teacher efficacy, teacher concern and teacher orientation.
Teaching is complex and the relationships between the constructs of teacher efficacy, teacher
concern, and teacher orientation are not simple or linear. These three constructs appear to be
important influences and contributions to understanding preservice teachers’ development, and
the nature of nestedness from complexity science emerges. The following explicates the
constructs of teacher efficacy, teacher concern, and teacher orientation with visual and
descriptive organizers. It will pull together the seemingly elusive connections between these
constructs and show how they are connected in a manner that advances the understanding of
preservice teacher development.
The data collected from the four case studies provides evidence that teacher efficacy appears to be defined by the underlying constructs of Internal and External efficacy, teacher concern and teacher orientation. There are a number of similarities amongst the four cases, however, they often separate themselves into pairs according to one of the underlying constructs. For example, from the survey, all four preservice teachers identified preservice program coursework as an important contribution to their teacher efficacy, but the two with high TSES and high Internal efficacy, PTF1 and PTF4 also stated practicum provided an important contribution to their teacher efficacy.

This sense of contribution to their teacher efficacy was maintained in the interviews. All four preservice teachers identified the coursework as an important contribution to their teacher efficacy. The two preservice teachers with high TSES and high Internal efficacy, PTF1 and PTF4, discussed the importance of what they learned in the preservice coursework, and then the importance of the practicum as a place to try this new learning in a practical setting, in particular situations and in the context of the secondary school classroom. Both of these preservice teachers discussed at length about the high degree of relevance they felt was in the preservice coursework, and appreciated the sense of professional growth and life-long learning inherent in being a teacher.

This suggests that these two preservice teachers understood the purpose of preservice coursework and practica. Their choice of words to express their thoughts and feelings leads one to think practicum is the greatest contributor, however, it is the integration of the coursework and the practicum that is the greatest contributor. It is the contribution to their sense and understanding of professionalism, and a holistic appreciation that classroom practice is more than just being in the classroom, or learning how to teach from a text.
In contrast, the nature of the relationship between coursework and practicum was different for PTF25 and PTM33. These two preservice teachers had low TSES scores, higher External efficacy values, and relatively equal Internal efficacy and External efficacy values, with PTM33 expressing much greater External efficacy than Internal efficacy. PTF25 was anxious about teaching in a secondary school classroom, and PTM33 was nervous about teaching in front of a class. While both stated coursework and practicum were equivalent contributors to their teacher efficacy, practicum actually represented the more important goal for the successful completion of this year of teacher preparation. The coursework was necessary as a place to prepare for the practicum. The preservice coursework and preservice course class periods were to provide the opportunities to practice teaching before the ‘practice teaching’ of the practicum.

Both university A and university B describe introducing and enabling preservice teachers to use a variety of teaching and learning strategies in their course descriptions and objectives. Course assignments in both universities involve teaching opportunities with peers, and learning about teaching through mathematics activities and technology activities. Micro teaching opportunities, learning the technology of the secondary school mathematics classroom, understanding student behaviour and classroom management issues and strategies, learning the mathematics content of the secondary school curriculum were all necessary and vital components to the preservice program coursework for the purposes of preparing the preservice teacher for the actual teaching in a classroom. In response to an interview prompt that the order of preservice coursework and practicum be changed, PTF25 exclaimed a definite no, because she wanted to be prepared with appropriate expectations of what a secondary school classroom might be like before she headed out into a secondary school.
The higher scores for the TSES subscale of instructional strategies may also reflect the common sense amongst these four preservice teachers that field experience is a vital characteristic for their preservice education instructors. All four preservice teachers provided examples of how the field experience of their preservice mathematics education instructor was valuable to their learning to be secondary school mathematics teachers. Relevant classroom and student experiences, proven classroom strategies, and stories of failures and successes were identified by these preservice teachers as having a positive impact and influence on the quality of their learning and the quantity of learning to teach in a secondary school classroom.

As Midgley, Feldlaufer and Eccles (1989) found, higher efficacy relates to Internal efficacy and lower efficacy relates to External efficacy. The preservice teachers with the highest External efficacy scores predominantly mentioned ‘practicum’ as the most important contributor to their teacher efficacy. Preservice teachers with marginal differences between Internal efficacy and External efficacy scores predominantly mentioned both coursework and practicum as contributors, and often indicated equivalence between these two contributing program components. Preservice teachers with strong Internal efficacy predominantly mentioned coursework and/or how coursework applied in practicum as greatly contributing to their teacher efficacy.

While PTM33 also stated that his other teaching subject preservice instructor’s field experience enhanced the quality of coursework and improved his learning, the lack of field experience from other preservice instructors was clearly and explicitly described as a factor that affected the amount of learning all four preservice teachers felt they acquired to become a secondary school classroom teacher. PTF25 talked about the lack of field experiences in her preservice courses on education law, psychology, and sociology. PTF4 and PTF1 described in
detail examples of how their other teaching subjects preservice instructors’ lack of field experience and/or inability to express the nature of their field experience reduced the learning they feel the preservice teachers acquired for teaching that subject in a secondary school classroom.

The various stakeholders, such as Principal, Department Head, parent, secondary school student, and fellow teachers, encroach on the preservice teachers’ memories and add other components to their understanding of their teacher concern. From an External efficacy perspective, PTF35 expresses an understanding of how the Associate teacher can hinder or help the preservice teacher’s development. Other preservice teachers also have a strong External efficacy, for example, PTF26, PTM33, PTM34, PTF35, and PTF36, in addition to a relatively low TSES score, and there is a qualitative relationship between TSES and Internal and External efficacy and the preservice teachers’ perceptions of the influences from which they felt they gained the greatest learning.

Teacher concern is generally a stable construct across data collection methods, that is, surveys, concern paragraph selections, and interview conversation for preservice teachers. Teacher concern is related to teacher efficacy, higher TSES scores correspond with expressions of impact concern and lower TSES scores correspond with self concerns (see Table 6 for data). Teacher concern is related to Internal efficacy more than External efficacy. The expression of impact concerns align with a greater sense of an internal locus of control. See Table 5 for data.

Results have shown that preservice teachers exhibit certain kinds of teacher concern, such as impact concern with high teacher efficacy, at the end of the program. Preservice teachers state that, generally, their teacher efficacy increases over the duration of the preservice program. The relationship is apparently, more between teacher efficacy and teacher concern than time,
although time is a factor. The transitions between teacher concerns with increasing teacher
efficacy correspond with other findings in the literature, such as an increase in teacher efficacy
and an increased variety of instructional strategies (Gerges, 2001), a change in teacher
orientation to motivating students from custodial (teacher directed motivation) to humanistic
(student directed motivation) (Woolfolk & Hoy, 1990), and a change from keeping power and
control of the classroom environment for themselves to giving power and control to students
(Staton, 1992). These findings match the quantitative results of this study. In particular, External
efficacy correlates negatively with instructional strategies (IS), 28% of the variance is explained
by IS. Instructional strategies (IS) are often acquired from external sources, such as course
instructors, resources books, and Associate teachers, hence, preservice teachers who express a
stronger External efficacy will feel more teacher efficacy because of the instructional strategies
acquired from other sources. In addition, Internal efficacy correlates well with student
engagement (SE), 51% of the variance is explained by SE. Creating a motivating and engaging
classroom environment and sharing this motivation with students requires finding creative
methods and collaborating with a personal level of trust with students. Greater Internal efficacy
aligns with greater instructional strategies (IS) teacher efficacy.

Teacher efficacy is the belief that the teacher will be able to influence, change, and
improve student learning. The changes in teacher concern, from self to task to impact, and the
changes in teacher efficacy may be reciprocal. Change in teacher efficacy, such as an increase,
means teachers are feeling more confident and will take more risks in their classroom practice
decisions, hence moving from one type of concern into another. Conversely, with the acquisition
of new teaching strategies, as a preservice teacher might gain from an Associate teacher during a
practicum placement, a teacher might find they are shifting from one teacher concern to another,
such as self concerns to task concerns. With a successful classroom implementation attending to the new teacher concerns, teacher efficacy is influenced, and increases.

The results of this study align with Fuller and Bown’s (1975) conjecture of the developmental nature of teacher concerns. Fuller and Bown (1975) have identified this progression for in-service teachers at the beginning of their teaching careers, that is, in a simplified trajectory, self concerns in the first year of teaching, task concerns in the second year, and impact concerns starting in the third year of teaching. While preservice teachers may be shown to express a dominant self concern in their first year of teaching, at this point within the immediacy of the context of the end of the teacher preparation program they are expressing a developmental position farther along the teacher concern trajectory.

Generally, a particular teacher concern was consistently expressed by the preservice teachers throughout the interview. Preservice teachers selected a particular teacher concern from the descriptive paragraphs and the expression of this teacher concern emerged in conversation. However, a more complete and contextual nature of teaching comes to the foreground within the act of conversation during the interview. The other teacher concerns emerge in conversation and appear as enhancements and extensions to the preservice teachers’ appreciation of teaching and learning because respondents talk about particular situations from a practicum experience. For example, PTF25 expresses a decidedly task concern, as she worries about finding the appropriate teaching method, and she expresses clear impact concerns when she describes using questionnaires with students every time she begins teaching with a new group of students in an effort to ascertain the students’ interests, orientation to math and math class, and their amount of enjoyment they have had with math classes in the past so that she can tailor her instructional practices to meet student needs.
This shows the complexity of the preservice teachers’ verbalization of their thoughts. As single, smaller lines of text, the preservice teachers’ words seem to fit a simple expression of a teacher concern. In this case, a task concern is really enveloped in an appreciation for impact concerns, and a Personal orientation, providing greater meaning and understanding to the nature of the task concern.

As teacher efficacy increases, so do the combinations of teacher concerns. For example, a teacher may start with self concerns and a particular level of teacher efficacy, and then as teacher task concerns are incorporated into their expressions or teacher efficacy increases, they increase the complexity of the nested teacher concerns. Combinations of teacher concern interplay with levels of teacher efficacy. Borrowing from complexity theory (Waldrop, 1992), the sense of a continuum and varying degrees of concerns suggests that these three concerns, self, task, and impact, are not described in a linear manner or appear in stages, or clusters, but can be described as nested conceptions. Teacher concern may not be time dependent but related to one’s level of teacher efficacy. The complexity of constructs at play in preservice teacher preparation demands flexible and dynamic representations. A nested conceptualization from complexity theory (Davis & Sumara, 2006; Waldrop, 1992) provides a graphic representation for the interaction between teacher efficacy and teacher concern, see Figure 8.

![Figure 8. Nested concerns of teachers.](image-url)
Fung and Chow (2002) stated that preservice teachers often hold a different sense of self than what is evident from their instructional behaviours in their classroom. Six of the eleven cases, PTF1, PTM17, PTF25, PTF27, PTF32, PTF35, select an orientation in the interview, \textit{TO-Interview selected}, different from the orientation that emerged when they responded to the two written survey questions about their teacher concerns and contributions to teacher efficacy, \textit{TO-s1}, \textit{TO-s2}. Now consider the orientations that emerged within the longer and protracted conversations of the interview, \textit{TO-Interview selected}, and, \textit{TO-Interview}. Only six of the eleven preservice teachers, PTF1, PTF4, PTF27, PTF32, PTM33, and PTF35 selected an orientation paragraph that matched the most frequently expressed and dominant teacher orientation in conversation. Now consider consistency of teacher orientation across all collected data – emergent teacher orientation from survey responses, teacher orientation paragraph selection, and interview conversation.

A relationship seems to appear with teacher efficacy. Preservice teachers with lower teacher efficacy, such as PTF32, PTM33, PTF35, express the same orientations in conversation as they do in writing about teacher concerns, contributions to teacher efficacy, and in their selection of orientation paragraphs. This possibly indicates a narrower and less sophisticated sense of self as a teacher. In contrast, the preservice teachers with a higher teacher efficacy, such as PTF1, PTF4, PTF6, PTM7, express further orientations in conversation than what they do in writing about teacher concerns, contributions to teacher efficacy, and in their selections of orientation paragraphs. The combinations of orientations in conversation often complement and add to the combinations of orientations from their written responses. This possibly indicates a more sophisticated and open-minded perspective of teaching and learning and the influence of context. They respond to the context when they discuss their teaching practice, indicating a
possible inclusive sense of teaching and learning (Allinder, 1994; Berman et al., 1977), which their greater teacher efficacy allows. Teachers with greater teacher efficacy set higher goals for themselves (Tschannen-Moran & Woolfolk Hoy, 2001). Preservice teachers with greater teacher efficacy may be setting higher goals for themselves and in turn incorporating greater numbers of orientations in the efforts to achieve their goals.

Predominantly, preservice teachers claim a Personal orientation; that they attend to the individual student and that understanding the student and meeting student needs is foremost in their classroom practice. The orientation predominantly expressed in conversation and elaborated with examples and explanations include the Personal orientation, however, are combined with many other orientations. For example, one preservice teacher, PTF27, states that she approached each practicum with an icebreaker activity, involved family-like anecdotes in classroom conversation, and attended to respectful interpersonal connections by pronouncing names correctly. This dominant Personal orientation is enhanced with the Academic and Technical orientations of knowing the math and making the appropriate lessons to teach the math in the classroom.

In addition, the results of this study indicate the complexity of the relationship between teacher orientation and teacher efficacy, as seen in the teacher orientation codes (TO-s2) that emerged from preservice teacher interview conversations. The codes in TO-s2 show predominantly single orientations at the low efficacy end of the table, see Table 7.

To place this complex model in a direct application of teacher efficacy and the five teacher orientations (Feimen-Nemser, 1990), a model similar to the teacher orientation pentagon from Figure 4 and Figure 5 will be used. This type of figure has been used to illustrate the collective nature of orientations held by preservice teachers in this study. Low complexity
(Adami, 2002) or simple patterns (McGuire, 2007) and low teacher efficacy are identified as single teacher orientations on the vertices of the pentagon. High complexity (Adami, 2002) or sophisticated patterns (McGuire, 2007) and high teacher efficacy are identified by numerous lines connecting numerous vertices, in a sense, shading the region inside the pentagon. A particular, individualized expression of a teacher’s orientation combination would be visible as a design of lines in the pentagon. See Figure 9 for the graphic representation of teacher orientation and teacher efficacy.

Higher teacher efficacy appears to be related to a combination of two or three dominant orientations, with other orientations beginning to emerge. In addition, some orientations appear more in preservice teachers with high teacher efficacy, such as the Critical/Social orientation. The Personal orientation prominently appears in combinations for preservice teachers with high teacher efficacy. Low teacher efficacy appears to be related to single dominant orientations or a combination of two orientations. Prevalent orientations for preservice teachers with low teacher efficacy are Technical, Practical, and Academic.

Figure 9. Teacher orientation and teacher efficacy
Another complexity appears in what may be seen as an alignment between teacher concern and teacher orientation. When preservice teachers are given descriptive paragraphs to read and pick one that most appeals to them, the emotionally engaging notions of teaching and the often stereotypical understanding of what it means to be a teacher come to the foreground. Those are the notions of being a teacher and connecting with students, children, and building relationships that deepen and enrich the learning opportunities. However, once preservice teachers start talking and explain their descriptive paragraph selections for teacher concern and what they perceive are the contributions to their teacher efficacy, providing reasons and examples, their underlying orientations, those foundational perspectives on teaching and learning emerge. As Fung and Chow (2002) claim, teacher images do not necessarily match actual classroom practice. This study has found a similar result, however there are cases where image and self-reported classroom expressions match.

For example, the Practical orientation appears in nine of the interview cases corresponding to the preservice teachers’ identification of the practicum being the greatest contributor to their teacher efficacy. A common expression from preservice teachers involves the feeling that the practicum is the most realistic scenario, and that understanding what teaching is all about comes from being in the secondary school classroom; as stated by PTF35, the faculty mathematics coursework will not help or guide their development as teachers.

PTM33 needed time in the preservice coursework to learn, or re-learn and review the content of the mathematics classroom and the technology used in the mathematics curriculum. He wanted more time than was afforded in the course for learning mathematics content and how to use the technology of the mathematics classroom. The focus on mathematics content, and the nature of the subject specific teaching at the secondary school suggests a connection between
teacher concern, self in this case, with particular teacher orientations, such as Academic and Technical orientations in this case.

Considering the data collected from the survey questions about teacher concerns and program contributions and the interview conversations, the four case study preservice teachers provide examples of how their expressed teacher concerns align with their expressed teacher orientations. For example, from the survey questions PTM33 expresses self concerns and task concerns. The survey data suggests an Academic orientation and a Technical orientation. The self concerns of knowing the mathematics content for teaching it in the secondary school mathematics classroom align with the orientation that the mathematics knowledge of the teacher is vital to one’s teacher efficacy. The self concern and the Academic orientation are both about ‘the mathematics’. This alignment continues with the data from the interview. PTM33 selects the self concern descriptive paragraph, and in conversation expresses mostly task concern with some underlying self concern. He selects the Technical orientation paragraph to describe his sense of self as a mathematics teacher and in conversation expresses a Technical and Academic orientation. Again, the self and task concerns identified and expressed align with the Technical and Academic orientations for PTM33. He feels he knows his mathematics and uses it in efforts to resolve motivation and classroom management issues in his classes, hence the Academic orientation for PTM33 aligns with his self concerns that combine knowing mathematics and classroom management worries. His Technical orientation is expressed in his views that the teaching of mathematics is productive with the right procedures and steps and with the right methods. This focus on methods aligns with the task concern of finding and having the right teaching methods. This kind of alignment is evident from the other three preservice teacher cases as well.
PTF1 expresses self concerns in the survey questions, and Technical and Academic orientations combination in the question about teaching concerns, and a Technical and Practical orientation combination in the question about program contributions to teacher efficacy. As stated above, the self concerns of knowing mathematics, classroom management worries and teaching with the appropriate strategies to make math exciting for students align with the Academic, Technical and Practical orientation combinations. In the interview, PTF1 selects the impact concern paragraph and selects the Personal orientation paragraph. The classroom actions described by PTF1, such as, bringing a security blanket to put under a student’s chair to alleviate test anxiety, finding the right assessment strategies for informing students of their achievement and talking with an interior designer to get ideas for making mathematics relevant and appealing to students, and expressing her passion and desire for empowerment in teaching and learning clearly indicate an alignment with a combination of the Personal, Practical and Critical Social orientations.

PTF4 expresses task concerns and the Practical orientation in her response to the survey question about teaching concerns. The task concerns of ‘making mathematics lessons fun and engaging on a regular basis’ emerge in a Practical orientation. The key words of ‘making’ and ‘lessons’ indicate the sense of finding the right method or technique or teaching procedure for a teaching episode. She is making things for teaching purposes rather than creating an environment with opportunities through which learning occurs. The phrase ‘on a regular basis’ indicates the Practical orientation as she is clearly stating a concern for teaching over a long period of time in the context of a full-time classroom teaching contract and not from a practicum experience. This alignment of teacher concern and teacher orientation appears in the interview responses as well. PTF4 selects the self concern paragraph and in conversation expresses a task and self concern
mix. She selects the Practical orientation paragraph, and in conversation expresses a dominant Practical orientation with some Personal and Technical orientations in the background. The teacher concerns and teacher orientations align between the survey and the interview, and are consistent between the survey and the interview. PTF4 expresses a distinct task concern through a combination of Technical and Practical orientations.

PTF25 has a similar consistency between survey responses and interview responses, where teacher concerns align with teacher orientations, however, the nature of PTF25 being an adult immigrant to Canada adds a layer of complexity to interpreting her situation. From the survey, PTF25 expresses a self and task concern and a Technical and Practical orientation. Given the above three preservice teacher cases analyses, this is an anticipated combination. It is the interview results that offer a more comprehensive picture. PTF25 selects the task concern paragraph because she feels she is missing some of the cultural knowledge of the Canadian education system and the knowledge of the Canadian adolescent culture. Over the course of the interview conversation, it is impact concerns that show themselves to be a dominant force in her conception of herself as a teacher. PTF25 selects the Academic and Personal orientation paragraphs in the interview because she is using her content knowledge and self-efficacy to support her teacher efficacy.

She is very self-efficacious, has a large amount of content knowledge in both her teaching subject areas of mathematics and computer science, and her career choices moving her into a highly inter-personal role as a secondary school mathematics teacher indicate evidence of an Academic and Personal orientation. These orientations align with a self-conception of task concern for the Canadian secondary school mathematics classroom. In conversation during the interview, the context of the secondary school mathematics classroom, and relating the
experiences of her practicum and summer school teaching provides a contextual basis for expressing her more natural Personal orientation as she works to ensure student learning, student motivation, student achievement, and student success. These are impact concerns. Her Personal orientation appears to align closely with an impact concern.

These results emerged after exploring the quantitative and qualitative data and incorporating a number of different perspectives and theoretical constructs such as Internal and External efficacy, teacher concern and teacher orientation. This may indicate a complexity to teacher practice previously unappreciated.

5.2.3 Research question three

3. How well do qualitative and quantitative teacher efficacy measures align in the preservice context?

TSES is a contextual value, that is, it measures the teacher efficacy one has as he or she thinks of himself or herself as a teacher against the three subscale scores of classroom management, student engagement, and instructional strategies. For all four case studies, the preservice teachers’ TSES aligned very closely with their subscale scores of instructional strategies, classroom management, and student engagement. Given the contrast between self-efficacy and teacher efficacy, this should be expected. Since the TSES is a contextual teacher efficacy measure, then the subscales that delve into the specific contextual aspects of teaching and learning should have the same relative score. It is interesting to note that the subscale score for instructional strategies is consistently higher than the other TSES subscale scores for three of the case study preservice teachers but a little lower in the case of the fourth preservice teacher, PTM33 who also expressed greater External efficacy. For the three preservice teachers, this is reflected in the consistent identification of the mathematics preservice education coursework as
important contributions to their teacher efficacy. These preservice teachers have learned something valuable about how to teach mathematics from the preservice mathematics course and this learning has translated into higher teacher efficacy scores.

It appears that the context in which preservice teachers are asked to describe and explain their teacher efficacy influences the nature of the words they choose and examples they select to support their thoughts. The context for which a survey question is directed, such as concerns one has for teaching, or the contributions one perceives influences teacher efficacy, appears to change the teacher orientation that is heard in the preservice teachers’ responses. Comparing the survey responses to the interview responses from the perspective of teacher orientation provides examples of the influence of context. While teacher orientations appear relatively stable across all the opportunities to gather data, survey questions and interview conversation, the particular teacher orientations expressed at each instance show variations.

For the two preservice teachers with relatively equal Internal and External efficacy scores, PTF25 and PTM33, their teacher orientations are similar across survey and interview questions. For example, PTM33 expresses an Academic and Technical orientation combination in the ‘concern’ survey questions, and a Technical orientation in the ‘contribution’ survey question. He selects the Technical orientation case in the interview and his conversation expresses a Technical and Academic orientation combination. Even within the context changes of ‘concern’ and ‘contribution’ survey questions, and the interview, very stable expressions of teacher orientation appear.

A similar finding appears with teacher concerns. From the survey, the four case study preservice teachers identified concerns that were similar if not the same as the concerns discussed in the interview. The one possible difference appears in a post-interview re-
interpretation of the response by PTF1. Her high level of confidence, at first makes her survey response look like self concerns. Her responses in the interview are of impact concerns. Re-reading the survey response with the knowledge of her interview responses allows for another interpretation. She said, “The only concern I have with regards to being a secondary school math teacher is my ability to find a job. I am confident in my classroom management, my content knowledge, and my ability to make math exciting for students at all levels.” These statements read in isolation as a survey response without the knowledge gained from an interview may be interpreted as strong self concerns, getting a job, focusing on classroom management, content knowledge, and some task concerns about making math exciting. Re-read with the knowledge gained from the interview, within her expression of high self-efficacy and teacher efficacy, her concern for getting a job is most notable because she has no other concerns. In addition, her expressions of high teacher efficacy about making math exciting for students at all levels may be re-interpreted as impact concerns, because of her focus on what students will think about math and learning and that success should be available for all students, that is, not just for the ones who can do the math already.

The overall value of TSES and the values of its subscales as a measure of teacher efficacy appear to provide valuable insight into the situational and contextual nature of being a teacher in a classroom. TSES measured teacher efficacy appears to be contextual, not only with respect to being situated in a secondary school classroom, teacher efficacy increases with secondary school classroom experience, but also with the nature of the questions posed when inquiring into teacher efficacy. Teacher efficacy also appears to be distinct and separate from self-efficacy. High levels of self-efficacy do not necessarily translate into high levels of teacher efficacy. By the absence of evidence to the contrary, it may also be surmised that a decreasing or low teacher efficacy does
not reduce one’s self-efficacy. The Internal efficacy and External efficacy values of the TES also appear to accurately measure preservice teachers’ sense of locus of control. Results of this study provide quantitative and qualitative support of the use of the TSES to measure contextual teacher efficacy and the use of the TES to measure the locus of control, and that the combination of TES and TSES provide a more comprehensive and authentic interpretation of teacher efficacy.

5.3 Major findings

The complexity of these models may provide context to support the appreciation of preservice teachers’ individuality. This may provide the necessary reason for appreciating the complexity of teacher preparation and the inability to find a single ‘correct’ and ‘true’ path towards successful teaching practice (Davis & Simmt, 2003). It therefore, may not be necessary to try to be consistent across institutions or jurisdictions and provide a single teacher preparation program. The complex nature of individualization of the learning process is sufficient for the healthy maintenance of quality secondary school mathematics teacher preparation experiences.

Preservice teachers stated that their practica were the best, and sometimes the worst, experiences. However, practicum was perceived as the predominant contribution to their teacher efficacy. Preservice teachers more often described professional relationships with their associates as more influential to their growth as teachers than their professional relationships with students in their classes.

Common factors and influences are most often related to practicum (Beeth & Adadan, 2006; McIntyre et al., 1996). Preservice teachers clearly stated that applicability and practical learning is key to their feelings of teacher efficacy and their feelings of being successful as a teacher in a classroom. Knowing the mathematics content, and then knowing possible teaching techniques, or how to ‘tell’ (Smith, 1996) in the classroom are clearly where their attention is.
This illustrates a strong self concern and task concern. There is an awareness of the possibilities of integrating mathematics concepts to other mathematics concepts, of creativity and the invention of learning tools, of attending to learning needs and learning strategies, but the preservice teachers’ appreciation appears to be vicarious through the examples and artifacts presented by course instructors and associate teachers. While some preservice teachers show a progression from self concerns to impact concerns in the short period of time of the preservice program (Beeth & Adadan, 2006), more often, preservice teachers’ attention is to their teaching rather than to student learning, indicating a lack of impact concern.

These perceptions and statements are evidence of particular teacher orientations (Feimen-Nemser, 1990), as the Practical and Technical orientations emerge in discussions about teaching. Preservice teachers wanted to know the steps, techniques, tricks, and gimmicks of teaching. They wanted classroom management tools. The Academic orientation emerges in discussions about being prepared to teach secondary school mathematics, that is, more often when preservice teachers state that they can review and remember mathematical content but they may not know how to teach it. The Personal orientation often emerged in descriptions of professional collaborations with associate teachers or other preservice teachers, and not as much in descriptions of collaborations with students.

From the analysis, we saw that teacher concern (Fuller & Bown, 1975) is closely aligned with teacher orientation (Feimen-Nemser, 1990). In the absence of other data, it may be possible to use knowledge of teacher concern to predict and/or appreciate a teacher’s orientation to the teaching and learning of mathematics. This implies a growth element to teacher orientation. As one’s teacher efficacy increases, teacher concerns change and include more task and then more impact concerns. As one’s teacher efficacy increases, and one’s teacher concerns change and
develop into impact concerns, teacher orientations change and become expressions of larger combinations of orientations and if not already, possibly incorporate orientations such as the Critical Social and Personal in an integrated manner (Hoy & Woolfolk, 1990) as one works towards facilitating impact concerns in teaching and learning situations. These results indicate relationships amongst existing theoretical constructs of teacher efficacy, teacher concern, and teacher orientation, and appear to imply an influence of teacher concern and teacher orientation on teacher efficacy.

The differences across the four cases emerge in the sense of Internal and External efficacy. Two preservice teacher cases contain greater Internal efficacy than External efficacy. The two other preservice teacher cases contain relatively equivalent Internal and External efficacy values, one case contains a higher External efficacy value, and the other case contains a higher Internal efficacy value. Independent of the other constructs such as TSES, teacher concern and teacher orientation, the Internal and External efficacy values may not provide enough data to form a perspective or interpretation of each teacher’s teacher efficacy and classroom practice. Used in combination with the other constructs of TSES, teacher concern and teacher orientation, the Internal and External efficacy values improve interpretability and opportunities to make inferences as is seen in the presentation of the four cases in chapter four.

Preservice teachers provide various reasons for this self-reported TSES increase and the study directs attention to the sense of Internal and External efficacy, their concerns as teachers, and their orientations to teaching. Higher teacher efficacy appears related to more expressions of impact concerns and combinations of teacher concerns. Higher teacher efficacy appears related to more robust combinations of teacher orientation, such as Personal, Practical, Critical Social,
Academic, while lower teacher efficacy appears related to Technical, Academic, Practical orientation combinations.

The cross case analysis of the four preservice teachers, and interview data for the eleven preservice teachers, and the survey data for the whole sample of thirty-six preservice teachers has provided valuable perspectives on teacher efficacy and the contributions of teacher concern, teacher orientation, preservice program contribution, and the sense of Internal and External efficacy. It has also illuminated possible relationships amongst these constructs in the context of preservice teacher preparation. The major findings for this study can be summarized as follows according to the three theoretical constructs that were evident in the study, teacher efficacy, teacher concern, and teacher orientation.

**Teacher Efficacy**

Preservice teacher preparation involves mathematics content knowledge and pedagogical knowledge. Content knowledge is evident in self concerns and the Academic orientation. Pedagogical knowledge is evident in task and impact concerns, and the Technical, Practical, and Personal orientations. Teacher efficacy, teacher concern, and teacher orientation have been shown to be qualitatively and quantitatively connected and provide an important perspective to the nature of preservice mathematics teacher preparation. Changes in teachers’ beliefs about teaching, and the interrelatedness of content knowledge and pedagogical knowledge in pedagogical content knowledge, imply a link between teacher efficacy and pedagogical content knowledge.

**Teacher Efficacy instrument**

Preservice teacher efficacy measured using the TSES (Tschannen-Moran & Woolfolk Hoy, 2001) provides a rich and contextual measure of preservice mathematics teachers’ efficacy.
Teacher efficacy as measured by the TSES matched the teacher efficacy expressed in conversation during the interviews.

**Teacher efficacy and Internal and External efficacy**

Preservice teachers’ sense of Internal efficacy and External efficacy as measured by TES (Guskey & Passaro, 1994) matched the results of the interview data. In combination with preservice teachers’ sense of self as individuals and their particular lived experiences, preservice teachers’ Internal efficacy and/or External efficacy align with teacher efficacy as measured by the TSES (Tschannen-Moran & Woolfolk Hoy, 2001), Internal efficacy more often aligns with higher teacher efficacy than with External efficacy. Internal efficacy and an internal locus of control results in greater risk taking and the setting of higher goals associated with greater teacher efficacy. External efficacy and an external locus of control results in a more custodial orientation to teaching associated with lower teacher efficacy.

**Teacher concern**

Teacher concern is a nested construct related more to teacher efficacy than to time. Quantitatively, higher Internal efficacy is significantly related to expressions of impact concern. Qualitatively, high teacher efficacy relates to expressions of impact concern in combination with self and task concerns. Low teacher efficacy relates to expressions that consist mostly of self concerns. Teacher concern and teacher efficacy change in a reciprocal manner, as teacher efficacy increases, teacher concerns change from primarily self concerns to a blend of self, task, and impact concerns, and vice versa, as teacher concern changes so does teacher efficacy.

**Teacher orientation**

Teacher orientation is a complex construct that aligns with teacher efficacy. Low teacher efficacy relates to expressions of single orientations, more often the Technical and Academic
orientations. High teacher efficacy relates to combinations of orientations, more often including the Critical Social, Personal, and Practical orientations in combination with the other orientations.

5.4 Suggestions and considerations for preservice programs

The inference quality (Teddlie & Tashakkori, 2003) of this study, and the reduction of legitimation issues as discussed in chapter 3, is a result of the research design and the incorporation of the quantitative and qualitative methods in this mixed methods research. For example, the quantitative data is used to identify the individual respondents’ sense of teacher efficacy and look for relationships to the other constructs of teacher concern and teacher orientation. The small sample size for quantitative generalizability is compensated with increased credibility from the qualitative sampling through survey questions and interview data for each respondent, and the collection of qualitative data at two different times.

The significance of this study is its ability to connect the three constructs of teacher efficacy, teacher concern, and teacher orientation in preservice mathematics teacher preparation, and the transferability of this theoretical framework and enhanced understanding of mathematics preservice teacher efficacy to teacher educator efforts in the design and implementation of mathematics teacher preparation programs.

Results from this study suggest that teacher concern and teacher orientation align with teacher efficacy. Attention to the nature of teacher concern and teacher orientation may direct the selection of course activities. The difference between the preservice teachers’ self-identification of teacher concern and teacher orientation and perceptions of classroom practice may indicate that preservice teachers hold a particular view of themselves (Fung & Chow, 2002) that has not been fully explored with professional reflection (Schon, 1983). Attention to the nature of Internal
efficacy and External efficacy may also affect program and course planning, design, and implementation. Preservice programs may be able to respond to student needs more effectively. This may have an important affect on the planning, organization, and design of preservice programs, preservice courses, and practica.

1. Preservice coursework and practica must both continue to be present and integrated in teacher preparation.

2. Continuous assessments of preservice teacher orientation, teacher concerns, and teacher efficacy will provide feedback for curricular and instructional decisions by preservice course instructors.

3. Considering common initial teacher orientations, Academic and Technical, and common initial teacher concern, self concerns, preservice mathematics education course activities can be selected to appeal to the preservice teachers’ initial need for survival, content knowledge, and classroom management knowledge. Attending to teacher concern of self and task may provide opportunities to increase teacher efficacy.

4. Consideration of the change in teacher orientation from single to combinations, and teacher concern from self concern to combinations of concerns, and the corresponding increased teacher efficacy, preservice course topic selection and topic order can now be organized to maximize preservice teacher learning and align with preservice teacher knowledge and understanding over the duration of the preservice program.

5. An initial focus on the Technical orientation will help preservice course instructors give preservice teachers a set of steps or procedures for teaching
activities, such as graphing curves on a graphing calculator, scripting lesson transitions, using the overhead projector. Then, the preservice instructor can transform the learning experiences over the length of the education course to increase the higher order thinking skills and increase the number of teaching and learning issues that occur simultaneously, creating a scaffolded learning curve that supports the increased number and combinations of teacher orientations as teacher efficacy increases.

6. It is possible that Critical Social and Personal orientations need to be emphasized later in the preservice course, after the preservice teacher has experienced more cognitive and affective growth and change, resulting in a more natural and authentic application in teacher practice.

7. Attention to teacher orientation and how it changes with teacher efficacy should be considered when considering practicum preparation. Workshops and professional development sessions for Associate teachers on teacher orientation and teacher concern will facilitate greater appreciation of preservice teacher development in field experiences.

8. Attention in mathematics education coursework for further self-reflection and professional reflection –in action, and –on action (Schon, 1983) opportunities for preservice teachers with teacher efficacy, teacher concern, and teacher orientation may facilitate a greater sense of self-understanding. This may improve and enhance preservice teachers’ learning of the teaching and learning of secondary school mathematics.
5.5 Implications for future research

The connections between teacher efficacy, teacher concern, and teacher orientation have research implications as well as professional practice implications, such as teacher preparation. Research on teacher preparation programs, preservice teacher development of knowledge, and preservice teacher knowledge may be explored from the different perspectives of teacher orientation and teacher concern.

The Internal and External efficacy influences and relationships to teacher efficacy and preservice program success should be explored. Maturation factors have not been fully explored in this study. However, the sense of Internal and External efficacy and lived experience before one attends a teacher preparation program may provide insight into the creation of alternative teacher preparation programs based in these factors rather than just on part-time, full-time, or concurrent time structures.

Program evaluation using the related theoretical constructs of teacher efficacy, teacher concern and teacher orientation may provide deeper understandings of teacher preparation for many stakeholders, such as the preservice students, Associate teachers and school boards, individual faculty, and collective faculty groups such as a Faculty of Education. Longitudinal research on preservice teachers’ changes in teacher concern and orientation with teacher efficacy and the connection and interplay between coursework and practica may provide opportunities to understand the professional growth and development in teacher knowledge.

Subsequent research following preservice teachers into their first few years of teaching may also have a great impact when looking back to the teacher preparation program and making improvements because a trajectory is visible and available for reflection. The knowledge of preservice teacher development and teacher efficacy may influence the relationships between the
tertiary and secondary education levels as university instructors and secondary school mathematics teachers and associate teachers may have a better framework from which to collaborate and share in the task of preservice teacher preparation.
References


Ball, D. L., & Sleep, L. (2007, January 25). What is mathematical knowledge for teaching and what are features of tasks that can be used to develop MKT? Paper presented at the Centre for Proficiency in Teaching Mathematics (CPTM) pre-session of the Annual Meeting of the Association of Mathematics Teacher Educators (AMTE), Irvine, CA.


Erikson, D. K. (1993). *Middle school mathematics teachers' views of mathematics and mathematics education, their planning and classroom instruction, and student beliefs and*
achievemnt. Paper presented at the Annual meeting of the American Educational Research Association, Atlanta, GA.


Hare, S. Z. (2007). We teach who we are: The intersection of teacher formation and educator dispositions. In M. E. Diez & J. Raths (Eds.), *Dispositions in Teacher Education* (pp. 139-149). Charlotte, NC.: Information Age Publishing.


Staton, A. Q. (1992). Teacher and student concern and classroom power and control. In V. P. Richmond & J. C. McCrosky (Eds.), *Power in the classroom: communication, control and concern* (pp. 159-176). Hillsdale, NJ.


## Appendix A

### TSES, TSES subscales, Internal Efficacy and External Efficacy averages

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Appendix B:

Online Survey

Login Page

For Anonymity, you will be asked to enter a pseudonym. This pseudonym will consist of your mother’s first name, two digits of your month of birth, and two digits of your year of birth. For example, if your mother’s name is Heather, and your birth month is July, and your birth year is 1965, then your pseudonym would be “Heather0765.”

This survey contains five sections; 1 & 2. two different, short, surveys, 3. two short answer questions, 4. seven demographic questions, and 5. contact fields if you wish to be considered for an interview.

Note 1: One or two of the questions in the two surveys may feel similar, but their intent and purpose is different in each survey. Answer each question on its own merit, as you feel appropriate.

Note 2: This web-based survey tool allows you to scroll to see all the questions in the section current on your screen. It also allows you to see a progress chart at the end of each section from which you can easily return or ‘jump’ to the questions again.

Part A: Pseudonym and Short Answer

1. Enter your pseudonym (your mother’s first name + your month and year of birth, e.g., Heather0765)

Part B: Short Answer questions

This section is two questions in length. It asks for short answer responses, and there are 1000 characters available for each response.

2. Describe concerns you have with respect to being a secondary school mathematics teacher.

3. Describe those things from the preservice program that you feel contributed to your level of confidence (your teachers' sense of efficacy).
Part C: Guskey and Passaro: Teacher Efficacy Scale

The following questions require you to pick one of six options. The questions are from the Guskey and Passaro (1994) Teacher Efficacy Scale. Answer these questions from your feelings and understanding of yourself as a teacher.

6-point likert scale for each item
a) strongly agree b) moderately agree c) agree slightly more than disagree
d) disagree slightly more than agree e) moderately disagree f) strongly disagree

4. When a student does better than usual, many times it is because the teacher exerts a little extra effort.
5. The hours in my class have little influence on students compared to the influence of their home environment.
6. The amount a student can learn is primarily related to family background.
7. If students aren’t disciplined at home, they aren’t likely to accept any discipline.
8. I have not been trained to deal with many of the learning problems my students have.
9. When a student is having difficulty with an assignment, I often have trouble adjusting it to his/her level.
10. When a student gets a better grade than he/she usually gets, it is usually because I found better ways of teaching that student.
11. When I really try, I can get through to most difficult students.
12. I am very limited in what I can achieve because a student’s home environment is a large influence on his/her achievement.
13. Teachers are not a very powerful influence on student achievement when all factors are considered.
14. When the grades of students improve, it is usually because their teachers found more effective teaching techniques.
15. If a student masters a new concept quickly, this might be because the teacher knew the necessary steps in teaching that concept.
16. If parents would do more for their children, teachers could do more.
17. If a student did not remember information I gave in a previous lesson, I would know how to increase his/her retention in the next lesson.
18. The influences of a student’s home experiences can be overcome by good teaching.
19. If a student in my class becomes disruptive and noisy, I feel assured that I know some techniques to redirect him/her quickly.
20. Even a teacher with good teaching abilities may not reach many students.
21. If a student couldn’t do a class assignment, most teachers would be able to accurately assess whether the assignment was at the correct level of difficulty.
22. If I really try hard, I can get through to even the most difficult or unmotivated students.
23. When it comes right down to it, a teacher really can’t do much because most of a student’s motivation and performance depends on his or her home environment.
24. My teacher training program and/or experience did not give me the necessary skills to be an effective teacher.
Part D: Tschannen-Moran and Woolfolk Hoy teacher efficacy survey

The following questions come from the Tschannen-Moran & Woolfolk Hoy (2001) Teachers' Sense of Efficacy Scale (short form -- modified for context with the inclusion of the word 'math').

9-item likert scale for each item
a) Nothing b) Very Little c) Some Influence d) Quite a bit e) A Great Deal

25. How much can you do to control disruptive behaviour in the math classroom?
26. How much can you do to motivate students who show low interest in math school work?
27. How much can you do to get students to believe they can do well in math school work?
28. How much can you do to help your students value math learning?
29. To what extent can you craft good questions for your students in math class?
30. How much can you do to get children to follow classroom rules in math class?
31. How much can you do to calm a student who is disruptive or noisy in math class?
32. How well can you establish a classroom management system with each group of students in math classes?
33. How much can you use a variety of assessment strategies in math class?
34. To what extent can you provide an alternative explanation or example when students are confused in math?
35. How much can you assist families in helping their children do well in math?
36. How well can you implement alternative strategies in your math classroom?

Part E: Demographic section

This next section contains seven questions. Provide your answers in the text boxes available.

37. What university did you attend for your bachelor of education program?
   University? ________________________________
38. What is your other Intermediate/Senior teaching subject that you are qualified to teach as of April 2008?
   Other teaching subject? ______________________
39. What is the last year you attended post-secondary education before your B.Ed?
   Month? _____________
   Year? __________________
40. What is your undergraduate ‘major’ (or equivalent)?
   Undergraduate ‘major’ or (equivalent)? __________________
41. What is your undergraduate ‘minor’ (or equivalent, and if applicable)?
   Undergraduate ‘minor’ (or equivalent, and if applicable) __________________
42. What number of full year undergraduate mathematics courses did you complete?
   Number of full year undergraduate courses? ____________
43. What is your Gender?
   Female ___
   Male ___
Part F: Contact Information.

This section is to be completed if you agree to be a possible candidate for a follow-up interview. The interview would last about 30 to 45 minutes. (Note: When you are finished with the survey and go to logout, the survey will close the whole internet window. That closing ends your session.)

44. Please provide your contact information;
   Name __________________________________
   Email address ___________________________
   Phone number ___________________________
   Address ________________________________
Appendix C: LETTER OF INFORMATION

My name is Jamie Pyper and I am a PhD student at the Ontario Institute for Studies in Education, University of Toronto. I am currently conducting research into Preservice Teachers’ levels of confidence and their perceptions and understanding of the factors for this level of confidence, and would like to invite you to participate in this research. As well, I am a University of Western Ontario Bachelor of Education mathematics education instructor. I have asked your OISE instructor to send this email invitation and contact you for this study. By this time all marks have been submitted, and as I am not your instructor, you can participate if you wish with no concerns about an impact on your bachelor of education experience.

The aims of this research are to explore the thinking and feeling of secondary school Preservice mathematics teachers as it pertains to their levels of confidence as they complete the Bachelor of Education degree, and to identify structural and preservice program features that are factors in the creation of this level of confidence.

Information for this research will be collected by means of a 43 item questionnaire, and for those that agree, possibly a one hour interview to provide you with an opportunity to elaborate on the program structures you feel contributed most to your level of confidence as you complete the Bachelor of Education degree.

The questionnaire will be completed online using a web-based survey tool. If you agree to participate in the interview, you will be asked to provide contact information at the end of the survey. If you only complete the survey, any identifying information will be modified with pseudonyms to ensure your anonymity. If you elect to participate in the interview, any identifying information will be modified with pseudonyms once the interview is complete to ensure your anonymity. After the analysis phase has begun, when not used for analysis purposes, all data collected will be kept locked in my office. As well, after the study, all data collected will remain locked in my office, and will be destroyed within 7 years of the completion of the study. All data collected will be used for research purposes only.

Your participation is voluntary. Should you consent to participate in this research, please be aware that you have the right to withdraw at any time without penalty, should you wish to do so, or to decline to answer any specific questions you would prefer not to answer. The research findings will be provided upon request, when they are ready.

Accessing the web-based survey tool will constitute consent on your part to participate in this research. There are no known risks by participating in this study.

If you have any questions about this research, or any comments to make now or at a later date, please contact Jamie Pyper, [phone number], [email address], or Dr. Douglas McDougall, [phone number], [email address]. If you wish to speak with someone aware of but not directly involved with the study, about your rights as a research participant, please contact the University of Toronto Ethics Review Office, 416-946-3273, ethics.review@utoronto.ca.

Jamie Pyper
Appendix D:

Interview Question Framework

Semi-structured Interview questions: Preservice teachers’ sense of efficacy in context.

1. *Read the Orientation Cases*
   a. Which of these most appeals to your sense of yourself as a mathematics teacher?

2. *Discussion:*
   a. *clarify and explain selection*
   b. *about beliefs*

3. *Read the Concern Cases*
   a. Which of these most accurately represents your concerns you have in your mathematics teaching at this point?

4. *Discuss the nature of this concern;*
   a. *Why do you feel this?*
   b. *Is this the same as at the beginning of the year?*
   c. 

5. What particular element of your preservice program do you attribute your level of confidence as a secondary school mathematics teacher?

   (If the response to the first question is different than the response to the short answer question, then ask question 2)

6. Do you think this other element is more or less important than the one you just described to me? Please explain why?

   (For all respondents)

7. If you had a chance to re-do any particular part of the preservice program, what would it be? Why?

8. (Specific efficacy questionnaire responses would be given to the respondent, and the respondent would be asked to clarify and/or explain their selection).
Appendix E:

Interview Teacher Orientation cases

Page A

Which of these most appeals to your sense of yourself as a mathematics teacher?

1. The teacher’s academic preparation is vital. The knowledge of the structure, concepts, skills, and processes of mathematics is the fundamental basis for successful teaching in a secondary school math classroom. I know the mathematics and my professional treatment of mathematics determines the quality of my teaching.

2. There are tried and true skills, processes, and steps to follow in order to be an effective classroom teacher. There are basic principles and procedures to be used by teachers to achieve specified goals. In order to be a successful teacher, it is necessary to develop proficiency in the skills of teaching.

3. The greatest source of knowledge about teaching mathematics is the experience of teaching mathematics. To become a successful classroom mathematics teacher, one must be immersed in the classroom environment as the teacher. Daily practical dilemmas and situations in the classroom provide the opportunities to develop and hone the teacher’s ability to learn to teach and develop the practical wisdom of expert teachers.

4. To be a good teacher one must know students as individuals. In order to select appropriate materials and tasks for student learning, the teacher must know the student’s individual interests, needs, and abilities. In addition teachers must know themselves and work towards personal fulfillment and meaning as a classroom teacher. These dual goals intersect and the attention to the personal development of the students and the teacher creates the opportunities for quality learning and successful teaching.

5. The critique of schooling in combination with a progressive social vision provides the optimal classroom environment for quality teaching and learning. A teacher’s social justice focus empowers students to connect the relevance of mathematics to their personal identity and find influential experiences in the larger local and/or global community.
Teacher Concern cases

Page B

Which of these most accurately represents your concerns you have in your mathematics teaching at this point?

1. Assessment is the first thing I think of and I worry about finding and then using the right assessment tool (for example; rubrics, Achievement Categories, checklists, performance criteria, marking schemes). I look for the right task and materials to adequately measure student achievement. Fairness and equitable assessment is important because I work to continually recognize the social and emotional needs of my students as well as their intellectual development.

2. I feel stress about class control – that is, classroom management and discipline and dealing with student behaviours in my class. I think about having to master all the content of courses I am to teach, and not knowing the answers to the mathematics questions my students will ask. I am concerned about being evaluated by supervisors, like my Associate Teacher during practicum, and soon my Principal when I start teaching in my own classroom. I feel in survival mode and sometimes I wonder how I will ever learn to teach at all.

3. I worry about finding the appropriate teaching method. It is vitally important to find the right materials too, like the right activity, task, computer applet, and using the smartboard or graphing calculators. For each topic I worry about how I am going to teach it. I know the math I am to teach, I am just unsure how I should teach it.