

Pre-service Mathematics Teacher Efficacy: Its Nature and Relationship to Teacher Concerns and Orientation

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In a mixed method study, teacher efficacy and contributing theoretical constructs of teacher concerns and teacher orientation with Intermediate/Senior mathematics pre-service teachers from two Ontario Faculties of Education are examined. Data sources include a web-based questionnaire containing two teacher efficacy scales and short answer questions, and interviews with the pre-service teachers. The study identifies a relationship between teacher efficacy (TE) and teacher concerns and orientation, and how high TE relates to combinations of teacher concerns and orientations and low TE relates to particular and individual teacher concerns and orientations. Future research and considerations for pre-service mathematics teacher programs are offered.

Cette étude à méthodologie mixte porte sur l'efficacité des enseignants et les modèles théoriques qui contribuent aux préoccupations et aux orientations des enseignants. La recherche a impliqué des stagiaires en mathématiques aux niveaux intermédiaire et sénior dans deux facultés d'éducation en Ontario. Les données proviennent d'un questionnaire en ligne comportant deux échelles qui évaluent l'efficacité des enseignants ainsi que des questions à réponses courtes, et des entrevues auprès des stagiaires. L'étude identifie un rapport entre l'efficacité des enseignants et leurs préoccupations et orientations, et démontre dans quelle mesure le niveau d'efficacité est lié à des préoccupations et des orientations particulières. On propose des éléments à prendre en compte et des facteurs de recherche à prendre en considération pour les programmes d'enseignement des mathématiques.

Background

The nature of the pre-service teacher education experience is complex because of the various beliefs, attitudes, and behaviours of the pre-service teacher when starting a teacher preparation program. A pre-service teacher begins his or her teacher preparation program with knowledge of teaching practice from a learner's perspective, and ends with knowledge of teaching practice from a teacher's perspective. One's beliefs about teaching, and one's beliefs about learning likely change with this knowledge. Teacher efficacy is a connecting belief structure between one's teaching, and students' learning. Teacher efficacy has been associated with teacher characteristics such as enthusiasm (Allinder, 1994; Guskey, 1984), commitment (Coladarci, 1992; Evans & Tribble, 1986), and classroom practice (Ross, 1994).

There are many calls for more 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). The impact of the initial teacher preparation experiences, the pre-service teacher program, on teachers’ professional practice over their careers is an issue that should not be ignored (Tschannen-Moran & Woolfolk Hoy, 2001). Conceptual clarity of teacher efficacy and attention to the sources of teacher efficacy in important contexts such as pre-service programs that make a difference in the formation of teacher efficacy must continue to be a research agenda (Klassen, Tze, Shea, & Gordon, 2010; Woolfolk Hoy & Spero, 2005).

Pre-service teacher education in Ontario is most often modeled in two particular ways; as a one-year program entered after completion of an undergraduate degree, known as a consecutive program; or, a multi-year program entered sometime within the first two years of an undergraduate degree, known as a concurrent program. Both models consist of faculty-based course work resulting in a Bachelor of Education degree, and practica, or in-school practice teaching experiences. Teacher certification with the Ontario College of Teachers is recommended when both are successfully completed.

Pre-service teachers wishing to teach at the secondary school level take Bachelor of Education courses to become certified to teach in two subject areas, such as mathematics and geography. The focus of the research, which resulted in this paper, was pre-service teachers who had completed the program requirements to become secondary school mathematics teachers. The purpose of the study was to explore the nature of secondary school mathematics pre-service teacher efficacy, and the pre-service teachers’ perceptions of the sources of their teacher efficacy at the end of a one-year pre-service teacher education program. Two research questions focused the lens on teacher efficacy for this study:

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

This paper will begin by setting the parameters of the theoretical constructs used to create a framework for exploration of sources of secondary school mathematics pre-service teacher efficacy, and then it will describe the methodological foundation of the study and briefly describe the particular methods employed. Analysis of the data will include quantitative and qualitative processes to show the relationships amongst the theoretical constructs of teacher efficacy, teacher concern, and teacher orientation. The results of this study will follow, indicating possible future research as well as conceptual and program considerations for the improvement of pre-service mathematics education.

Literature Review

In this paper, I will explore the nature of teacher efficacy from a pre-service teacher perspective upon completion of a mathematics education course within the one-year teacher education program in the Ontario Faculty of Education bachelor of education. To offer a framework that attends to some of the complexity of teaching and learning and the complexity of being a secondary school classroom teacher, four particular theoretical constructs are used; teacher efficacy, locus of control, teacher concern, and teacher orientation.

Teacher Efficacy and Locus of Control

“Teacher 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). However, teacher efficacy was often envisioned through some combination of two prominent psychological theories; social learning theory (Rotter, 1966), and social cognitive theory (Bandura, 1977).

Social learning theory (Rotter, 1966) and locus of control suggested that teachers hold beliefs about their ability to affect and/or influence student outcomes, and that their ability is attributed 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 outside of one’s control. Social cognitive theory (Bandura, 1977, 1982, 1986) provided opportunities to re-consider teacher efficacy less as a continuum between an internal and external locus of control, and rather as two separate factors that might correlate. These two separate factors became known as general teacher efficacy (GTE) and personal teacher efficacy (PTE). Bandura conceptualized one’s judgment of his or her ability to perform a particular action as self-efficacy expectation (hence PTE), and one’s judgment and beliefs about the likely consequences of the particular action as outcome expectation (hence GTE). However, this conceptualization of teacher efficacy drew upon both Rotter’s and Bandura’s ideas, and led to difficulties interpreting teacher efficacy.

As Bandura clarified his conception of teacher efficacy, cognitive social learning theory became *social cognitive theory*, and perceived self-efficacy was defined as “beliefs in one’s capabilities to organize and execute the course of action required to produce given arguments” (1997, p. 3). Summarizing Bandura, Tschannen-Moran, Woolfolk Hoy, and Hoy (1998) stated, “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 action” (p. 211). Woolfolk Hoy and Spero’s (2005) descriptions of these past attempts to understand teacher efficacy belie the confusion concerning Rotter’s and Bandura’s conceptions of teacher efficacy, “. . . researchers turned to Bandura’s *cognitive social learning* theory of self-efficacy to interpret the two factors” (p. 347, italics added). Thus, social learning theory may be thought of as a question of causality and social cognitive theory may be thought of as a question of value.

Guskey and Passaro (1994) re-interpreted the commonly used Gibson and Dembo (1984) Teacher Efficacy Scale (TES) to clarify the two factors measured in the scale as an internal influence and an external influence in teaching situations and to align the TES items more closely with the original psychological construct of locus of control. Bandura (1997) created a Teachers’ Self-efficacy Scale which contained 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. Following Bandura’s (1997) work on his scale, Tschannen-Moran and Woolfolk Hoy (2001) then developed the Ohio State teacher efficacy scale (OSTES), now called the Teachers’ Sense of Efficacy Scale (TSES).

The TSES (Tschannen-Moran & Woolfolk Hoy, 2001) contained three subscales: efficacy for student engagement, efficacy for instructional strategies, and efficacy for classroom management; reliably measured in a short form of twelve items. These subscales represented a very classroom-focused contextual perspective for teacher efficacy. The results of this scale

presented the classroom-contextualized teachers' sense of self-efficacy that may more concisely be identified as 'teacher efficacy'. Hence, teacher efficacy is understood as following more closely with Bandura's social cognitive theory conception rooted in the classroom context, as seen in the TSES. The Guskey and Passaro (1994) scale reliably measured teachers' sense of self-efficacy from a locus of control perspective that may more concisely be called, internal efficacy and external efficacy. These two scales offered two lenses with which to examine and discuss teachers' sense of self-efficacy (teacher efficacy and locus of control) in their classroom practice.

Teacher Concern

Fuller (1969) identified perceived problems or worries of teachers as teacher concerns. Fuller and Bown (1975) suggested teachers progress through stages of concerns, self-concerns to task-concerns to impact-concerns. Self-concerns involved a focus on survival in the classroom with students, such as classroom discipline and knowing the subject matter, and in the school setting with supervisors, such as professional evaluations. Task-concerns involved a focus on the presentation of the subject matter, lesson timing, and instructional duties. Impact-concerns involved an awareness of the learner, of the learner's needs, whether there had been learning and the nature of the assessment and evaluation of learning.

Teacher concerns may be conceptualized as a linear progression (Borich & Tombai, 1997; Fuller & Bown, 1975; Staton, 1992). It is possible that varying degrees of concerns will be evident in teachers' expressions of beliefs and classroom practice (Muis, 2004), as it may be for pre-service teachers (Beeth & Adadan, 2006).

Teacher Orientation

Teacher orientation was derived from the construct of institutional orientation. An institutional orientation emerges from institutional conceptions of pre-service education held by a faculty of education that define and explain the institutional perspective behind program and instructional decisions made for the teacher preparation program. The potential institutional orientation or mix of orientations may influence the subsequent classroom practice orientation of pre-service teachers (Cotti & Schiro, 2004; Feiman-Nemser, 1990). Conversely, pre-service teachers may enter a teacher preparation program with their own orientations, and Anderson (2001) noted that knowing pre-service teacher orientations can help educators in pre-service program design. Feiman-Nemser (1990) proposed five particular institutional orientations that were re-conceptualized as teacher orientations: Academic, Practical, Technological, Personal, and Critical-Social.

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" (Feiman-Nemser, 1990, p. 221). For example, 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 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 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. To reduce the effect of respondent misinterpretation and because the word technological is predominantly interpreted to mean computer or other electronic facility, Technological orientation was re-named as *Technical* for the purposes of this study. 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 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 (Feiman-Nemser, 1990).

Methodology and Method

Methodologically, a pragmatic paradigm (Morgan, 2007) underlies the perspective that quantitative and qualitative data and analysis methods were necessary to identify and describe, as completely as possible, the sources of teacher efficacy for pre-service teachers at the end of their teacher preparation program. In this mixed method study, the data collection phase of the study used a two-phase sequential design (Creswell & Plano Clark, 2007). The data analysis and inference phase used a form of cross-track analysis of moving back and forth between qualitative and quantitative data (Li, Marquart, & Zercher, 2000), which included an integrated analytic strategy (Caracelli & Greene, 1993), and which featured the quantizing of qualitative data (Sandelowski, Voils, & Knafl, 2009) to aid in the identification and analysis of the a priori themes of teacher concerns and teacher orientations.

A url link to a web-based questionnaire consisting of 33 Likert type scaled items, two short answer questions, and demographic items was sent to all secondary school mathematics pre-service teachers in two faculties of education. The 33 items consisted of the 21 items from the Teacher Efficacy Scale (TES) (Guskey & Passaro, 1994) and the 12 items from the Teachers' Sense of Efficacy Scale (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001). These were used to assess internal and external locus of control, and teacher efficacy respectively. The two short answer questions of: 1. "Describe concerns you have with respect to being a secondary school mathematics teacher," and 2. "Describe those things from the pre-service program that you feel contributed to your level of confidence," were used to gain insights into teacher concern and teacher orientation. Quantitative analysis on the TSES items was performed to identify extreme high and low cases of teacher efficacy for selection of respondents for interviews.

For those respondents that provided contact information, interview participation was confirmed by email, and then a second email was sent to them prior to the interview. This second email contained a two page document for them to read in preparation for the interview with a page containing a descriptive paragraph of each teacher concern, self-, task-, and impact-concern; and a page containing a descriptive paragraph of each teacher orientation. The

descriptive paragraphs were untitled and not in any particular order on the page. Interviews lasted from 45 to 60 minutes.

Sampling and Data Collection

Two faculties of education were purposefully selected because of their relatively similar pre-service mathematics population size, and it was anticipated the researcher's familiarity with the programs and instructors would increase the potential for a high response rate for the study. That the two institutions were similar in program structure, expectations, and intent was discerned from conversations with instructors, and examination of program documentation and course outlines. The author was an instructor in one of the programs, however, the study was completed after the program ended and all marks had been entered for the program. Thus, the instructor/student relationship had ended. From approximately 180 pre-service teachers, 36 responded to the study, 14 male and 22 female. All 11 respondents who provided contact information were interviewed. Four of these respondents constituted case studies for further analysis. These four respondents were identified as case studies because they appeared as extreme cases having achieved either two of the highest or two of the lowest TSES teacher efficacy scores.

Analysis

Item analyses were conducted on the TES scale items that related to the Internal and External efficacies. The coefficient alpha for the 10 Internal efficacy items was .78 and the coefficient alpha for the 11 External efficacy items was .83. 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 Internal efficacy and External efficacy theoretical score maximums were 6, with greater Internal efficacy indicated by higher Internal efficacy mean values and greater External efficacy indicated by lower External efficacy mean values. The External efficacy values were reversed so higher scores would indicate greater External efficacy. 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 coefficient of determination was 31% indicating greater efficacy values for one variable was a moderate indicator of a greater efficacy value for the other variable. This seemed reasonable, since it is possible to feel that one's teacher efficacy has both internal and external influences. The possibility of experiencing both internal and external influences led to the calculation of the difference between the internal and external efficacies in an effort to examine further the strength of internal versus external influences on teacher efficacy (TSES) in relation to teacher concern and teacher orientation.

Item analyses were conducted on the TSES scale items and the coefficient alpha was .92. Coefficient alphas for the three subscales were also calculated with a resulting .93 for Classroom management efficacy, .79 for Student Engagement efficacy, and .83 for Instructional Strategies efficacy. There were 4 items in each subscale and each subscale had a maximum score value of 8 with greater efficacy indicated by higher values. A Pearson correlation was performed between the means of TSES and TSES subscales, and the Internal efficacy and External efficacy (see Table 1).

The teacher concern codes were translated into numerical values, self = 1, self/task = 2, task = 3, impact/self = 4, task/impact = 5, impact = 6. Self-concern was allocated a value of 1, and

Table 1

Pearson correlations (N = 36)

	Internal efficacy	External efficacy	TSES	TSES– Classroom management	TSES– Student engagement	TSES– Instructional strategies
Internal efficacy		-.56*	.72*	.59*	.72*	.57*
External efficacy			-.56*	-.42**	-.49**	-.53*

* p < .001 (2-tailed)

** p < .01 (2-tailed)

impact-concern a value of 6. Other values were allocated according to an increasing sense of concern amongst the combinations of teacher concerns and the singular task-concern. 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.

The difference calculation of Internal efficacy minus External efficacy was labeled I/E Difference (see Appendix for respondents TSES scores and I/E Difference calculations.) A Spearman correlation was performed between the ordinal 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-concern, and the relationship to the holistic sense of locus of control that the I/E Difference value provides, that is, positive I/E Difference values indicating greater Internal efficacy in comparison with External efficacy. 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 versus external efficacy measure as a correlational variable with teacher efficacy; the greater the internal efficacy, the more chance teachers experience impact-concern.

The written responses from the survey question about concerns, question 1, were coded using five codes taken from Feiman-Nemser’s (1990) teacher orientations. The following graphic provides a visual sense of the nature of the orientations expressed when pre-service mathematics teachers talked about their concerns as teachers (see Figure 1). Analysis indicated an expression of either one orientation or a combination of two orientations. The numbers at

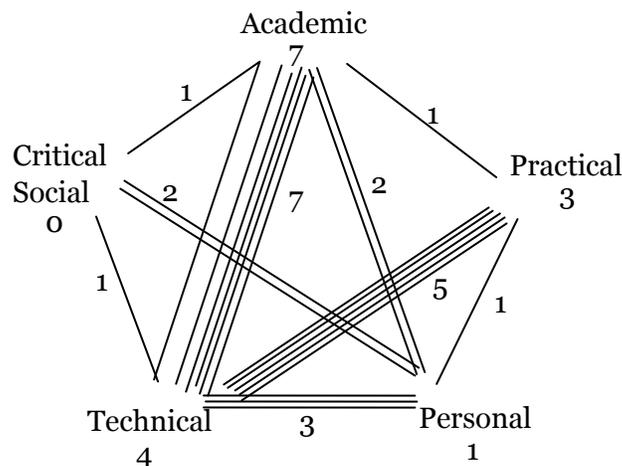


Figure 1. Teacher orientation graphic about concerns

each vertex of the pentagon indicate the number of respondents for whom one particular orientation was coded; each line indicates a respondent for whom two orientations were coded. For example, four respondents were coded with a Technical orientation, and five respondents were coded with a combination of the Practical and Technical orientation.

The written responses from the survey question about contributions, question 2, were coded using five codes taken from Feiman-Nemser's (1990) teacher orientations. The following graphic provides a visual sense of the nature of the orientations expressed when pre-service mathematics teachers talked about what they perceived as contributions to their development as teachers (see Figure 2). Analysis indicated an expression of either one orientation or a combination of two orientations.

The eleven interviews were transcribed and analysed using the same codes of teacher concern and teacher orientation as were used for the written responses to the two survey questions, about concerns and contributions. A more in-depth discussion of the four case studies is planned for a future article, however for the purposes of this article, it can be stated that the four case studies aligned with the overall results of analysis for the eleven respondents who were interviewed.

A relationship seemed to appear with teacher efficacy. Predominantly single teacher orientation codes appeared in written responses for pre-service teachers with low teacher efficacy. Prevalent orientations for pre-service teachers with low teacher efficacy were Technical, Practical, and Academic. Pre-service teachers with lower teacher efficacy, such as PTF32, PTM33, PTF35,¹ expressed the same orientations in conversation as they did in writing about teacher concerns, contributions to teacher efficacy, and in their selection of orientation paragraphs. This possibly indicated a narrower and less sophisticated sense of self as a teacher. In addition, respondents who identified more self- and task-concerns more often expressed Technical and Academic orientations, providing a further connection between teacher efficacy and teacher concerns and orientations.

In contrast, the pre-service teachers with a higher teacher efficacy, such as PTF1, PTF4, PTF6, PTM7, expressed more orientations in conversation than what they did in writing about teacher concerns, contributions to teacher efficacy, and in their selections of orientation

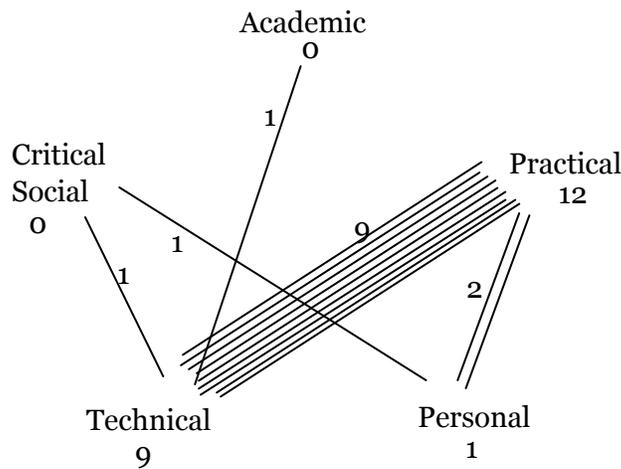


Figure 2. Teacher orientation graphic about contributions.

paragraphs. The combinations of orientations in conversation often complemented and added to the combinations of orientations from their written responses. This possibly indicated a more sophisticated and open-minded perspective of teaching and learning and the influence of context. They responded to the context when they discussed their teaching practice, indicating a possible inclusive sense of teaching and learning (Allinder, 1994; Berman et al., 1977), which their greater teacher efficacy allowed. Teachers with greater teacher efficacy set higher goals for themselves (Tschannen-Moran & Woolfolk Hoy, 2001); therefore, these pre-service teachers with greater teacher efficacy may have set higher goals for themselves and, in turn, incorporated greater numbers of orientations in the efforts to achieve their goals.

Higher teacher efficacy appeared to be related to a combination of two or three dominant orientations, with other orientations beginning to emerge. In addition, some orientations appeared more in pre-service teachers with high teacher efficacy, such as the Critical/Social orientation, and the Personal orientation. In addition, respondents who identified more task- and impact-concerns more often expressed Critical Social and Personal orientations in combination with another orientation.

The following are two examples of participant responses that exemplified the above analysis. The first came from PTF1, a pre-service teacher with the highest teacher efficacy score of the study. In response to the question on the survey about her concerns, she said:

The only concern that 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.

This was her response to the survey question about contributions to her teacher efficacy:

The practicum placements had the greatest impact on my confidence as a teacher. But from the teaching mathematics class the topic that has increased my confidence was assessment and evaluation of students because that was not always consistent or in line with the curriculum expectations.

This pre-service teacher with high teacher efficacy included self-, task-, and impact-concerns from a position of confidence and in an integrated manner, and appeared to express a combination of Academic and Technical orientations. When discussing the contributions to her teacher efficacy she recognized her positioning in the Practical orientation, however continued on to identify the task- and impact-concerns of assessment and evaluation which indicated an underlying thinking from a Personal orientation – a student’s learning of the curriculum (a possible Academic orientation) from assessment strategies used by a teacher (a possible Technical orientation).

In her interview PTF1 elaborated on her thoughts about assessment by saying:

I guess my only worries are that I am going to get stuck in a rut and do the same thing over and over again. Then you’re not really giving students a chance to excel in a bunch of different ways. So I guess that’s my fear because I think it’s easy to get into one of those ruts and you’re like, I don’t know what to do. I’ll just do it this way. I think that’s my only concern. I want to find a way of, and I am not really sure how it’s going to work yet, but of having assessment [in which] you’re assessing the same thing but in different ways and you’re giving students (especially in a workplace level math) an option. Even if it’s the exact same project, having it with different topics. At least you’re appealing to different students. . . . I am afraid of getting into that . . . [rut] and feel like I am doing something great for the

students but really I am just making myself feel good.

Her combinations of orientation—Personal, Academic, Technical, and Practical—were woven together with, what was for her an obvious and unstated expectation, of impact-concerns as she strived to give students “a chance”, and “an option”, and “a bunch of different ways” to show what they know and have learned. In addition, her last sentence illustrated an insight that there was a difference between anticipated classroom outcomes and actual classroom practice (i.e., Fung & Chow, 2002). Her impact-concerns were first and foremost in her thinking about teaching, however, within these impact-concerns were elements of task-concerns and self-concerns expressed as options, different ways, and the possibility of creating an easy classroom practice for her. Also, note the strong Internal locus of control to her teacher efficacy that the assimilation of pedagogical knowledge into her personal teaching style would achieve success in her teaching.

The second example came from PTM33, a pre-service teacher with one of the lowest teacher efficacy scores in the study. In response to the question about concerns, he said:

Being up-to-speed with the content of the curriculum, especially at the higher grade levels e.g. calculus. Not being able to reach some students who are experiencing difficulties in math. Not having too much of an arsenal of techniques to use in teaching math.

This was his response to the survey question about the contributions to his teacher efficacy:

Use of technology such as TI calculators and Geometer's Sketchpad in the pre-service was useful because high-school students appreciate these enhancements to the curriculum. Some specific questions and techniques that we covered in class. Mind you, there was not very much of this :(

This pre-service teacher with low teacher efficacy expressed the self-concerns of knowledge of subject matter and the collection of teaching techniques. It was the desire to have an “arsenal” of techniques that made this a self-concern (i.e., survival) rather than a task-concern (i.e., strategies to teach particular topics in particular ways). The focus on mathematics content and teaching techniques positioned him in the Academic and Technical orientations. When discussing the contributions to his teacher efficacy, PTM33 expressed task-concerns from the Technical orientation with his focus on technological enhancements to the curriculum, and specific questions and techniques – the implication being that these specific questions and techniques would apply to particular student questions and situations. A strong self-concern became evident in his last sentence, a disappointment (the unhappy face :(symbol) at the apparent lack of such details.

In his interview, PTM33 elaborated on his approach to teaching:

Yes, I did a fair bit of reading on getting myself organized, being super organized on the first day, because I think that sets the tone for the whole course. Normally what I do is I give them, I do a brief review and do some introductory activities. Actually, I tried that in my first practicum, with the applied class last session. I tried doing icebreakers and stuff like that. And they went okay and I am experimenting a different way with this session [in a summer school class] so I went in completely business-like on the Friday. I'm 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'm going to slack off a little bit. Especially because it's an academic class and a lot of them are trying to go through to university, and I want to push them. And

from talking to a VP in my first session, [he] told me “just push them hard initially and then you can slack off a little bit towards the second week if you want”. But, just keep them on their toes kind of thing and just be business-like. Give it to them, try to motivate them that way.

Self- and task-concerns dominated his thinking of classroom practice. Potential impact-concern behaviours did not appear to be a focus of his reflection-on-action (Schon, 1983) and potential student response to these impact-concern attempts were left unanswered. For example, motivating students has inexplicably moved from ice-breaker classroom activities to being content focused and disciplinarily “tough” through the rigour of an Academic and Technical orientation. Also note the strong External locus of control to his teacher efficacy; for example, various technologies, supervisors (e.g., the Vice Principal), and the curriculum would achieve success in his teaching.

Issues of Validity and Reliability

Under the mixed methods lexicon of legitimation (Onwuegbuzie & Johnson, 2006), quantitative issues of validity, and qualitative issues of trustworthiness, credibility, plausibility, and/or dependability were reduced, and with the readers permission, will be presented in another article that will describe and explore the mixed method methodological design and implementation of this study.

Results

The TSES and TES scales are more often used with in-service teachers. Results from this study showed the TSES scale appeared to be a valid contextual measure of teacher efficacy for pre-service mathematics teachers. The Internal efficacy and External efficacy values of the TES also appeared to be a valid measure of pre-service mathematics teachers’ sense of locus of control. Results of this study provided 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 provided a more comprehensive and authentic interpretation of pre-service mathematics teacher efficacy. TSES scores appeared higher with higher Internal efficacy scores and TSES scores appeared lower with higher External efficacy scores.

Teacher concern appeared to be a nested construct and, because this study was performed as a single ‘snapshot in time’, appeared related more to teacher efficacy than to time. Figure 3 offers a graphic of the nested sense of teacher concern and its relationship to teacher efficacy. For example, a pre-service mathematics teacher with high teacher efficacy would more often express a combination of all three teacher concerns predominantly focusing on impact-concerns. A pre-service teacher with low teacher efficacy would more often express one dominant teacher concern, that of self-concern.

Quantitatively, higher Internal efficacy, as a relationship to External efficacy with the I/E Difference calculation, was significantly related to more expressions that included impact-concern. Qualitatively, high teacher efficacy related to expressions of impact-concern in combination with task-concerns and self-concerns. Low teacher efficacy related to expressions that consisted mostly of self-concerns. Across respondents, the constructs of teacher concern and teacher efficacy appeared to change together; greater teacher efficacy values for respondents

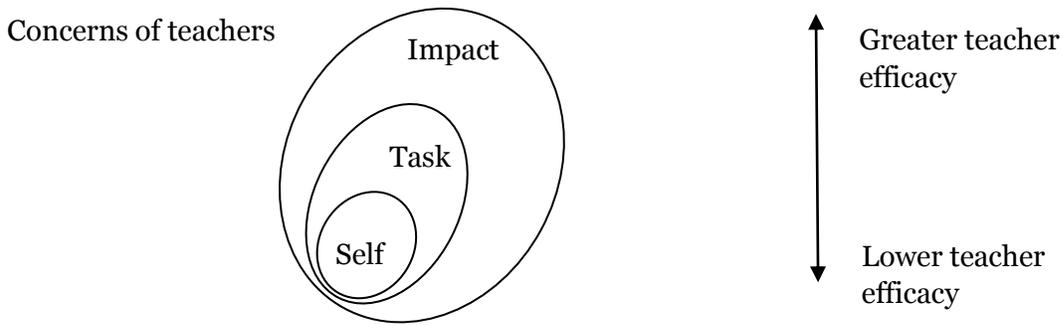


Figure 3. Nested concerns of teachers. The nestedness of teacher concerns means that an expression of impact-concern does not indicate an absence of the other two teacher concerns. All three teacher concerns exist but with varying amounts of expression depending upon the level of teacher efficacy.

aligned with particular teacher concerns. For example, as teacher efficacy values increased from one respondent to another, teacher concerns changed from primarily self-concerns to a blend of, task-, impact-, and self-concerns, and vice versa, as teacher concern changed so did teacher efficacy.

Teacher orientation appeared to be a complex construct that had a connection with teacher efficacy. Low teacher efficacy aligned with expressions of single orientations, more often the Technical and Academic orientations. High teacher efficacy aligned with combinations of orientations, more often including the Critical Social and/or Personal, in combination with the other orientations. Figure 4 offers a graphic representation of the relationship between teacher efficacy and teacher orientation. Pre-service mathematics teachers with low teacher efficacy would more often express single orientations, indicated by the vertices of the pentagon in the graphic. Pre-service mathematics teachers with high teacher efficacy would more often express combinations of teacher orientations, indicated by the lines between vertices and the shaded region in the centre of the pentagon in the graphic.

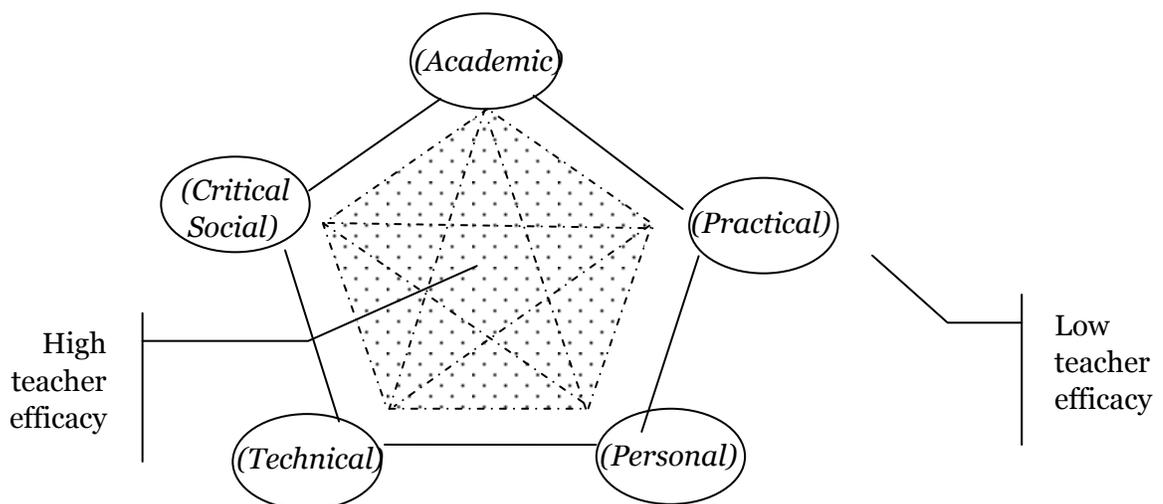


Figure 4. Teacher orientation and teacher efficacy

Conclusions and Future Research

There are two important outcomes of this study: its ability to connect the three constructs of teacher efficacy, teacher concern, and teacher orientation in pre-service mathematics teacher preparation; and the potential for transferability of this theoretical framework and enhanced understanding of mathematics pre-service teacher efficacy (see Hoy & Woolfolk, 1990) to educator efforts in the design and implementation of mathematics teacher preparation.

Results from this study suggest that teacher concern and teacher orientation align with teacher efficacy, and attention to the nature of teacher concern and teacher orientation may increase pre-service mathematics teachers' efficacy. Further research should be completed to more strongly articulate the relationships amongst teacher efficacy and teacher concern and teacher orientation and how teacher concern and teacher orientation may contribute to the sources of teacher efficacy (Klassen et al., 2010). For example, attention in mathematics education coursework for further self-reflection and professional reflection, both "in action", and "on action" (Schon, 1983) opportunities for mathematics pre-service teachers with a focus on teacher efficacy, teacher concern, and teacher orientation, may improve and enhance mathematics pre-service teachers' learning of the teaching and learning of secondary school mathematics.

Berliner (1994) suggested that pre-service teachers might not travel very far along their learning curve within the time frame of a pre-service program relative to their career as an In-service teacher. Additionally in this study, respondents stated their teacher efficacy increased over the duration of the pre-service program, and Erikson (1993) suggested there exists a continuum on which beliefs and classroom practice change, which points to the potential value of an inquiry into the changes in teacher efficacy, teacher concern, and teacher orientation over the duration of the pre-service program. Continuous assessments of pre-service teacher orientation, teacher concerns, and teacher efficacy might provide feedback for curricular and instructional decisions by pre-service course instructors. For example, pre-service mathematics education course activities may be selected to appeal to the pre-service teachers' initial need for survival, content knowledge, and classroom management knowledge, given a common initial teacher concern of self-concern (Fuller & Bown, 1975; Veenman, 1984), and common initial teacher orientations of Academic and Technical. An initial focus on the Technical orientation may help pre-service course instructors give pre-service teachers a set of steps or procedures for teaching activities, such as graphing curves on a graphing calculator, scripting lesson transitions, or using the overhead projector. This study also showed that few mathematics pre-service teachers, and then only those with high teacher efficacy, expressed a Critical Social orientation. What might this mean for social justice issues in terms of the development and awareness of such issues within mathematics pre-service teacher programs? Could this potentially result in a more natural and authentic application in teacher practice?

Lastly, some research has shown that teachers' perceptions of themselves, such as their concerns and orientations, do not match classroom practice (Bramald, Hardman, & Leat, 1995; Bullough & Stokes, 1994; Fung & Chow, 2002), and other research has shown that teachers' perceptions of themselves do match classroom practice (Doolittle, Dodds, & Placek, 1993; Johnson, 1994; McDiarmid, 1990). This study indicated that teachers with high teacher efficacy expressed orientations that matched their stories of classroom practice, and that teachers with low teacher efficacy expressed a particular view of themselves that may not match the stories of their classroom practice. The nature of teacher efficacy and teachers' perceptions of their

professional practice compared to observed classroom practice might be a fruitful inquiry into the interplay of teacher preparation course work and teacher preparation in practicum.²

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Notes

¹ The letter-number combinations were pseudonyms representing the pre-service teacher participants. The pseudonyms were designed as PT = pre-service teacher, M or F = male or female, and the number represented a relative teacher efficacy value: 1, 2, or 3 represented higher teacher efficacy values than 33, 34, or 35.

² Author's Note: This paper is drawn from a larger PhD study, "Pre-service mathematics teacher efficacy: Its nature and the contributing factors of the pre-service program." More detailed analyses and presentation of data can be found in the dissertation, and will be available in other papers to be drawn from the larger study.

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Appendix: TSES, Internal Efficacy and External Efficacy difference

Respondent	TSES(maximum is 8.00)	I/E Difference (Internal value minus External value)
PTF1	8.00	3.77
PTF2	8.00	2.85
PTM3	8.00	2.31
PTF4	7.83	3.22
PTF5	7.17	-0.14
PTF6	6.92	3.38
PTM7	6.83	2.44
PTM8	6.83	2.26
PTM9	6.83	1.97
PTF10	6.67	2.78
PTF11	6.67	1.90
PTF12	6.67	2.16
PTF13	6.58	0.77
PTF14	6.50	2.10
PTM15	6.33	0.75
PTF16	6.25	1.50
PTM17	6.25	0.28
PTM18	6.17	0.77
PTF19	6.00	1.61
PTF20	6.00	1.74
PTM21	6.00	0.75
PTM22	6.00	1.25
PTF23	5.92	2.07
PTM24	5.92	0.05
PTF25	5.67	1.66
PTF26	5.58	0.01
PTF27	5.58	2.24
PTM28	5.58	1.02
PTF29	5.42	1.48
PTM30	5.33	0.85
PTF31	5.25	1.57
PTF32	4.75	1.40
PTM33	4.67	-1.81
PTM34	4.58	-1.15
PTF35	4.08	0.30
PTF36	4.00	-1.21