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Exploring Science Teachers' Self-Efficacy Perceptions to Teach in Ontario's Diverse Classrooms: A Mixed-Methods Investigation

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ABSTRACT

In the past few years, Canadian schools have experienced increasing diversity with a large number of English Language Learners (ELLs) becoming part of the mainstream classroom. Research has shown that ELLs will achieve academic success when their cultural and linguistic backgrounds are incorporated within the curriculum and pedagogy (Gay, 2000). However, our curriculum is largely Eurocentric and caters predominantly to students from mainstream backgrounds. As a result, it has become critical to investigate teachers' perceptions in terms of providing culturally- and linguistically-inclusive pedagogy in various classroom contexts. Hence, the purpose of this study was to examine the self-efficacy perceptions of Ontario's science teachers to teach in diverse classrooms. Theories of self-efficacy (Bandura, 1997) and culturally responsive pedagogy (Gay, 2000) were drawn on to frame this research. This investigation employed a mixed methods approach including surveys ($N = 76$) and interviews ($n = 10$) of science teachers teaching within the Kindergarten to Grade 12 division in Ontario. Quantitative and qualitative data were analyzed to explore teachers' self-efficacy perceptions overall as well as on general pedagogical practices as opposed to culturally responsive pedagogical practices. Additionally, data were analyzed to explore the correlation between the teachers' demographic characteristics including the grade-level they taught, their linguistic background and teaching experience and their self-efficacy perceptions. Findings revealed that teachers' self-efficacy perceptions in terms of providing culturally responsive pedagogy in particular are significantly lower in comparison to providing general pedagogy. Also, demographic factors such as the grade-level taught by the teachers (i.e., elementary or secondary), their linguistic background

(i.e., monolingual or multilingual) as well as teaching experience (i.e., novice or experienced) did not have any correlation with their self-efficacy perceptions. In addition, interview data revealed that teachers face a number of challenges amidst diverse classrooms including time restrictions, lack of appropriate resources as well as cultural and linguistic barriers between themselves and the ELLs. Considering that self-efficacy perceptions influence one's thoughts, feelings and actions, this research has shed light on specific issues related to inclusive pedagogical practices that need to be targeted. This study has implications for teachers, school boards as well as teacher education programs.

Keywords: Self-efficacy, Culturally responsive pedagogy, English Language Learners (ELLs), Science education, Science teachers

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English Language Learners	ELLs
English as a Second Language	ESL
First Language	L1
Second Language	L2
Second Language Acquisition	SLA

CHAPTER 1 INTRODUCTION

Context

Individuals from all over the world have been choosing Canada as home for many decades now. At over 20%, Canada had the highest proportion of foreign-born population among the G8 countries in 2011 (Statistics Canada, 2013). With Ontario as the most culturally and linguistically diverse province in the country, Toronto has become one of the most ethnically diverse cities across the globe (Toronto District School Board, 2013). As a result, classrooms across Canada have become a microcosm of the diverse national context. Students from culturally and linguistically diverse communities are becoming a considerable demographic of mainstream classrooms (Webster & Valeo, 2011; Lucas, Villegas & Martin, 2015). The Ontario Ministry of Education (2007) refers to students from diverse backgrounds as English Language Learners (ELLs)[1] and defines them as "students in provincially funded English language schools whose first language is a language other than English, or is a variety of English that is significantly different from the variety used for instruction in Ontario's schools" (p. 7). ELLs may be born in Canada or may be children of recently arrived immigrants from other countries belonging to diverse backgrounds, previous academic experiences, strengths as well as needs (Ontario Ministry of Education, 2007).

Despite an increasing number of ELLs in the classrooms, the curriculum is largely geared toward the mainstream students which disadvantages students from

[1] From this point forward, I use the abbreviation "ELLs" to refer to students in Ontario classrooms that have come from diverse cultural and linguistic backgrounds and have not yet attained full proficiency in English.

nonmainstream backgrounds including ELLs (e.g., Krugly-Smolska, 1996; Webster & Valeo, 2011; Kang, Bianchini & Kelly, 2012; Lee & Buxton, 2008). Christiansen, Jenkins and Haskell (2004) bring to light the challenges that teachers face in order to help ELLs achieve the same access as the mainstream students to the core curricula of subjects such as science. Research has also looked at the role of culture in educational achievement and many have discovered that a failure to acknowledge students' cultures results in their academic failure (e.g., Ladson-Billings, 1995). Gay (2000, 2002) has also claimed that pedagogy will be most beneficial when it is entrenched within the students' cultural backgrounds. Ladson-Billings (1995) uses the term culturally responsive pedagogy to refer to "a more dynamic or synergistic relationship between home/community culture and school culture" (p. 467). However, on many occasions, cultural and linguistic barriers between teachers and students cause frustration and discouragement for the teachers which could result in the students' underachievement and consequent failure (Christiansen et al., 2004).

It should come as little surprise that teachers are one of the most important agents in the education process of students. With increasing numbers of ELLs in the classrooms, García-Nevarez, Stafford and Arias (2005) remark that teachers must show sensitivity and possess an attitude of inclusion in terms of their cultural and linguistic needs. However, researchers have shown that many teachers are not aware of how to support ELLs in ways that will be most effective for their academic achievement (e.g., Yoon, 2008). On the other hand, research has proven that students from diverse cultural and linguistic backgrounds succeed in academics when their teachers are able to infuse the students' culture throughout the curriculum and instruction (Ladson-Billings, 1995;

Siwatu, Frazier, Osaghae & Starker, 2011). Research on teachers' beliefs has shown that perceptions have a significant impact on teachers' thought process and behaviour (Ashton, 2015; Fives & Buehl, 2008). Also, teachers' perceptions about teaching and learning and their self-efficacy help guide their experiences and interpretations as well as how they deal with challenges (Levin, 2015). Moreover, statistics such as those showing that in the Toronto District School Board (2013) a quarter of the students are immigrants from over 190 countries speaking 115 different languages necessitate the need to understand the teachers' perceptions and attitudes about teaching in such diverse contexts. Hence, this study investigated Ontario's science teachers' self-efficacy perceptions to teach in diverse classrooms.

Purpose of the Study

Teachers' beliefs regarding their abilities to perform a task successfully is known as self-efficacy. Bandura (1995) defines self-efficacy as the "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations" (p. 2). Teachers' perceptions of their self-efficacy have a tremendous influence on factors such as their conflict-resolution techniques and level of perseverance as well as student interest, motivation and success among many others (Bandura, 1997). Researchers have also stated that self-efficacy beliefs are context-dependent and hence, must be examined as such (Bandura, 1997). Teachers' self-efficacy beliefs also have a significant impact on their teaching practices (Knoblauch & Hoy, 2008). Research has also shown that teachers are not adequately prepared to respond to the needs of the increasingly diverse student population (Lucas et al., 2015). Considering the kind of diversity in Ontario's classrooms, investigating teachers' self-efficacy beliefs in this specific context is vital in order to

understand how appropriate instruction can be targeted toward all students including ELLs.

Researchers have highlighted a number of gaps in the literature regarding teachers' beliefs in the context of diverse classrooms. Tran (2015) speaks about this issue as "a topic that has been least explored in the literature regarding teachers' perceptions and efficacy beliefs for working with ELLs in the United States and abroad" (p. 38). Much of the research on teachers' self-efficacy beliefs has focused on preservice teachers and rarely inservice teachers (Levin, 2015; Gay, 2015). There is also a lack of diversity when it comes to studying participants in terms of experience, gender, race and language backgrounds among others (Levin, 2015). This research has aimed to fulfil these gaps by investigating inservice science teachers' self-efficacy perceptions in terms of providing culturally and linguistically relevant pedagogy in their classrooms. The research participants in this study have come from a diverse pool of participants who teach various grade-levels (i.e., elementary and secondary), belong to different linguistic backgrounds (i.e., monolingual English-speakers and multilinguals) as well as are at differing stages of their teaching careers (i.e., novice and experienced).

It has also been mentioned in the literature that self-efficacy beliefs must be studied in domain-specific contexts as well in that teachers' self-efficacy perceptions regarding teaching History will not necessarily remain the same when it comes to teaching Geography (Bandura, 1997; Siwatu, 2011a). Hence, I have chosen to specifically include science teachers in this study. Before outlining my rationale for choosing science in particular, I provide a brief context of science teaching in Ontario. According to the Ontario science curriculum (2007, p. 4), "science is a way of knowing

that seeks to describe and explain the natural and physical world" and the overarching aim has been the scientific and technological literacy for all students. The three goals of the Ontario science curriculum are: (a) to relate science and technology to the broader society, (b) to develop skills and strategies required for scientific inquiry and (c) to gain an understanding of the fundamental scientific and technological concepts. The fundamental concepts that are covered in the curriculum for Grades 1 to 12 include matter, energy, systems and interactions, structure and function, sustainability and stewardship, and change and continuity" (p. 5). Generally speaking, elementary teachers (i.e., K-8) are generalist teachers that teach all subjects including science while secondary teachers (i.e., Grades 9-12) are specialist teachers -who only teach science[2]. Considering the increasing number of ELLs in mainstream classrooms, the Ontario Ministry of Education has undertaken a number of initiatives for more inclusive classrooms including policy documents on supporting ELLs, guides to conduct initial and ongoing assessments as well as subject-specific resources.

My rationale for having chosen to investigate the domain of science (as opposed to another) comes from the various complications it presents unlike any other subject especially for ELLs. First, science has its own specific language which ELLs must acquire in addition to learning English to achieve academic success. Lee and Fradd (1998) state that, "Learning science vocabulary becomes more complex when comparable terms and parallel ways of considering ideas do not exist across languages. The words of one language cannot always be completely translated into another" (p. 16). Second, the way science is taught in Ontario is at times problematic for ELLs from other

[2] I discuss the way K-12 classrooms are organized in Ontario in detail in Chapter 3.

countries who are accustomed to the teacher being the sole expert. Inquiry is an essential component of science education in Ontario and it requires students to engage in explorations, generate hypotheses and construct their understanding based on empirical observations (Lee & Fradd, 1998). Cummins and Early (2015) also state that the big ideas that are embedded in our science curricula are often difficult to understand for all students, especially ELLs. Third, individuals belonging to different cultures have varied perspectives on a number of scientific issues. For instance, the debate on creation and evolution is one of the many topics on which individuals from various religious backgrounds have had a difference of opinion. Such controversial issues become even more important to address in the realm of education. As a result, I wished to explore how Ontario's science teachers deal with issues such as teaching ELLs the language of science, bridging the gap between ELLs' previous academic experiences with the Canadian model of learning through inquiry as well as accommodating differing perspectives on contentious matters.

This study is timely in its investigation of Ontario's science teachers' self-efficacy perceptions to teach in diverse classrooms. Findings from this study can help highlight particular issues on which teachers need specific support. Also, an exploration of teachers' self-efficacy perceptions can uncover their attitudes toward aspects of diversity and ELL inclusion. Since self-efficacy has a direct impact on student performance (Bandura, 1997), this study can shed light on why certain groups of ELLs are underperforming in comparison to others. Even though this study is context-specific, the findings of this research can be extrapolated to other diverse classroom contexts across Canada and around the world.

Research Questions

The purpose of this research was to explore the self-efficacy perceptions of science teachers to teach in diverse classrooms across Ontario using a mixed methods approach. Survey questionnaires and semi-structured interviews were employed to collect data from science teachers teaching within the K-12 program in Ontario. The following research questions guided the investigation:

1. What are science teachers' perceptions of their self-efficacy regarding teaching science in a diverse classroom?

(a) How do elementary teachers' self-efficacy perceptions compare with secondary teachers' perceptions?

(b) How do monolingual teachers' self-efficacy perceptions compare with multilingual teachers' perceptions?

(c) How do novice teachers' self-efficacy perceptions compare with experienced teachers' perceptions?

2. How do science teachers' self-efficacy perceptions compare on general pedagogical practices as opposed to culturally responsive pedagogical practices?
3. What are Ontario's science teachers' attitudes toward diversity and ELL inclusion?

(a) What challenges do science teachers face in diverse classrooms?

(b) How do science teachers perceive their role amidst a diverse classroom?

(c) How do science teachers incorporate aspects of diversity (ELLs' cultures and languages) within the science curriculum and instruction?

Overview of the Dissertation

This dissertation has been organized into seven chapters. Chapter 2 discusses the theoretical framework namely self-efficacy theory (Bandura, 1997) and culturally responsive pedagogy (Gay, 2002). It also presents a review of relevant literature in the following areas: (a) teachers' beliefs, (b) teachers' self-efficacy perceptions, (c) teacher preparedness, (d) teachers' attitudes toward diverse classrooms and (e) science education in diverse classrooms. Chapter 3 presents the methodology employed in this study. I rationalize the use of a mixed methods approach and discuss various issues related to data collection, the implementation of the methods and data analysis. The findings of this research are presented in Chapters 4 and 5. Chapter 4 presents findings related to the first and second research questions through a discussion of teachers' overall self-efficacy perceptions to teach in diverse classrooms as well as on issues of general pedagogy as opposed to culturally responsive pedagogy. Chapter 5 presents findings pertaining to the third research question with regards to teachers' overall attitudes toward diversity and ELL inclusion as well as the challenges they face, their role as science teachers and how they negotiate diversity within the curriculum and instruction. Chapter 6 discusses the findings in light of the theoretical framework and previous research. In addition to presenting a summary of the research findings in Chapter 7, I conclude this dissertation with a discussion of the implications of this research, the limitations of this study as well as recommendations for future research.

CHAPTER 2 THEORETICAL FRAMEWORK AND RELEVANT LITERATURE

Introduction

This chapter presents the theoretical framework that I draw on and the relevant literature I have reviewed surrounding the discussion on science teachers' self-efficacy perceptions to teach in Ontario's diverse classroom contexts. This chapter is divided into two broad sections: (a) the theoretical framework in which I discuss the concepts of self-efficacy (Bandura, 1997) as well as culturally responsive pedagogy (Gay, 2000) and (b) a literature review focusing on issues including teachers' self-efficacy perceptions, teachers' attitudes toward ELLs and culturally relevant teaching in the science classroom among others.

Theoretical Framework

This study investigated the self-efficacy perceptions of Ontario's science teachers to teach in diverse classrooms. As a result, it was important to understand both the nature of self-efficacy and pedagogy in diverse classroom contexts. It was essential to utilize theories which not only explained the two concepts particularly but also complemented each other resulting in a more holistic understanding of the issue. Therefore, the theories that frame this study most appropriately are Bandura's (1995, 1997) theory of self-efficacy and Gay's (2000) framework of culturally responsive pedagogy. In this section, I present the two theories. First, I discuss the construct of self-efficacy and then, explore the nature and sources of self-efficacy beliefs as well as teachers' perceptions of self-efficacy. I also present the controversy surrounding the connotations of the term self-efficacy and clarify my understanding of it. Second, I discuss culturally responsive

pedagogy and its characteristics and outline the five main competencies of the theory. Thereafter, I explain how the theories dovetail to frame this investigation most suitably.

Self-Efficacy

Research on self-efficacy has grown out of two broad theoretical strands: (a) Rotter's (1966) locus of control and (b) Bandura's (1977) social cognitive theory. The first theoretical strand grew out of the framework of Rotter's (1966) social learning theory and was explored by the RAND researchers who defined teacher efficacy as "the extent to which teachers believed that they could control the reinforcement of their actions, that is, whether control of reinforcement lay within themselves or in the environment" (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998, p. 202). According to this theory, teachers perceive that the environment has a stronger influence on a student's learning and believe that their teaching efforts lie outside their control and hence, are external to them. Teachers who are confident in their own ability to teach difficult students operate from the belief that their teaching efforts lie within their control and thus, are internal (Tschannen-Moran et al., 1998.) Simply put, teachers who have a high level of efficacy believe that they have a strong impact on aspects such as student motivation and achievement.

The second theoretical branch was based in Bandura's (1977) social cognitive theory and identified teacher efficacy as "a type of self-efficacy- a cognitive process in which people construct beliefs about their capacity to perform at a given level of attainment" (Tschannen-Moran et al., 1998, p. 203). Under this theory, self-efficacy is viewed as a future-oriented concept which explores the level of competence that an

individual expects to show under certain circumstances (Tschannen-Moran et al., 1998). I explore the concept of self-efficacy through Bandura's (1997) lens in this study.

Societies of today are undergoing constant social and technological changes putting pressure on individuals to continuously keep up and renew themselves accordingly. Most of the theories show individuals as bystanders to these changes who have no personal autonomy over their lives. In reality, individuals do have agency to alter their own lives and societies. Bandura (1997) states that individuals have a reciprocal relationship with their environment in which they are both the producers as well as the products of it. When one strives for control, one is better able to affect the outcomes of the activity undertaken. He mentions that the perceptions that individuals have in their capabilities to produce desired effects of their actions is known as self-efficacy. Bandura (1995) defines self-efficacy as the "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations" (p. 2). Tschannen-Moran et al. (1998) explain that self-efficacy is strongly related to one's perception of competence and not the actual level of competence. Hence, an individual's overestimation or underestimation in his or her abilities will have an impact on the consequence of the action.

Bandura (1997) states that the uncertainty individuals face in important matters leads them to predict the outcomes. Consequently, predictability cultivates preparedness which guides individuals to strive for and exercise control over their lives. Hence, the more control individuals think they have over the events in their lives, the more they are able to shape those events in desired ways. The author states that motivation, emotions and actions are based on individuals' beliefs rather than what they know to be objectively

true. As such, one's capabilities are not necessarily innate or the result of one's 'drive to succeed'. Simply put, the belief that 'one must be born with it' is not accurate by any measure. Personal agency in general and self-efficacy in particular are developed over time. Bandura (1997) elucidates this by stating "Unless people believe they can produce desired effects by their actions, they have little incentive to act. Efficacy belief, therefore, is a major basis of action. People guide their lives by their beliefs of personal efficacy" (pp. 2-3). Individuals' beliefs in their self-efficacy influence a whole host of factors such as: (a) the courses of action they choose to pursue, (b) how much effort they expend in activities they undertake, (c) how long they will persevere in the face of obstacles and failures, (d) their resilience during hardship, (e) whether their thought patterns help or hinder them, (f) how much stress and depression they experience in coping with environmental demands and (g) the level of accomplishments they realize (Bandura, 1997).

Classrooms of today are becoming rapidly diverse. However, curriculum and instruction even in science are geared largely toward White, middle-class students (Christiansen et al., 2004; Settlage & Southerland, 2012). Teachers are under immense pressure to provide targeted instruction to all students. According to the social cognitive theory (Bandura, 1997), there is a reciprocal relationship between behavioural, cognitive and personal elements as well as the environment. As a result, it is important to explore the relationship between teachers' self-efficacy beliefs (behavioural, cognitive and personal factors) and the school context (environmental factor) (Tschannen-Moran et al., 1998). This study investigates science teachers' self-efficacy beliefs in their capabilities to teach in a diverse classroom. Bandura (1995) mentions that, "To fully understand

personal causation requires a comprehensive theory that explains, within a unified conceptual framework, the origins of beliefs of personal efficacy, their structure and function, the processes through which they operate, and their diverse effects" (p. 2). Mere perceptions of high self-efficacy are not the only requisite for effective teaching as they do not necessarily replace knowledge and skills required for the task. However, perceptions of low self-efficacy most assuredly work against effective teaching (Raudenbush, Rowan & Cheong, 1992) and this makes a study into teacher perceptions of self-efficacy essential.

Efficacy beliefs have an impact on how individuals think, act and feel. Research also shows that efficacy beliefs "contribute significantly to human motivation and attainments" (Bandura, 1995, p. 3). Not only do self-efficacy beliefs affect one's cognitive processes but they are also linked to behaviour (Bandura, 1977). Self-efficacy beliefs affect one's choice of activities and coping efforts in the face of obstacles. Bandura (1997) further argues that the stronger one's self-efficacy perceptions, the more active the efforts. This shows that teachers' self-efficacy beliefs have tremendous implications for pedagogical issues, especially teaching students from diverse backgrounds. Research shows that science teachers face many challenges in teaching science to ELLs including issues of vocabulary (e.g., McDonnough & Cho, 2009) as well as aspects of diverse cultures and languages. Hence, I believe that studying science teachers' self-efficacy beliefs can shed light on the amount of effort they expend in the face of these inherent challenges.

The nature of self-efficacy beliefs.

It is important to recognize how self-efficacy beliefs are structured. In its rejection in the belief that success or failure comes from an innate drive, self-efficacy theory acknowledges a wide range of human capabilities (Bandura, 1997). Additionally, "it treats the efficacy belief system not as an omnibus trait but as a differentiated set of self-beliefs linked to distinct realms of functioning" (p. 36). Within this framework, it is essential to consider: (a) the dissimilarity between self-efficacy and skills, (b) the importance of measuring self-efficacy specifically and (c) the contribution of self-efficacy to performance.

The primary misconception that individuals have about self-efficacy is that it is synonymous with personal skills. Even when individuals are proficient in a certain activity, they may still experience failure in it. For instance, skilled Olympic athletes often experience failure in the exact sport in which they may have previously broken world records. Clearly, there are other factors involved which may influence one's performance such as the external circumstances. Hence, self-efficacy has to do more with one's belief in the capabilities to perform in particular circumstances rather than the skill set one possesses. Efficacy beliefs are a significant element within the framework of human competence and that is why "different people with similar skills, or the same person under different circumstances, may perform poorly, adequately, or extraordinarily, depending on fluctuations in their beliefs of personal efficacy" (Bandura, 1997, p. 37). Regardless of how skilled an individual is, doubts and insecurity could undermine the skills and therefore, "perceived self-efficacy is an important contributor to performance accomplishments, whatever the underlying skills might be" (p. 37). Having competent

knowledge and skills will not result in successful outcomes if one lacks high self-efficacy. Hence, a teacher who is extremely skilled and possesses a competent science content-knowledge base might not feel very efficacious about teaching in a diverse setting without high self-efficacy. Bandura (1997) remarks that subskills required for performance may contribute to one's judgement in his or her self-efficacy but they do not substitute for it.

Bandura (1997) highlights the importance of creating specific self-efficacy measures so that it can be evaluated accurately. He explains that human competence does not remain the same across different activity domains. Hence, creating a measure which evaluates general self-efficacy loses its predictability. This study investigated self-efficacy in the realm of education which makes the specificity of the context even more important as noted by the author:

> A self-efficacy measure cast in terms of the general academic domain would be more explanatory and predictive, but still deficient because scientific, mathematical, linguistic, literary, and artistic academic subdomains differ markedly in the types of competencies they require. A self-efficacy measure tailored to the mathematical domain would be even more predictive of choice of mathematical activities, how vigorously they are pursued, and level of mathematical achievement. Particularized efficacy beliefs are most predictive because those are the types of beliefs that guide which activities are undertaken and how well they are performed (Bandura, 1997, p. 40).

A popular misconception is that general beliefs of self-efficacy generate self-efficacy beliefs in specific tasks. This erroneously means that if a teacher reported his or her self-

efficacy beliefs as high in terms of general teaching, his or her self-efficacy beliefs in teaching science will also be high as a result. The fact that general indicators of self-efficacy beliefs can inform a researcher about an individual's self-efficacy in specific activities is simply untrue. In fact, self-efficacy beliefs operate diversely across different realms of activity depending on the situational requirements as opposed to in a decontextualized, general manner. Hence, measuring teachers' general self-efficacy beliefs will yield little information about the subject they teach, the situational challenges they face and how they cope in diverse classroom contexts. It is exceedingly important to create a self-efficacy measure which is specific to the goals of the study in order to gain accurate insight.

While self-efficacy beliefs do predict future performances, they contribute to those performances as well (Bandura, 1997). As explained previously, this theory purports that individuals are not simply onlookers but have a hand in the outcome as well and that "There is a world of difference between doing and undergoing" (Bandura, 1997, p. 39). Hence, a judgement of one's capabilities before the activity is performed has a huge impact on the outcome. Bandura (1997) states that individuals who doubt their capabilities in a particular activity will hesitate to take on difficult tasks. Such individuals generally find it difficult to motivate themselves and surrender when facing hardships. They lack inspiration and commitment toward their goals. Those with low self-efficacy tend to focus on their flaws and the difficulty of the task which further undermines their efforts. In cases of failure at particular tasks, the recovery process is significantly longer in comparison to others. They are also more likely to experience stress and depression over small setbacks. On the other hand, those who have strong beliefs in their capabilities

view activities as challenges to conquer rather than obstacles in their path. Such a disposition promotes interest and involvement as well as commitment in every endeavour they decide to take on. The investment of effort as well as perseverance during failure are also considerably higher in such individuals. This type of positive outlook generally increases performance accomplishments and reduces stress and depression among individuals. According to Bandura (1997), these findings are solid proof that self-efficacy beliefs are more than simply predictors of future performance in that they are active contributors to it as well.

Sources of self-efficacy.

Bandura (1997) states that, "People's beliefs about their personal efficacy constitute a major aspect of their self-knowledge" (p. 79). Hence, it is essential to consider the sources from which one gains one's self-efficacy beliefs and whether self-efficacy beliefs are malleable and can change as a result of one's experiences. Generally speaking, the way in which experiences are processed is what affects one's self-efficacy (Carleton, Fitch & Krockover, 2008). Additionally, Bandura (1997) explains that the sources of self-efficacy themselves do not directly affect one's level of self-efficacy. In fact, they affect one's cognitive processing which then has an impact on their self-efficacy. As noted by Tschannen-Moran et al. (1998), "What is attended to, what is considered important or credible, and what is remembered influence the impact of experience on efficacy beliefs" (p. 230). Simply put, it is what one makes of the experiences he or she has which affects their personal efficacy. There are four main sources from which one develops self-efficacy beliefs: (a) mastery experiences, (b)

vicarious experiences, (c) social persuasion and (d) psychological and emotional states (Bandura, 1977, 1995, 1997).

According to Bandura (1997), *mastery experiences* are the most significant source of efficacy because they offer the most accurate proof of whether an individual has what it takes to succeed at a task (Bandura, 1977, 1995). Mastery experiences are essentially interpretations of one's actual performances. Interpretations of actual performance are important since they "provide the most reliable information for assessing self-efficacy because these interpretations are tangible indicators of one's capabilities" (Schunk & Pajares, 2009, p. 36). Tschannen-Moran and Woolfolk Hoy (2007) add that, "While self-efficacy beliefs are anticipatory in nature, looking toward the future with the expectation of either success or failure, they are based in part on an assessment of past performances" (p. 949). Hence, performances that are interpreted as successful increase self-efficacy levels and those viewed as failures decrease the level of self-efficacy. Consequently, one's mastery experiences are raised with each success and lowered with each failure. However, if a firm sense of efficacy is strongly established before an individual experiences failure, then he or she is more likely to show resilience and make an effort to overcome the obstacles. It is essential to experience difficult situations since they provide opportunities for growth as well as perseverance during setbacks. For instance, a science teacher with high efficacy overall will be resilient and will exercise effective coping mechanisms even if he or she faces failure during the use of a particular teaching method. Bandura (1995, 1997) further states that developing one's self-efficacy through mastery experiences is not limited to adopting ready-made practices. It is about acquiring the tools for executing appropriate action to meet rapidly changing societal demands. Interestingly,

Bandura (1997) states that, "Although performance successes are forceful persuaders, they do not necessarily raise efficacy beliefs, nor do performance failures necessarily lower them" (p. 81). After all, the level of self-efficacy will only be influenced depending on what one makes of one's performance. If an individual views a mastery experience as weak even though others might consider it a success, his or her self-efficacy will not necessarily be enhanced. On the other hand, even during what might be considered a failure according to the standards of the general population, an individual may experience an increase in the level of self-efficacy if he or she deems the mastery experience a success. Hence, performance alone does not provide enough information to judge one's self-efficacy and that "appraisal of personal efficacy is an inferential process in which the relative contribution of ability and nonability factors to performance successes and failures must be weighted" (Bandura, 1997, p. 81). There are a number of factors that come into play during mastery experiences which alter one's self-efficacy perceptions including the level of task difficulty, the amount of effort spent, the external context and how the experiences are cognitively viewed.

Vicarious experiences or modeling are also an important source for enhancing individuals' self-efficacy perceptions. Often, the only possible way to measure the adequacy of certain activities is comparing them to the performance of others. For instance, scoring '20 points' on an activity with no context for judgement makes it difficult to ascertain whether it is a good or poor score without comparing it to others' performance. In such instances, social comparison becomes necessary to appraise one's capabilities. Observing others perform certain activities can help cause expectations in the observer that he or she too can succeed by making more persistent effort (Bandura,

1995). When one sees or imagines others perform a task successfully, it enhances their self-efficacy beliefs to undertake and succeed at similar activities and seeing others fail at something lowers their self-efficacy beliefs. However, Bandura (1997) posits that personal efficacy is influenced greatly if one visualizes someone similar to oneself. If people see others as different from themselves, then their self-efficacy beliefs are not necessarily affected by the models' success or failure. For instance, a teacher candidate may develop a stronger sense of self-efficacy by watching the mentor teacher that he or she considers similar to himself or herself perform successfully. Bandura (1997) adds that, often, vicarious experiences prove to be even more powerful than mastery experiences because when individuals see their models fail, they quickly accept their own failures prior to the actual performance itself. Consequently, their inefficacy beliefs make them behave incompetently in order to generate confirmatory evidence. In contrast, vicarious experiences may also convince individuals of their high efficacy which may lead to a lower probability of failure. The author remarks that vicarious experiences are much more effective than simply providing a standard against which one judges one's capabilities. In fact, individuals tend to pursue those who have aspirational skills and that "By their behavior and expressed ways of thinking, competent models transmit knowledge and teach observers effective skills and strategies for managing environmental demands. Acquisition of effective means raises beliefs of personal efficacy" (Bandura, 1997, p. 88). Hence, vicarious experiences can motivate individuals to engage in self-development aiding in increased self-efficacy levels.

The third source of self-efficacy beliefs is *social persuasion* whereby individuals who are persuaded verbally regarding their own capability of success are more likely to

put in greater effort (Bandura, 1995). When significant individuals in one's life express their faith in him or her during trying times, it is easier to maintain a high sense of efficacy. Verbal persuasion is increasingly used because it is easily accessible. Even though self-efficacy beliefs developed in this way are comparatively weaker, one can benefit through positive affirmations from others because "people who are persuaded verbally that they possess the capabilities to master given tasks are likely to mobilize greater effort and sustain it than if they harbor self-doubts and dwell on personal deficiencies when difficulties arise" (Bandura, 1997, p. 101). However, it must be noted that verbal persuasion does not necessarily entail false praises. It is important that the persuader encourages an individual to have strong belief in their own capabilities (Schunk & Pajares, 2009). For instance, a novice teacher may experience an increase in his or her self-efficacy beliefs upon receiving a 'pep talk' from mentors who strongly believe that the teacher has what it takes to succeed.

Finally, one can develop self-efficacy beliefs through *psychological arousal* because, "In judging their capabilities, people rely partly on somatic information conveyed by psychological and emotional states" (Bandura, 1997, p. 106). If an individual experiences fear or anxiety, he or she may feel much less efficacious in performing a particular task. When an individual is in a stressful situation, physical and psychological reactions such as anxiety or discomfort might be seen as signs of inability and impending failure. One may feel highly efficacious if the surrounding environment is perceived as supportive and harmonious. For instance, a teacher who has only taught classrooms with a homogeneous student population may feel anxious and consequently, less efficacious when teaching in a diverse classroom if diversity is perceived as an

obstacle instead of as a positive change. One's mood and level of attention also have an impact on their self-efficacy appraisal. If one gives more attention to the external situation than to one's internal somatic state then that will affect one's self-efficacy level. The psychological states and reactions themselves are not indicative of self-efficacy but the impact they have on one's cognitive functioning does affect self-efficacy levels.

Teachers' self-efficacy perceptions.

Previous research has shown that teachers have the most significant influence on the learning environment of the classroom as well as student achievement. Hence, investigating teachers' sense of self-efficacy might provide incredible insight into effective pedagogy, student motivation and interest as well as academic performance. Bandura (1997) cites Gibson and Dembo's (1984) study looking at teacher efficacy in terms of student motivation which found that teachers with a high sense of efficacy believed that even unmotivated students could be taught with increased effort and through a variety of techniques. Teachers with low self-efficacy were of the belief that they could not accomplish much if the students were not motivated themselves. They also believed that their own influence on the students was limited and that the students' home and surrounding environment were more significant factors. Teachers with high efficacy also tended to dedicate more time to academic activities and offered positive feedback to unmotivated students while those with low self-efficacy spent more time on non-academic tasks, were resigned toward difficult students and tended to give negative feedback to unmotivated students.

Teachers' sense of self-efficacy is essential to study as it affects the students' sense of their own efficacy as well. Bandura (1997) states that the teachers who "believe

strongly in their ability to promote learning create mastery experiences for their students, but those beset by self-doubts about their instructional efficacy construct classroom environments that are likely to undermine students' judgements of their abilities and their cognitive development" (p. 241). Teachers' sense of efficacy also has a general as well as specific impact on their disposition toward education. Those with low self-efficacy tend to be pessimistic about student performance and tend to have strict rules regarding classroom behaviour while those with high self-efficacy do not feel the need to show unnecessary authority and control and guide their students' interest and development. As a result of their pessimism, teachers with a low sense of efficacy do not view every student as teachable and tend to blame the inability of the student as a consequence of their failure. Optimistic and highly efficacious teachers believe that they can reach every student and view the challenges that some students face as conquerable through effort. The author states that transitions such as new teachers or changes in their school can present challenges for students resulting in a decrease in their self-efficacy. Moreover, the problems tend to increase if such students are taught by teachers with low self-efficacy themselves. Hence, an investigation into teachers' sense of self-efficacy is of significance.

As discussed previously, individuals with a low sense of self-efficacy face stress and depression. As a result, teachers with low self-efficacy may eventually face burnout. In the case of stressful situations, those with high efficacy will invest in their efforts toward solving the problems while those with low efficacy may avoid dealing with their issues altogether. Bandura (1997) states that, eventually, "The pattern of coping by withdrawal heightens emotional exhaustion, depersonalization, and a growing sense of

futility" (p. 242). Siwatu (2007, 2011) also brings to attention the increasing rate of teacher attrition which is the result of low self-efficacy. Although a daunting prospect, it is a very realistic possibility that teachers with low self-efficacy who experience burnout may be unfortunate contributors to student depression and burnout as well.

It has already been established that measures of self-efficacy must be contextualized as specifically as possible in order to attain an in-depth understanding. Bandura (1997) reiterates the diversity of human capability across different domains when he argues that "Teachers' sense of instructional efficacy is not necessarily uniform across different subjects. Thus, teachers who judge themselves highly inefficacious in mathematical or science instruction may be much less assured of their efficacy in language instruction and vice versa" (p. 243). The author claims that studying teachers' efficacy in terms of science is of even more interest considering the growing need for scientific and technological literacy. In addition to looking at teachers of science specifically, this study also specifies the self-efficacy appraisal of teachers to operate in contexts of cultural and linguistic diversity.

Terminology surrounding the discussion on self-efficacy.

According to Bandura (1997), a concept that has secured an important place within the theories explaining human behaviour in the recent decades is self-referent thought which includes the concept of self-efficacy. The term self-efficacy has been defined in a number of different ways throughout the literature on the topic. While it is important to discuss what self-efficacy is, it is equally important to discuss what self-efficacy is not. Terms such as self-concept, self-esteem, self-confidence and locus of

control among others[3] have been mentioned in the discussion on self-efficacy. There are some researchers (e.g., Tschannen-Moran et al., 1998; Maddux & Gosselin, 2012) that staunchly believe that self-efficacy is not related to any of the previously listed concepts and should not be mistaken for any of them while others (e.g., Siwatu, 2007) have taken the liberty to synonymise self-efficacy with a few of those terms. However, Bandura (1997) believes that simply based on the fact that facets of self-conceptions are self-referential, it does not necessarily mean they are related to self-efficacy. He further adds that even if there are theories that relate to the concept of self-efficacy, they vary in terms of "how they view the nature of efficacy beliefs, their origins, the effects they have, their changeability, and the intervening processes through which they affect psychosocial functioning" (Bandura, 1997, p. 10). In this section, I first present perspectives on the following five concepts which are often used interchangeably with self-efficacy: (a) self-concept, (b) self-esteem, (c) self-confidence, (d) locus of control and (e) preparedness and effectiveness. Then, I explain my understanding and definition of the concept of self-efficacy in the context of this research.

The first concept with which self-efficacy should not be conflated is that of self-concept. Bandura (1997) defines self-concept as "a composite view of oneself that is presumed to be formed through direct experience and evaluations adopted from significant others" (p. 10). Schunk and Pajares (2009) describe the self-concept as a

[3] It should be noted that these are not the only terms discussed in relation to self-efficacy. There are other concepts including competencies, effectance motivation, intentions, outcome expectancies, traits and perceived control (and possibly more) that are included in the literature. However, I have chosen to include those that I came across most frequently and are most relevant to this discussion in my review of theory and literature on the topic.

collection of self-perceptions that have been formulated as a result of experiences with the environment and through evaluations by others. It essentially reveals how one perceives oneself in relation to others. It is a multidimensional concept which is organized as a general self-concept on top and sub-area self-concepts below. Competency in each sub-area combines to form that self-concept (Schunk & Pajares, 2009). For instance, an individual's competence in soccer and baseball will determine his or her 'athletic self-concept.' Bandura (1997) states that an examination of the self-concept provides an understanding of individuals' attitudes toward themselves and their influence on their orientation toward life. The self-concept is composed of numerous attributes and combining them all into a single measure is not effective since it does not explain how each of those attributes is weighed individually.

Bandura (1997) declares that self-concept does not effectively explain complex self-efficacy beliefs considering that they "vary across different domains of activities, within the same activity domain at different levels of difficulty, and under different circumstances" (p. 11). The self-concept is made up of separate parts which may result in weak correlations but does not accurately predict behaviour under different conditions while self-efficacy does. Self-efficacy may possibly be one part of the self-concept because the author states that when self-efficacy is factored out, the self-concept measure loses its ability to predict behaviour. Maddux and Gosselin (2012) also argue that self-efficacy beliefs form a significant portion of the self-concept but the self-concept framework includes numerous other beliefs which have little to do with self-efficacy such as personality and physical attributes.

In essence, self-concept cannot be thought of as identical to self-efficacy for a number of reasons. Self-concept does not necessarily explain or predict human behaviour while self-efficacy does. Self-concept is general while self-efficacy perceptions are context-specific. As a result, self-efficacy perceptions change depending on the task while self-concept is generally more stable. Also, self-efficacy beliefs are future-oriented judgements of one's competence while self-concept includes self-perceptions based on past experiences.

Self-efficacy is also incorrectly supplanted with self-esteem on many occasions. Bandura (1997) claims that self-esteem and self-efficacy are completely different concepts which do not even share a part-whole relationship in the manner that self-concept and self-efficacy do. He explains that "perceived self-efficacy is concerned with judgements of personal capability, whereas self-esteem is concerned with judgements of self-worth" (Bandura, 1997, p. 11). Maddux and Gosselin (2012) also believe that while self-esteem is an emotionally loaded term, self-efficacy is not. Self-efficacy beliefs are based on one's capabilities to perform a particular task while self-esteem is based on whether one likes or dislikes oneself. One may feel inefficacious in an activity without necessarily disliking oneself as a result of the low self-efficacy and one may also be highly efficacious in a certain activity without taking any pride in it. Individuals do not necessarily invest their self-worth in activities in which they are capable. Simply put, it is possible to be good at something without being proud of one's success in that activity and, at the same time, not being good at something does not always damage the amount of self-value one has. For instance, one can be good at playing the piano without gaining any satisfaction from the skill and one can also be incapable of playing the piano without

necessarily losing any amount of self-love. Hence, the beliefs one has regarding what one does is in no way connected to how much value that individual puts on himself or herself.

Another concept which is sometimes used interchangeably with self-efficacy by a few is confidence or self-confidence. Walan and Rundgren (2014) acknowledge the abundance of researchers discussing teachers' confidence but without providing any definitions whatsoever to differentiate between the constructs of self-efficacy, self-confidence or confidence. Schunk and Pajares (2009) believe that self-confidence differs from self-efficacy and define self-confidence as "a general capability self-belief that often fails to specify the object of the belief (e.g., one who exudes self-confidence)" (p. 40). While self-confidence is general, self-efficacy beliefs in contrast are clear and context-specific. They state that even though highly self-confident individuals are more likely to be highly self-efficacious, there is no automatic correlation between the two concepts; an individual can be highly confident about his or her low self-efficacy and possible failure in a particular task.

There are other researchers including Siwatu (2007) who do not necessarily posit self-efficacy and self-confidence as completely separate and believe that there is a link between the two. In his study of preservice teachers on a questionnaire measuring self-efficacy, Siwatu (2007) asked participants to "rate how confident they are in their ability to engage in specific culturally responsive teaching practices (e.g., 'I am able to identify the diverse needs of my students') by indicating a degree of confidence ranging from 0 (no confidence at all) to 100 (completely confident)" (p. 1091). His results conclude that "participants who have higher scores on the culturally responsive teaching self-efficacy scale are more confident in their ability compared to those who were less confident in

their abilities" (Siwatu, 2007, p. 1091). Onafowora (2005) studied novice teachers' self-efficacy perceptions and their relation to teaching and learning in their professional development training and believes that "the efficacy attribute is linked to 'self' confidence or an innate ability to reinforce self-initiated actions" (p. 36).

The concept of locus of control by Rotter (1966) is also included in the conversation surrounding self-efficacy. However, Bandura (1997, p. 20) believes that the two are "sometimes mistakenly viewed as essentially the same phenomenon" even though they are completely separate. Simply put, self-efficacy has to do with one's beliefs in his or her own capabilities while the locus of control is the extent to which an individual believes he or she has control to influence the events occurring. The locus can either be internal or external. Those with an internal locus of control believe that life occurrences happen essentially due to their own actions while those with an external locus of control believe that external factors are responsible for the events that take place in their lives (Tschannen-Moran & Woolfolk Hoy, 2001). As Tschannen-Moran et al. (1998) state, "Rotter's scheme of internal-external locus of control is basically concerned with causal beliefs about the relationship between actions and outcomes, not with personal efficacy" (p. 211). For instance, an individual with an internal locus of control will only blame himself or herself as a result of an unsuccessful job interview while one with an external locus of control will blame the interviewer or other external factors for the failed outcome. Speaking in terms of self-efficacy in this matter, one will only be able to predict one's own capabilities in order to succeed at the job interview without necessarily focusing on the external contributing factors. Hence, Bandura (1997) argues that "beliefs about whether one can produce certain actions (*perceived self-efficacy*)

cannot, by any stretch of the imagination, be considered the same as beliefs about whether actions affect outcomes (*locus of control*)" (p. 20; emphasis in original). He states that while self-efficacy beliefs are strong predictors, locus of control is not; it is a weak predictor, at best.

There are additional concepts such as preparedness and effectiveness that are also viewed as being similar to self-efficacy by some but not others. Darling-Hammond, Chung & Frelow (2002) show the connection between preparedness, efficacy and effectiveness. Their study examined survey data of beginning teachers in New York City regarding their perceptions of their preparation for teaching among others. The survey asked teachers to appraise their preparedness, their sense of self-efficacy and their plans to remain in the profession. Their analysis showed that teachers' appraisal of their overall preparedness is significantly related to their sense of efficacy. They discovered that "sense of preparedness is by far the strongest predictor of teaching efficacy" (Darling-Hammond et al., 2002, p. 294). In their mixed-methods study of novice teachers of English to speakers of other languages (ESOL) looking at teachers' perceptions of their teacher preparation, Faez and Valeo (2012) also measured preparedness, effectiveness and efficacy as a unified construct. Their survey questionnaire asked participants to "rate their sense of preparedness and efficacy on a scale of 0 to 10 where 0 represented *not at all prepared/effective* and 10 *extremely well prepared/effective*" (Faez & Valeo, 2012, p. 457; emphasis in original). Raudenbush et al. (1992) also show in their research that level of preparation on the part of the teacher had a strong impact on their efficacy.

As far as this study is concerned, I identify with Bandura's (1997) description of self-efficacy which stands for an individual's judgements about his or her capability to

perform a particular task successfully. I also believe that self-efficacy is highly context-specific and is very malleable. While I do agree with the research (e.g., Darling-Hammond et al., 2002) showing that preparedness is a significant predictor of self-efficacy, I do not think they are essentially the same concept and hence, I do not use self-efficacy interchangeably with preparedness or effectiveness or confidence. I also acknowledge that self-efficacy is not the same as self-concept or self-esteem. I have also come across researchers differentiating between the phrases *teacher efficacy* and *teacher self-efficacy* (e.g., Dellinger, Bobbett, Olivier & Ellett, 2008). It is stated that when teacher efficacy is defined as teachers' perceptions of their capabilities to affect student performance, the definition overlooks the significant role played by teachers' perceptions of their capabilities to perform various teaching practices, according to Dellinger et al. (2008). Conversely, the authors state that teacher self-efficacy beliefs "focus on *successfully performing specific teaching tasks* in a teacher's current teaching situation (specific school/classroom/students)" (p. 753; emphasis in original). I use the phrase "teachers' self-efficacy perceptions" consistently throughout this dissertation and define it in the same way as Dellinger et al. (2008) define teacher self-efficacy. Maddux and Gosselin (2012) suggest that researchers must be careful about not measuring one of the aforementioned concepts in the name of self-efficacy. In order to account for this, I refrained from using any of the terms discussed in this section interchangeably with self-efficacy. I ensured that the instructions on the online survey adhered to my definition of self-efficacy and thus, clearly directed my participants to "judge their capabilities to engage in culturally responsive teaching practices in the science classroom on a scale of 0 meaning *no feelings of self-efficacy* to 10 meaning *high feelings of self-efficacy*."

I reckon one's understanding regarding the concept of self-efficacy may also depend on one's expertise in the varied sub-disciplines of research such as Applied Linguistics and Social/Applied Psychology among others. Different epistemological underpinnings give rise to differing perspectives on the topic. Therefore, I do not necessarily believe that any of these researchers are incorrect in their understanding of self-efficacy. My aim in presenting these views was simply to show that self-efficacy has been understood from multiple perspectives and that "this has been the source of some confusion in the literature" (Bandura, 1997, p. 10). Hence, it was important to clarify how I viewed self-efficacy for the purpose of this investigation.

Culturally Responsive Pedagogy

Canadian classrooms have been witness to students from culturally and linguistically diverse backgrounds for decades now. However, our classrooms and instructional methods as well as the curricular content have been designed with those students who share the same homogeneous mainstream cultural environment in mind (Coelho, 2012). Consequently, students from culturally and linguistically diverse backgrounds that are different from the mainstream students are underperforming academically. Cummins and Early (2015) categorize three types of students who experience educational difficulties: (a) students whose L1 is different from English, (b) students belonging to lower socioeconomic backgrounds and (c) students belonging to communities that have been discriminated against for generations in the wider society. It has become critical to understand the reasons behind their underachievement so that proper measures can be taken to ameliorate the situation. As Coelho (2012) states, it is essential for teachers "to adjust to the reality that some of their students are learning the

language of instruction and have a set of knowledge and skills based in another geographic and cultural environment" (p. 16). Hence, it is very important that pedagogical methods be situated in a framework that is familiar to culturally and linguistically diverse students so that they are given equal opportunities for success (Howard, 2010).

The first step is for educators to understand that success and failure are mere experiences. They are "not the totality of a student's personal identity or the essence of his or her human worth" (Gay, 2000, p. 1). In fact, Collier (2005) goes a step further and argues that failure is not attached to the student but to the teacher "who must search within to find a more effective way to reach the student" (p. 353). Regardless of how certain students fare in their academic pursuits, they still possess skills that can be utilized by the teacher in the classroom. Every student brings aspects of culture, language, traditions, race and ethnicity among numerous others to their educational endeavour. It is essential that teachers view them as resources as opposed to obstacles and infuse them within the curricular and pedagogical protocols. In order for this to happen, Gay (2000) among other researchers proposes the theory of culturally responsive pedagogy which is "a means for unleashing the higher learning potentials of ethnically diverse students by simultaneously cultivating their academic and psychosocial abilities" (p. 20). The author states that incorporating diverse students' culture into the classroom could very well aid in reversing the statistics of their academic underachievement since culturally responsive pedagogy does for ELLs what mainstream teaching practices do for mainstream students.

Gay (2000) outlines a number of principles as to why culturally responsive pedagogy is an absolute must in terms of providing targeted instruction to all students, especially ELLs. Culture is truly omnipresent and we can never divorce ourselves from it. Howard (2010) writes, "Culture matters because it shapes all aspects of daily living and activities" (p. 51). It is the essence of everything we do including all that is undertaken in the field of education. Be it curricular design, instructional approaches or even assessment, culture is at the heart of it all (Gay, 2000). The researcher further states that "culture determines how we think, believe, and behave, and these, in turn, affect how we teach and learn" (p. 9). One reason as to why ELLs underperform is the mismatch between their home culture and that of the school. According to Howard (2010, p. 55), "this cultural discontinuity from home to school is one explanation for lower educational outcomes for students from culturally diverse groups". Hence, it is extremely important for teachers to be mindful of how to bridge these cultural gaps so that ELLs can access the same resources as their Canadian-born peers.

Many also state that the reforms that have been made in education have been insufficient because at the heart of them all lies a deficit mindset (Gay, 2000; Howard, 2010). If culturally and linguistically diverse students underperform, educators believe that the fault must lie with the students alone. Howard (2010) explains this further by highlighting the pervasive belief that "mainstream or European culture and ways of being, thinking, and communicating are considered 'normal'. Consequently, deviations from mainstream forms of verbal and cognitive processing are viewed as dysfunctional, pathological, or inferior" (pp. 29-30). Cone (2009) discusses the vicious cycle that these beliefs can cause for educators and students. She states that if teachers believe that

aspects of culture, language and race among others are causes for the underperformance of culturally and linguistically diverse students, then, this could potentially lead teachers to lower their expectations. Having low expectations from culturally and linguistically diverse students eventually results in decreasing teachers' self-efficacy which directly affects the students' performance in the classroom.

Attempts at any type of reform can never only focus on academic performance and achievement. Educators and other stakeholders must understand that aspects of culture and language cannot be considered as separate entities that have no impact on academics. In fact, Gay (2000) argues that "they are inseparably interrelated; all must be carefully understood, and the insights gleaned from this understanding should be the driving force for the redesign of education for cultural diversity" (p. 14). Additionally, factors other than language and culture that affect student learning include social status, geography, immigration, gender, family history as well as religion (Howard, 2010). Pedagogy will be most authentic when it is rooted in these elements and contextualized in students' prior lives, communities and cultural identities (Gay, 2000). Cummins and Early (2015) elaborate on the matter by stating that effective instruction for ELLs should go beyond a simple focus on teaching English and that "equally relevant for many students is instruction that aims to counteract both the negative consequences of socioeconomic variables and the devaluation of student and community identity experienced by marginalized groups" (p. 25). The authors believe that the negative impact that background variables have on academic achievement of ELLs can be reduced through appropriate education. It is essential to understand the influence these aspects

have on academic performance as well as achievement before any measures may be taken toward bridging the achievement gap.

Many teachers are aware of the cultural and linguistic differences that exist within their classrooms. Most teachers are passionate about teaching and are extremely well-intentioned when it comes to the success of all of their students. However, Gay (2000) states that noble intentions are insufficient to make a real impact. She notes that "awareness or appreciation without action will not change the educational enterprise. Mastery of knowledge and skills related to working with culturally diverse students in pedagogical situations is imperative for this task" (p. 14). Unfortunately, few teachers are aware of how to convert those good intentions into culturally and linguistically responsive teaching. Educators must move away from what Gay (2000, p. 21) refers to as "cultural blindness" and understand that culture and heritage are relevant in the discussion of 'what education is'. The culture of culturally and linguistically diverse students is not an abstract or imaginary idea that has little to do with academics. It is suggested that teachers must be mindful of how our classrooms only reflect the mainstream culture and unless pedagogy is culturally relevant and reflective of culturally and linguistically diverse students, they will continue to underperform and underachieve.

Characteristics of Culturally Responsive Pedagogy

Many terms have been used to describe culturally responsive pedagogy including "*culturally relevant, sensitive, centered, congruent, reflective, mediated, contextualized, synchronized,* and *responsive*" (Gay, 2000, p. 29; emphasis in original). More recently, the framework has been given additional designations in the literature such as 'multicultural education' (Banks, 2013), a 'cross-cultural perspective' in teaching

(Aikenhead & Otsuji, 2000) and 'culturally relevant pedagogy' (Parhar & Sensoy, 2011). However, at the heart of them all runs the common theme of the importance of incorporating ELLs' culture within pedagogy.

Gay (2000) remarks that culturally responsive pedagogy is both routine and radical at the same time. It is routine because it infuses the ELLs' cultures into the curriculum just as the mainstream culture has been infused into our curriculum up until now and it is radical due to its insistence on legitimizing minority cultures into the education system. The author believes that culturally responsive pedagogy has six important characteristics: (a) culturally responsive pedagogy is validating, (b) culturally responsive pedagogy is comprehensive, (c) culturally responsive pedagogy is multidimensional, (d) culturally responsive pedagogy is empowering, (e) culturally responsive pedagogy is transformative and (f) culturally responsive pedagogy is emancipatory. I explain each of them briefly in the subsequent paragraphs.

If the essence of culturally responsive pedagogy is to account for the cultures, languages and traditions of ELLs in teaching and learning practices, then, surely it legitimizes their importance. To acknowledge the influence one's culture and heritage have on academic achievement is to view them as resources as opposed to hindrances. Validating the cultural environment of ELLs also involves valuing their existing knowledge and connecting their prior experiences to new knowledge. Culturally responsive pedagogy also takes into account the need to employ pedagogical strategies that cater to diverse learning styles which are also an offshoot of their culture. Validating one's culture also teaches him or her how to validate another's culture. One way in which pedagogy can become validating for ELLs is through the creation of identity texts

(Cummins & Early, 2015). The authors state that "students invest their identities in the creation of 'texts,' which can be written, spoken, signed, visual, musical, or dramatic texts, or text combinations in multimodal form" (p. 18). When students are able to express their learning through topics that are important to them, often in multiple languages, pedagogy automatically validates their cultures and languages.

A good education extends far beyond academics and socialization. Skills that are taught both explicitly and implicitly form the foundation of good citizenship. The culturally responsive pedagogical approach teaches "the whole child" (Gay, 2000, p. 30). Culturally responsive pedagogy ensures that academic success is not the only goal but simply one aspect of education that also includes teaching about the importance of identity maintenance, the development of community as well as the importance of responsibility among many others. Gay (2000) argues that under this approach, "Students are held accountable for each other's learning as well as their own. They are expected to internalize the value that learning is a communal, reciprocal, interdependent affair, and manifest it habitually in their expressive behaviors" (p. 30).

Culturally responsive pedagogy emphasizes the importance of taking into account perspectives that are not only cross-cultural but multifaceted as well. The author illustrates this through an example of how the topic of 'protest' may be taught through different disciplines including social studies, art and music. It is important for students to learn about the multiple ways in which content can be expressed. It also allows students to provide their input in terms of the evaluation of their performance. By giving students autonomy in the learning process, culturally responsive pedagogy holds them accountable for their knowledge, emotions as well as reflexivity.

Culturally responsive pedagogy teaches all students the importance of success and how to achieve it. It illustrates essential skills such as confidence, courage and competence through pedagogical approaches. Teachers must model proper expectations for all students. They must show students that it is important to "believe they can succeed in learning tasks and be willing to pursue success relentlessly until mastery is obtained" (Gay, 2000, p. 32). If teachers operate from the mindset of empowering all students through pedagogy, then, they can provide appropriate support and respond to their students' needs most effectively. In this framework, students are not viewed simply as the consumers of knowledge but also the producers of it.

Since inclusion and respect for culturally and linguistically diverse students' heritage are at the center, culturally responsive pedagogy clearly challenges existing conventional truths. This approach not only views aspects of ELLs' culture as strengths but also "filters curriculum content and teaching strategies through their cultural frames of reference to make the content more personally meaningful and easier to master" (Gay, 2000, p. 24). One of the strengths of culturally responsive pedagogy is that it does not posit culture and academic success as mutually exclusive but shows how they can be synchronized simultaneously. Another essential aspect that culturally responsive pedagogy stands for which is the most crucial is to encourage ELLs to maintain their pride in their heritage. Only through a transformative approach to pedagogy will students learn to understand the existing inequities in the world and become agents of change.

Culturally responsive pedagogy frees the minds of students "from the constraining manacles of mainstream canons of knowledge and ways of knowing" (Gay, 2000, p. 35). It provides equal access to different kinds of knowledge for all students. It emancipates

students from only learning about a particular version of what is considered true and teaches them the importance of contextualizing controversial issues. Only by having access to multiple *knowledges* and the allowances to question the notion of truth will students find their own unique voice.

Culturally Responsive Pedagogy: The Five-Point Framework

Gay (2002) defines culturally responsive pedagogy as "using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively" (p. 106). She adds that when knowledge and skills are embedded within the lived experiences of students, their academic achievement will improve. There are five essential components or what Siwatu (2007) calls 'culturally responsive teaching competencies' of culturally responsive pedagogy: (a) developing a cultural diversity knowledge base, (b) designing culturally relevant curricula, (c) demonstrating a cultural caring and building a learning community, (d) cross-cultural communications and (e) cultural congruity in classroom instruction. I discuss each of these briefly in the following section.

Developing a cultural diversity knowledge base.

Gay (2002) states that *the knowledge base of a teacher* should go beyond content knowledge and include students' "values, traditions, communication, learning styles, contributions, and relational patterns" (p. 107). Howard (2010) claims that research has confirmed how crucial the characteristics of personal and cultural knowledge are to understanding how students learn. He further adds that teachers who do not share their students' cultural background should not be hesitant in developing a cultural diversity knowledge base because willingness in doing so is much more important than belonging

to the same culture as the students. In their explanation of Lucas, Villegas and Freedson-Gonzalez's (2008), linguistically responsive instruction framework, Cummins and Early (2015) also point out that learning about their ELLs is the first step to providing targeted instruction. Hence, every teacher regardless of his or her own background should go beyond the content knowledge and construct a strong foundation of their students' cultural identities and values as well.

Many teachers believe this is not possible to do in science or math classrooms (e.g., Tan, 2011; Shahn, 1990). However, Gay (2002) states that there is a place for cultural diversity in every context. Tan (2011) also believes that subjects such as science do not necessarily have to be culturally and emotionally empty. A place for cultural diversity can be made in science by going beyond "the Eurocentric tradition of WMS [Western Modern science] and creat[ing] opportunities for the intersection between the cultural practices of schools and students' cultural norms" (p. 562). Hence, even in the science classroom, the teachers must make efforts to become well-informed about their students' backgrounds closely to understand where their perspectives on scientific topics may come from.

Designing culturally relevant curricula.

Designing culturally relevant curricula involves converting the acquired knowledge base into culturally responsive curricular designs and methods of instruction. According to Howard (2010), "The mere understanding of culture cannot translate into effective teaching strategies" (p. 75). Often, there are competent teachers who have a strong foundation of their students' backgrounds but they are not successful in translating that diversity knowledge base into aiding their students in becoming competent learners.

Gay (2002) remarks that teaching diverse students does not entail avoiding controversial subjects. In fact, the appropriate way to teach responsibly is to deal with controversy, contextualize issues of gender and race and include multiple perspectives (Banks, 2013). For instance, the debate on evolution must be addressed from the viewpoints of various cultural and religious groups in order to give the students an unbiased and inclusive take on the issue. Hence, in the science classroom this may entail including the contributions to science from members of cultural backgrounds similar to the ELLs'.

Demonstrating a cultural caring and building a learning community.

Demonstrating a cultural caring and building a learning community involves creating classroom environments conducive to learning for diverse students. Additionally, caring is also "manifested in the form of teacher attitudes, expectations, and behaviors about students' human value, intellectual capability, and performance responsibilities" (Gay, 2000, p. 45). Simply put, teachers must aim to want the best for their students in all areas by first viewing them as *human beings* above anything else. Caring also involves having the same expectations from all students regardless of their cultural or linguistic differences from the mainstream students. Gay (2002) believes that teachers must know how to use 'cultural scaffolding' but it should not be misunderstood with overindulging students from minority backgrounds to the extent of leniency and negligence which leads to their falling behind. It is essential that teachers hold their students responsible and accountable for their success so that they can have the same opportunities as everyone else. Settlage and Southerland (2012) also believe that becoming informed about students' cultural norms will help in "creating a classroom environment supportive of students' sense of belongingness" (p. 337). One way in which

this can be accomplished is by designing a classroom showcasing scientific topics in different languages.

Cummins and Early (2015) state that if the classroom environment causes anxiety and stress for ELLs, it could cause distractions for them which could inhibit their learning and cause them to avoid socializing with their peers. Collier (2005) suggests that a culture of caring is not only beneficial for the student but will aid in reinforcing a positive relationship between the teacher and the students. She claims that this relationship is reciprocal where students receive support which enhances academic growth and social development and where teachers receive experiences of satisfaction and appreciation for the profession. In fact, Collier (2005) adds that "caring is the fuel for teacher efficacy working in tandem to create the stable, capable and committed teaching force required for the effective education for our nation's children" (p. 358). Hence, a culture of caring does not only aid in implementing culturally responsive pedagogical teaching practices for the students but also in turn, helps teachers have a stronger sense of efficacy and preparedness.

Cross-cultural communications.

In developing effective *cross-cultural communications*, teachers must acknowledge that styles of communication across cultures are different from the typical student-teacher dialogue in classrooms here (Gay, 2002). It is important to first understand that each classroom has its own protocol including the way teachers interact with their students, the level of formality or informality in the communication as well as the nonverbal communication that occurs in the classroom. Many ELLs are not familiar with these protocols which might be vastly different from those in their classrooms in

their home countries. For instance, a student who is used to a strict classroom environment where it is considered disrespectful to look at the teacher directly when speaking could be misconstrued as someone that is rude or uninterested during classroom communication in a Canadian classroom. These differences could directly or indirectly result in their underachievement as well. Gay (2000) claims that culturally and linguistically diverse students who are "most traditional in their communication styles and other aspects of culture and ethnicity are likely to encounter more obstacles to school achievement than those who think, behave, and express themselves in ways that approximate school and mainstream cultural norms" (pp. 77-78). Hence, it is important that teachers attempt to understand how similar or different communication styles are in various classrooms and then, make accommodations accordingly. In the science classroom, if students come from cultural backgrounds where doing group presentations is not common and thus, do not possess the competent skills of a cooperative group dynamic, teachers must give them alternate ways to complete required assignments to extract their full potential whenever the pedagogical context permits.

Cultural congruity in classroom instruction.

Cultural congruity in classroom instruction involves the actual delivery of instruction in diverse classrooms. Gay (2002) emphasizes that "Culture is deeply embedded in any teaching; therefore, teaching ethnically diverse students has to be *multiculturalized*" (p. 112; emphasis in original). Teachers must connect prior knowledge with new knowledge by giving multicultural illustrations which she calls 'pedagogical bridges.' It is also important for teachers to know that no matter how 'new' the knowledge they are teaching might be for ELLs, it is essential for them to connect it to

the ELLs' culture appropriately. It might also be worthwhile to understand how their prior knowledge is organized. Aikenhead and Otsuji (2000) state that a teacher must be a 'culture broker' who negotiates the cultural boundaries between the science curriculum and the students. In a science classroom, a teacher must use the ELLs' prior knowledge and teach them how to comprehend the new knowledge by connecting the bridge.

Integrating the Theories

The theoretical concepts of self-efficacy and culturally responsive pedagogy frame this investigation most appropriately due to the overlap between the two: Culturally responsive pedagogy is essential in ensuring that ELLs succeed in academics and teachers' self-efficacy is an important construct in understanding whether ELLs will succeed. Hence, if science teachers feel highly efficacious in their culturally responsive teaching abilities, then all students, especially ELLs will fare well in their academic endeavours.

There is sparse evidence of teachers' self-efficacy beliefs regarding the five competencies of culturally responsive pedagogy (Gay, 2002). Even the results that do exist are from studies that are not domain-specific (e.g., science). In terms of developing a knowledge base about the students' cultural backgrounds and developing cross-cultural communication, one study shows that preservice teachers are neither highly efficacious to teach diverse students about their own cultures' contributions to science nor in their ability to use a phrase in the ELLs' L1 (Siwatu, Polydore & Starker, 2009). As far as cultural caring is concerned, another study shows that Internationally Educated Teachers (IETs) are more empathetic toward ELLs but not necessarily more prepared to teach them by virtue of their background (Faez, 2012).

Research has shown that ELLs' cultures and languages need to be validated in the curriculum and instruction in order for them to succeed (Gay, 2000). As such, this study has tried to specifically understand science teachers' self-efficacy perceptions in relation to providing culturally responsive pedagogy. Hence, the two theories are compatible to the extent that they both strive to ensure the academic success of ELLs and have guided this study appropriately at every stage.

Literature Review

The literature on self-efficacy is very broad and includes an abundance of interdisciplinary research on a number of concepts related to the topic. Even though I perused the literature on many themes relevant to self-efficacy including preservice teachers' self-efficacy beliefs, collective self-efficacy beliefs, self-efficacy measurement scales and tools, students' self-efficacy, self-efficacy and professional development, self-efficacy and its effect on motivation, I have included a review of a few salient themes in order to maintain focus of the main goals of this study. Additionally, self-efficacy is inherently a psychological construct and this study is situated in the realm of Applied Linguistics. Hence, it was important to contextualize the areas within the research on self-efficacy to remain true to the essence of this study. Even though self-efficacy is a major focus of this study, the context (culturally and linguistically diverse classrooms) still remains integral to this research. Therefore, it was essential to ensure that the literature that I perused on self-efficacy dovetailed with the context of this study. In addition to self-efficacy, I also reviewed literature in order to understand the relationship between teachers' perceptions and practice, their perceptions of preparedness, their attitudes toward ELLs as well as science pedagogy in diverse classrooms. The literature

review focuses on the following five areas: (a) teachers' beliefs, (b) teachers' self-efficacy perceptions, (c) teacher preparedness, (d) teachers' attitudes toward ELLs and (e) science education in diverse classrooms.

Teachers' Beliefs

Considering that this investigation explores teachers' perceptions of self-efficacy to teach in diverse classrooms, it was important to first understand the concept of teachers' beliefs especially in their relation to practice. Pajares (1992) remarks on the elusive nature of belief and defines it as "an individual's judgement of the truth or falsity of a proposition" (p. 316). He provides a lengthy list of terms with which beliefs are often used interchangeably including perceptions, conceptions, ideologies and opinions among many others. Ashton (2015) has stated that research on teachers' beliefs has been abundant in the last couple of decades. Researchers believe one reason for this might be that beliefs have a tremendous impact on teachers' thought process as well as behaviour (Ashton, 2015; Fives & Buehl, 2008). Teachers' perceptions involving pedagogy, epistemology and self-efficacy among others act as filters and guides for how they interpret experiences, address challenges and take actions (Levin, 2015). Hence, investigating teachers' beliefs could provide insight into their behaviour in different teaching contexts.

A number of researchers have attempted to distinguish belief from knowledge (e.g., Buehl & Beck, 2015); a task Pajares (1992) has termed as "a daunting undertaking" (p. 309). However, he explains the distinction and concludes that belief is founded upon appraisal and judgement while knowledge is based on empirical fact. For instance, a teacher might be knowledgeable about the importance of maintaining ELLs' L1 in theory

but might still hold the belief that ELLs should restrict their use of L1 in the classroom. Even though there is a distinction between the two concepts, beliefs and knowledge are closely related considering that practical knowledge generally guides their behaviour (Levin, 2015).

Researchers inform us that teachers have numerous beliefs about aspects including their work, their students and their knowledge base among others (Pajares, 1992; Buehl & Beck, 2015; Levin, 2015). Pajares (1992) remarks on the connectedness of beliefs held by individuals. A teacher's belief on a particular aspect in his or her classroom may be connected to a belief he or she holds about the broader society, concepts of race or ethnicity or even family. Buehl and Beck (2015) believe that some beliefs are explicit while others may be implicit but "all beliefs exist within a complex, interconnected, and multidimensional system" (p. 66). As a result, when it comes to studying teachers' perceptions, it is important that the context in which they are being investigated be defined specifically considering that "teachers' beliefs and actions cannot be separated from situations in which they occur" (Pajares, 1992, p. 51).

One aim of investigating the nature of an individual's or a collective's beliefs is to be able to understand their resulting behaviour considering that thoughts and beliefs precede actions (Bandura, 1997; Buehl & Beck, 2015). However, the relationship between beliefs and their enactment (practice) is more complicated than may be perceived. Buehl and Beck (2015) provide a review of studies confirming three types of possible relationships that exist between beliefs and practice. First, there is existing research on the nature of beliefs as being precursors to practice. The authors claim that studies have identified teachers' beliefs through quantitative and/or qualitative methods

and then, corroborated their enactment through observations. Second, there also exists research which states that in fact, the relationship between beliefs and practice is the other way around in that engaging in certain actions shape teachers' beliefs (Buehl & Beck, 2015). Finally, another set of research studies shows that there is no relationship between teachers' beliefs and practices whatsoever. As a result, the authors conclude that beliefs and practices do have an impact on one another and that the nature of this relationship varies across individuals, contexts as well as the types of beliefs being investigated. They believe that despite the conflicting evidence regarding the connection between belief and practice, "this lack of congruence is no reason to discount the power of beliefs" (Buehl & Beck, 2015, p. 66). When it comes to self-efficacy beliefs, many have stated that individuals are more likely to enact their beliefs when they feel highly efficacious about certain practices (Bandura, 1997). Hence, a study into teachers' self-efficacy beliefs could highlight the pedagogical aspects teachers are likely to enact and those that they are not due to low efficacy.

Many have remarked on the malleability of beliefs as well. Pajares (1992) states that "the earlier a belief is incorporated into the belief structure, the more difficult it is to alter, for these beliefs subsequently affect perception and strongly influence the processing of new information" (p. 317). Bandura (1997) has also noted that once beliefs are formed, they usually maintain their stability thereafter. In fact, Pajares (1992) warns that even though some beliefs may be held based on incorrect information, individuals will most likely continue to hold on to them even if those beliefs are proven wrong by logic and knowledge. This is extremely important to take into account in the realm of education especially in the context of diverse classrooms. Gay (2015) brings this issue to

light when she remarks that "Because these beliefs have profound consequences for the learning opportunities African, Asian, Pacific Islander, Latino/a, and Native American students receive in classrooms, they need to be carefully analyzed" (p. 436). The author further states that when it comes to the notion of classroom diversity, teachers' beliefs and their resulting actions are intimately linked. Additionally, much of the research in this area involves preservice teachers and that inservice teachers are largely absent from reports (Levin, 2015; Gay, 2015). Hence, this study aims to contribute to this gap through an investigation into inservice teachers' self-efficacy beliefs on culturally and linguistically relevant pedagogical practices in science.

Teachers' Self-Efficacy Perceptions

Woolfolk Hoy and Spero (2005) define self-efficacy beliefs as "a future-oriented judgement that has to do with perceptions of competence rather than actual level of competence" (p. 344). Bandura (1995) states that high self-efficacy beliefs are a must for any individual to innovate or carry out social reforms of any magnitude. There is no doubt that teachers are viewed as social reformers and innovators of society. Teachers do not only have a significant impact on the next generation of citizens they teach but also have a hand in preparing future social reformers and innovators. If it is an essential necessity that social reformers have high levels of self-efficacy beliefs and it is stated by many that "if a teacher believes he or she will succeed in teaching a subject or lesson, he or she is more likely to do so" (Gunning & Mensah, 2011, p. 174), then it is of extreme importance that self-efficacy perceptions of teachers be studied extensively. In this section, I explore teachers' self-efficacy perceptions in relation to: (a) student motivation and achievement, (b) diverse classrooms, (c) teachers' demographic characteristics.

Many have pointed out that there is a positive correlation between teachers' self-efficacy beliefs and student achievement (e.g., Bandura, 1995) and this also holds true for science teachers specifically (e.g., Bolshakova, Johnson & Czerniak, 2011). Bandura (1977) articulates this perfectly:

> Not only can perceived self-efficacy have directive influence on choice of activities and settings, but, through expectations of eventual success, it can affect coping efforts once they are initiated. Efficacy expectations determine how much effort people will persist in the face of obstacles and aversive experiences. The stronger the perceived self-efficacy, the more active the efforts (p. 194).

Woolfolk Hoy and Spero (2005) also note that "teachers' self-efficacy beliefs appear to affect the effort teachers invest in teaching, their level of aspiration, and the goals they set" (p. 345). Hence, if highly self-efficacious teachers tend to expend more effort in the face of any challenge having to do with science instruction for all students, especially ELLs, the automatic consequence of this will be high levels of student achievement. Bandura (1995) believes that "schools in which the staffs collectively judge themselves as powerless to get difficult students to achieve academic success to convey a group sense of academic futility that can pervade the entire life of the school" (p. 21). Bolshakova et al. (2011) reiterate that increased levels of teacher efficacy had a positive impact not only on student achievement but on student efficacy in their study. The authors further state that science teachers' perceptions of their own capabilities were strongly associated with "future science achievement and science-related careers of their students" (p. 961).

Mojavezi and Tamiz (2012) looked at the relationship between teachers' self-efficacy and student motivation and achievement in Iran and discovered that teachers with high levels of self-efficacy had a positive impact on student motivation. However, more interestingly, their research findings show that even though self-efficacy is a trait which requires to be studied in specific contexts for accurate results, the relationship between teachers' self-efficacy and student success is consistent across cultural and educational contexts. Hence, teachers' self-efficacy beliefs are a significant factor in student motivation and success.

Bandura (1995) also identifies the increasing number of culturally and linguistically diverse students across classrooms and schools. He remarks that socioeconomic status and aspects of diversity are important factors of success as well. He further states that "The higher the proportion of students from lower socioeconomic levels and of minority status, the lower the staff's collective beliefs in their efficacy to achieve academic progress, and the worse the schools fare academically" (Bandura, 1995, p. 21). Many students from minority language and culture groups underachieve in schools today. Siwatu et al. (2009) also state that because of the challenges faced by teachers teaching in diverse urban settings, "it is important that the faculty believe in their collective ability to help students succeed" (p. 3).

Researchers have suggested that culturally and linguistically diverse students do not always find the curriculum and instruction relevant to their experience (e.g., Siwatu, 2011b; Gay, 2000). Siwatu (2011b) conducted a study to explore preservice teachers' (N = 192) self-efficacy-forming experiences by employing a survey examining their self-efficacy on culturally responsive teaching practices and interviews. His findings show

that those who had previously had experiences with culturally responsive teaching theory as well as practices had higher self-efficacy than those without any pedagogical or field experience on the topic. Weinstein (1988) reports on a study exploring preservice teachers' (N = 118) expectations about the first year of teaching through a 33-item questionnaire. She found that participants in the study estimated the difficulties they expected to face in regards to student motivation, organizing classroom activities, relating to their students' families and dealing with individual differences while overestimated the difficulty of teaching students from diverse cultural backgrounds.

Siwatu (2011a) conducted a study where he examined teachers' perceptions of self-efficacy when they taught in an urban school compared to a suburban school. The urban school had more students belonging to visible minority groups while the teachers were predominantly White whereas in the suburban school, most students and teachers were White. The results from the study shows that preservice teachers felt more efficacious to teach in a suburban school compared to an urban school. In their review of the literature, Sharma, Loreman and Forlin (2012) also conclude that "a teacher who has high teacher efficacy in teaching Mathematics will not necessarily have high efficacy in teaching languages" (p. 13). Chia-Ju, Brady and Houn-Lin (2008) also state why self-efficacy must be studied in particular contexts:

> a teacher's overall belief of self-efficacy may not properly represent the individual's beliefs about his or her ability to execute effective programs in specific subjects such as science. To be effective in teaching science, it is imperative that the teacher's teaching self-efficacy belief is science specific (pp. 20-21).

Raudenbush et al. (1992) report results from a study they conducted on 315 teachers who taught 1,258 classes in total from 16 different High Schools across California and Michigan. Their study examined how one teacher's self-efficacy varies across classes or *intrateacher variation* and how self-efficacy varies among teachers or *interteacher variation* on a series of variables. In terms of intrateacher variation, their results showed that self-efficacy is highly dependent on the stream of the classroom such that those who taught honours and academic classes were more efficacious than those who taught students in the vocational track. Also, teachers reported a much higher sense of self-efficacy when they taught younger students. Self-efficacy was high when there was a match between a teacher's educational background and interest and the subject that he or she taught. Finally, teachers who taught larger classes reported a higher sense of self-efficacy in comparison to those who taught smaller classes. In terms of the interteacher variation, the most significant finding showed that teachers who had higher control over issues of instruction and professional collaboration reported higher self-efficacy. Hence, self-efficacy beliefs can be expected to change as the external context changes which calls for a necessity to study teachers' self-efficacy beliefs in particular contexts.

Tschannen-Moran and Johnson (2011) explored teachers' (N = 648) self-efficacy perceptions in terms of literacy instruction and found that a number of contextual factors influenced their self-efficacy. They examined the impact of grade-level taught (elementary or intermediate), school context (population of students from lower socioeconomic backgrounds) and the school setting (urban, suburban or rural) on teachers' self-efficacy through two survey questionnaires. The findings showed that even

though the effect size was small, suburban teachers and those teaching in schools with a higher proportion of students from a low socioeconomic status had a higher mean self-efficacy for literacy instruction. However, in a previous study conducted by Tschannen-Moran and Woolfolk Hoy (2007) examining the impact of contextual factors including school setting (urban, suburban or rural) on teachers' self-efficacy, they found that the variable was unrelated to self-efficacy. The results were in contrast with their original hypothesis which was the prediction that those teaching in urban schools would face more challenges in comparison and thus, would have a lower self-efficacy measure.

A number of researchers have pointed out that a majority of the teachers are from mainstream background in that they are White, mostly female and monolingual and have expressed a need for the self-efficacy perceptions of teachers belonging to diverse backgrounds to be studied (Fehr, 2010; Levin, 2015; Gay, 2000, 2015). Research examining the correlation between self-efficacy and the languages spoken by the teachers specifically is sparse. Studies have examined the impact of teachers' cultural backgrounds but very rarely do they include their language backgrounds. With studies that have looked at teachers' cultural and ethnic backgrounds, the categorization has not been broad enough. One study by Tschannen-Moran and Woolfolk Hoy (2007) which examined the potential sources of teachers' self-efficacy perceptions included a single category whereby teachers could select the racial or cultural group with which they identified most. However, the study only provided three options including European American, African American and Latinas, Asian/Pacific Islanders & Others. All of the participants that were not European American or African American were grouped under

one broad sub-group. Moreover, this study did not take into account the teachers' linguistic backgrounds.

Fehr (2010, p. 273) acknowledges that the prototypical teacher candidates are "White, 20'ish, middle-class, and monolingual young women" who do not share their students' characteristics. The author further adds the importance of studying teacher candidates who come from diverse backgrounds that are different from the typical teacher candidates so that they can provide appropriate culturally relevant pedagogy to their students. In her study, she presents a qualitative case of one teacher candidate who is very different from the typical teacher candidates she describes. However, the difference in her participant compared to the other teacher candidates is in terms of enduring a difficult childhood and adolescence. Even though the author recognizes the need to study those who are multilingual (among other aspects), she does not explore other factors of diversity such as the language background of her participant.

Coady, Harper and de Jong (2011) report on a study about a preservice program which had incorporated an ESL-infused teacher education component in Florida which has the fourth largest population of ELLs in the United States. They explored how graduates from this particular program ($N = 85$) who were now elementary teachers, perceived their level of preparedness and effectiveness to teach ELLs. Among other measures, the researchers administered a survey looking at the teachers' effectiveness and preparedness to work with ELLs in terms of five domains: (a) social and cultural dimensions of teaching, (b) content area instruction, (c) language and literacy development, (d) curriculum and classroom organization and (e) assessment issues. One of the variables included teachers' proficiency in a language other than English

considering that one-quarter of the population spoke a second language (primarily Spanish). Findings revealed that teachers who spoke a language other than English felt significantly more prepared to teach ELLs in each of the domains of the survey. The authors conclude that "Teachers' personal experiences learning additional languages may provide them with unique insights into language structure and language-learning strategies and can help them to develop empathy and respect for ELLs facing the challenge of learning language and content simultaneously in school" (p. 235). The few studies that have included a look into the languages spoken by teachers present interesting findings. Hence, this study contributes to the gap by examining the correlation between teachers' linguistic background and their perceived self-efficacy.

If self-efficacy has to do with personal judgements regarding one's capabilities, a lay person might assume that self-efficacy perceptions increase with experience. As one gains more experience at a particular job, his or her self-efficacy must technically increase, as a result. With this understanding, it could be predicted that broadly speaking, novice teachers would have lower self-efficacy which would develop over time. Youngs and Youngs Jr. (2001) also state that "With respect to age, one is tempted to argue that increased age (or teaching experience or both) means increased maturity, tolerance of diversity, and an evolving understanding of the teacher's role" (p. 104). However, research on the impact of experience on a teacher's self-efficacy perceptions has shown conflicting results (e.g., Chan, 2008; Putman, 2012). Bandura (1997) has noted that once an individual's self-efficacy perceptions are formed, they are resistant to change. Tschannen-Moran and Woolfolk Hoy (2007) add that "It might seem as though teaching experience would be related to teachers' self-efficacy beliefs, but if self-efficacy beliefs

tend to be fairly stable once set, then they would not necessarily tend to increase as years of experience increase" (p. 952). Some studies have shown that experience has a considerable influence on self-efficacy (e.g., Tschannen-Moran & Woolfolk Hoy, 2007) while others have shown that experience has little influence on teachers' self-efficacy (e.g., Chan, 2008).

Tschannen-Moran and Woolfolk Hoy (2007) conducted a study looking at the impact of two sources of self-efficacy namely mastery experiences and verbal persuasion on teachers (N = 255) grouped as novice (n = 74) and experienced (n = 181). Mastery experiences are essentially interpretations of one's performance while verbal persuasion entails positive reinforcement from friends and colleagues (Bandura, 1997). The researchers defined novice teachers as those with three or fewer years of teaching experience and experienced teachers (which they refer to as "career teachers") with four or more years of teaching experience. They hypothesized that since novice teachers have fewer mastery experiences, "other sources of self-efficacy would play a more prominent role in the formation of their self-efficacy beliefs" (p. 945). The researchers employed a self-efficacy survey (Teachers' Sense of Efficacy Scale) which measures teachers' self-efficacy in a number of domains including student engagement, instructional strategies and classroom management and other items which assessed perceptions of support with their teaching performance. It was found that overall, novice teachers had slightly lower self-efficacy perceptions than experienced teachers with regards to classroom management and instructional strategies but there were no differences between the groups in terms of student engagement.

The findings further showed that the two sources of self-efficacy (mastery experiences and verbal persuasion) differed among the novice and experienced sub-groups. Verbal persuasion in the form of interpersonal support by school administrators, colleagues, parents and the community had a more significant impact on the novice teachers' self-efficacy beliefs in comparison to mastery experiences. The researchers explained that those with low self-efficacy tend to rely on positive persuasion from others around them especially when they do not have an abundance of previous experience to rely on. In contrast, mastery experiences had a greater influence on experienced teachers' self-efficacy perceptions in comparison to the other contextual factors including the availability of resources and verbal persuasion such as interpersonal support from others.

Chan (2008) assessed the global and domain-specific self-efficacy perceptions among Chinese preservice and inservice teachers ($N = 273$) teaching in Hong Kong. He employed three different scales to measure general, collective and domain-specific self-efficacy perceptions of preservice teachers (comprised of two groups where $n = 91$ had no student teaching experience and $n = 97$ had one month of student teaching experience), novice teachers who had between one and two years of experience ($n = 51$) and experienced teachers with experience ranging from three years to 19 years ($n = 34$). The findings show that teachers felt most efficacious in terms of teaching highly capable students and in guiding and counselling students while the least efficacious in terms of managing student problems and engaging students to value education. The low level of self-efficacy in classroom management and student engagement was consistent among the preservice and novice groups. The experienced teachers had substantially higher global and collective self-efficacy compared to the preservice and novice groups

regardless of whether they had completed student teaching. The author acknowledges that his previously held hypothesis that preservice teachers have unrealistically high self-efficacy prior to gaining student teaching experience which then drops afterwards was not supported by the findings of this study. In fact, his study showed that self-efficacy levels increase as teachers complete their teacher education program and transition to novice and then, are maintained as they eventually reach the experienced stage.

In his study, Putman (2012) examined the self-efficacy of preservice teachers, novice teachers as well as experienced teachers (N = 484) in terms of student engagement, instructional strategies and classroom management. He divided the preservice group into those who had completed student teaching (n = 240) and those who had not (n = 64). He defined novice teachers as those with three or fewer years of experience (n = 57) and experienced as those with three years or more experience (n = 123). The findings showed that overall, preservice and novice teachers scored significantly lower than experienced teachers. The author explains that the underlying reason might be the fact that experienced teachers have accumulated more mastery experiences, which are considered to be the most significant source of self-efficacy, than the novice and preservice groups. Interestingly, similar to Chan's (2008) study, the self-efficacy beliefs of the preservice and novice groups were similar despite the variation in the preservice sub-groups. This finding is especially interesting considering the fact that one sub-group among the preservice teachers had not had any teaching experience at the time of this study. This shows that teaching experience had no impact on their self-efficacy appraisal. Also, even though the preservice and novice groups had significantly lower self-efficacy than the experienced groups overall, the differences did not differ

significantly in the domains of student engagement, instructional strategies and classroom management.

Other studies have shown conflicting results regarding the impact of experience on self-efficacy. In their study looking at 648 teachers' self-efficacy perceptions with regard to literacy instruction, Tschannen-Moran and Johnson (2011) explored whether teaching experience was influential in lowering or raising their self-efficacy perceptions. Results from the ANOVA showed that experience was unrelated to the teachers' self-efficacy beliefs. They further discuss that if teachers begin with a high sense of efficacy, they will build on that strong belief through experience whereas those who begin with a low sense of efficacy are likely to only engage in actions that reinforce those beliefs.

Citing inconsistencies in the literature looking at the impact of experience on self-efficacy, Putman (2012) has called for further research on the topic. He acknowledges that only a "few studies have been conducted examining differences in efficacy among groups of teachers with varying levels of experience" (p. 26). This study contributes to this gap by exploring the impact of teaching experience on the self-efficacy perceptions of novice and experienced teachers.

Teacher Preparedness

Flores and Smith (2008) state that while studying teachers' beliefs about student diversity is important, an investigation of teacher preparedness to operate in diverse classroom contexts is even more important. As stated earlier, teacher preparedness is the strongest indicator of teachers' self-efficacy (Darling-Hammond et al., 2002). Research has shown that despite increasing diversity in the classrooms, there is a shortage of information in terms of teachers' preparedness levels to teach ELLs (Faez, 2012; Fehr &

Agnello, 2012). Webster and Valeo (2011) note that "It is commonly believed that ELL-related knowledge is the special domain of ESL/ELL specialists; yet such knowledge has become necessary for all teachers who plan to educate children successfully in Ontario schools" (p. 113). Lucas et al. (2015) among others have claimed that many teachers do not feel very prepared to teach in diverse classrooms and as a result, prefer not to have ELLs in their classrooms. The research in this area has essentially looked at the correlation between teacher preparedness and aspects such as exposure to diversity and ELLs, the subject taught and the teachers' own cultural and linguistic backgrounds.

Christiansen et al. (2004) acknowledge the challenge educators face in providing the same access to the curriculum for ELLs as other students. They studied preparedness of secondary school teachers (N = 692) to teach ELLs in three school districts in the state of Utah. The goal of the study was to test four hypotheses regarding the sources of preparedness to teach ELLs: (a) the amount of exposure to ELLs, (b) ESL or multicultural training, (c) external experiences with diverse cultures or languages and (d) subjects taught. Their findings show that regardless of the amount of exposure to ELLs, all teachers expressed feelings of unpreparedness to teach ELLs. It was hypothesized that teachers who had received specialized training would feel more prepared to teach ELLs but no significant differences were found between those who had received ESL-inclusive training and those who had not. The researchers had also hypothesized that those who had accumulated previous experience with diversity such as learning a foreign language would feel more prepared to teach ELLs. However, there were no significant differences between teachers who had had previous experience with diversity and those who had not. It was found that "Teachers with additional cultural/language experience did feel *slightly*

more prepared to teach LEP students, and *slightly* less frustrated when teaching, but it was concluded that outside experience alone was not sufficient to prepare teachers for educating LEP students" (Christiansen et al., 2004, p. 76; emphasis in original). Also, the type of subject taught by the teachers did not play a role in their feelings of preparedness. Hence, none of the factors that the authors explored had any influence on the teachers' feelings of preparedness to teach in diverse classrooms.

Studies have also shown that a common cultural and linguistic background between teachers and students and increased knowledge about multiculturalism also contributes very little to teacher preparedness in diverse classrooms. In her study, Faez (2012) shows that a common background between the students and the teachers may lead to a higher sense of empathy and understanding but it does not automatically lead to increased preparedness to teach diverse classrooms. She explored self-perceived preparedness to teach ELLs among preservice Canadian-born and Internationally Educated Teacher Candidates (IETCs) ($N = 25$) from diverse linguistic and cultural backgrounds. The objective of the study was to elicit information regarding their perceived level of empathy and preparedness to teach ELLs as well as level of responsibility towards developing ELLs' linguistic proficiency in the classroom. It was found that IETCs had higher perceptions of empathy toward ELLs as a result of a shared background as well as an increased self-perceived understanding of diversity-related issues as opposed to the Canadian-born group. Even though IETCs reported higher empathy toward ELLs, they indicated a lower sense of responsibility toward ELLs than teacher candidates who received ESL-inclusive pedagogy. The findings indicate that highly empathetic teachers do not automatically adopt ESL-inclusive teaching practices

and conclude that all teachers, regardless of cultural and linguistic backgrounds require appropriate preparation to teach ELLs.

Similar to the previous study, Wasonga (2005) also found that simple knowledge of multiculturalism was not enough for teacher candidates in her study to feel more prepared to teach ELLs. She studied the impact of a course of multiculturalism on three classes of preservice teachers on multicultural knowledge base, attitudes and feelings of preparedness to teach ELLs. Using a case study methodology, pre- and post-tests found no correlation between multicultural knowledge and attitudes as well as between multicultural attitudes and feelings of preparedness to teach ELLs. The author explains that teacher preparedness in teaching diverse classrooms needs to go beyond merely including courses in multicultural education. Fehr and Agnello (2005) also explored preparedness in terms of culturally responsive pedagogy for teacher candidates ($N = 225$) and found that courses on diversity do not have a strong influence on increasing levels of preparedness. Overall, they found that most candidates were unfamiliar with the types of diversity that exists in the classrooms and highlight an explicit need to teach preservice teachers about culturally relevant pedagogical practices.

As shown by the literature review, courses on diversity in teacher education programs, exposure to diversity through other ways or a shared background with the students have done little to prepare teachers to teach in diverse classrooms. Since feelings of preparedness is the strongest indicator of teachers' self-efficacy, exploring teachers' self-efficacy perceptions on specific culturally responsive pedagogical practices would be worthwhile in informing the field about the particular areas that teachers find challenging

in teaching ELLs. Although indirectly, this study makes a valuable contribution to the research on teacher preparedness in diverse contexts.

Teachers' Attitudes toward Diverse Classrooms

It has become critical to explore mainstream teachers' attitudes and perceptions toward diversity in the classrooms considering that their beliefs toward ELLs are likely to influence what they will learn (Byrnes, Kiger & Manning, 1997; Youngs & Youngs Jr., 2001; García-Nevarez et al., 2005). Dooly (2005) goes a step further and states that "the teachers' perspectives about multicultural and multilinguistic components within a classroom can have far-reaching impact on educational opportunities and, consequentially, influence employment life opportunities for many students in the diverse classroom" (p. 99). It has been suggested that research on mainstream teachers' attitudes on ELL inclusion is scarce (Reeves, 2006) and the relationship between ELLs' linguistic backgrounds (Flores & Smith, 2008) and cultural backgrounds (Yoon, 2008) even scarcer. Gay (2015) brings to attention that most of the research on teachers' beliefs on cultural diversity involve prospective teachers and that "classroom teachers are largely absent from the research studies and scholarship reported" (p. 437). Several themes have emerged within the literature on teachers' attitudes regarding diversity in the classroom which I present in this section.

Walker, Shafer and Iiams (2004) note that the dominant societal attitudes about diversity can influence teachers' perceptions which they bring into the classroom and this could be detrimental if those attitudes are negative. Therefore, the researchers remark on the urgency of understanding teachers' attitudes toward diversity. A number of studies have shown that many teachers believe that the United States is an English-speaking

country and hence, English should be the only medium of instruction. As a result, studies have also revealed many teachers' believe that ELLs should discontinue using their L1 in the classroom. Dooly (2005) also notes that the significance of how teachers categorize ELLs "within the context of linguistic diversity cannot be understated. The attitudes of language teachers towards diversity will have repercussions in the teachers' behaviour and teaching schemes once they are inside the classroom" (p. 108).

Research has shown a number of misconceptions held by teachers regarding ELLs' native languages as well as their acquisition of English (Lucas et al., 2015; Lee & Oxelson, 2006). In a qualitative study set in Ontario, Webster and Valeo (2011) examined the perceptions of novice elementary teachers (N = 6) regarding ELLs in their classrooms and found that ELLs' needs were thought of as being similar to those of students with disabilities. Another misconception was the teachers' belief that mere exposure to the curriculum in English was sufficient for ELLs to gain proficiency. In her study of American secondary teachers' (N = 279) attitudes and perceptions of ELL inclusion, Reeves (2006) also found that almost 72% believed that ELLs should be able to acquire proficiency in English within two years of enrolling in an American school. Additionally, it was found that nearly 40% agreed that ELLs should discontinue the use of their native language in school. Dooly (2005) analyzed the perceptions of language teachers in Spain toward diverse students. She remarks that foreign language teachers can prove to be crucial in the integration of culturally and linguistically diverse students since they have an advantage due to their background in culture and language acquisition as well as metalinguistic awareness as a result of being bi/multilinguals themselves. However, in her study of preservice and inservice foreign language teachers (N = 61), she found that

inservice teachers did not see incorporating the language learners' L1 as a positive factor which would aid in their self-confidence in the classroom. Walker et al. (2004) conducted a mixed methods study administering surveys to mainstream teachers (N = 422) teaching in the K-12 division and interviews (N = 6) of ESL teachers to explore the nature and extent of teacher attitudes toward ELLs in what they refer to as 'The Great Plains state' in the United States. Findings from their study also showed that 15% of teachers felt that ELLs learn better if they are prevented from using their L1 in the classroom and 7% believed that ELLs should be able to acquire proficiency in English after one year of ESL instruction.

Research has also shown inconsistencies in teachers' attitudes toward the inclusion of ELLs in the mainstream classrooms. Even though many teachers feel that ELLs were welcome in their schools, they do not want any in their own classrooms. A study of secondary teachers by Reeves (2006) revealed that there is a discrepancy between teachers' general attitudes toward ELL inclusion and specific factors related to ELL inclusion. Even though overall, teachers held a welcoming attitude toward ELL inclusion, more than 40% did not believe that all students benefitted from the inclusion of ELLs in their classrooms and 75% believed that ELLs should not be in mainstream classrooms without having attained a minimum proficiency in English. Nearly 70% also reported that they did not have enough time to attend to the needs of ELLs. Walker et al.'s (2004) findings also revealed that the overall nature of teacher attitudes toward ELLs ranged between neutral to strongly negative across different demographic categories and schools within diverse community contexts. At 70%, the majority was not actively interested in having ELLs in their classrooms. Paradoxically, 62% felt that their schools

were open and welcoming to ELLs and embraced their native cultural and linguistic diversity while 78% felt that linguistically diverse students brought the required diversity to schools. The researchers state that the participants' political correctness could be the cause for this paradox in the findings.

Research has also focused on uncovering factors that may influence a teacher's perceptions toward diversity in the classroom. Studies have shown that teachers who understand the students' language and cultural backgrounds are sensitive to their students' needs. García-Nevarez et al. (2005) investigated Arizona elementary teachers' attitudes toward the use of ELLs' L1 (Spanish) in the classroom. The total population (N = 152) included bilingual teachers (n = 47), ESL teachers (n = 31) and regular (mainstream) teachers (n = 74). Survey and focus group data findings show that bilingual teachers believed that using Spanish in the class elevated the ELLs' self-esteem. On the other hand, ESL teachers and mainstream teachers were less supportive of using Spanish for instructional purposes. In particular, the mainstream teachers had the most negative attitudes toward using the ELLs' L1 in the classroom. They believed that curriculum in the elementary grades should exclusively be taught in English. The researchers also examined the impact of experience and the teachers' ethnicity on their attitudes toward ELLs' L1 use in the classroom. Their findings revealed that Latino teachers had more positive attitudes than non-Latino teachers. Also, interestingly, the more teaching experience a teacher had accumulated, the more negative were his or her attitudes toward the ELLs' L1.

Youngs and Youngs Jr. (2001) examined mainstream teachers' attitudes toward ELLs and explored possible predictors of those attitudes. The researchers propose a

model of six possible predictors (although they only report on the first five) of mainstream teachers' attitudes toward teaching ELLs based on previous research on the topic: (a) general educational experiences, (b) specific ESL training, (c) personal contact with diverse cultures (e.g., travel abroad), (d) prior contact with ELLs, (e) demographic characteristics (e.g., gender) and (f) personality. They employed a survey to junior high and middle school mainstream teachers (N = 143) exploring their perceptions on ELL inclusion in light of five (i.e., a, b, c, d & e) possible predictors. Findings show that mainstream teachers' attitudes toward teaching ELLs ranged from generally neutral to slightly positive. It was also found that the five predictors had some influence on the mainstream teachers' attitudes. Teachers were more likely to have positive attitudes toward ELLs if they: (a) worked in the humanities, social sciences or natural/physical sciences and had taken a foreign language course or a multicultural education course, (b) had some sort of ESL training, (c) had experience living or teaching outside of the United States (d) had interacted with a culturally diverse population and (e) were female. In a study examining mainstream teachers' (N = 191) language attitudes, Byrnes et al. (1997) also found that formal training and a graduate degree were associated with having positive attitudes toward linguistic diversity in the classroom. Overall, it was found that teachers who had more experience with language-minority children were more likely to have a positive orientation toward student diversity.

Some researchers have shown that a shared ethnic or cultural background with the students does not necessarily guarantee sensitivity and compatibility. Lee and Oxelson (2006) have stated that teachers do not necessarily have to belong to their ELLs' backgrounds in order to reinforce the importance of maintaining their home languages

and cultures. Additionally, Flores and Smith (2008) note that teachers who perceive linguistic diversity as negative are not always from linguistically diverse groups themselves. They conducted a study to examine how the teacher characteristics of ethnicity, language proficiency and the amount of diversity training intersected with teachers' attitudinal beliefs regarding four proposed constructs: (a) the belief that ELLs' L1 was a problem, (b) the belief that the scope of teaching should be depersonalized (uncaring and unemotional), (c) the belief that minority groups should either be excluded or assimilated in the school system and (d) the belief that the responsibility of ELLs' academic failure lay with them and their families and not with the school. The researchers used a 34-item survey with generalist teachers (N = 564) teaching in South Texas. Participants comprised of two large groups with 41.3% Hispanic and 52.5% White, non-Hispanic. Overall, teachers held a moderate orientation toward linguistic diversity in the classroom. The findings show that not all teachers responded with a positive orientation toward each of the constructs. Some teachers viewed ELLs' L1 as a "gatekeeper" to the entire schooling experience and some generally believed that the lack of English and exclusive attention to mainstream culture in the curriculum may result in ignorance and decreased learning potentialities for ELLs. Teachers were ambivalent in terms of caring and the responsibility of ELLs' failure being their family's problem. Additionally, teachers also believed that proficiency in English was symbolic of membership and citizenship in the American culture.

In terms of the ethnicity variable, Hispanics had more positive orientations toward the four constructs than European Americans. In terms of language proficiency, bilingual Hispanics were more positive than monolingual Hispanics in their views. Diversity

training was the most significant variable in that teachers with increased exposure to diversity training held more positive views toward linguistic diversity. It was found that Hispanics with limited diversity preparation were just as likely as their White counterparts to indicate negative beliefs about the constructs of linguistic and cultural diversity. Interestingly, the findings also show that years of experience alone did not ensure positive beliefs toward the four constructs. The researchers remark that since diversity training was the most significant variable, it is possible that although experienced, teachers who did not have diversity training during their teacher education programs did not feel positive toward classroom diversity, as a result. Novice teachers who while inexperienced may hold more positive views toward diversity due to having been exposed to diversity training during their teacher education programs. This finding was corroborated by a recent study by Tran (2015) examining teachers' perceptions of preparation and efficacy to support ELLs. It was found that efficacy beliefs were higher for those who held ESL certification through coursework and field experiences. As the literature review points out, teachers' attitudes toward ELLs vary by context. Hence, a study into science teachers' perceptions and attitudes toward ELLs in Ontario makes a contribution to the existing literature.

Science Education in Diverse Classrooms

In this section, I present a review of the literature in the area of science education in diverse classrooms including the role of science teachers to teach science to ELLs, an inclusive science curriculum and the nature of culturally responsive science teaching. With the number of ELLs increasing in schools, it has become important to recognize the challenges they face particularly in science classrooms as well as to develop a

comprehensive foundation to provide targeted science instruction to all students (Lee & Fradd, 1998). Even though studies in the past have looked at issues of diversity and equity in science, few have explored them in light of culturally responsive pedagogy in the science classroom (Kelly-Jackson & Jackson, 2011; Ryu, 2015).

Lee and Buxton (2008) address issues of the science curriculum for students belonging to nonmainstream culturally and linguistically diverse backgrounds. The science curriculum in North America is essentially derived from the Western perspective of scientific inquiry (Aikenhead, 2001). Boutte, Kelly-Jackson and Johnson (2010) phrase this phenomenon of a Eurocentric perspective of science as "scientific racism" (p. 11) and Aikenhead (2001) refers to it as "scientism" where "curricula attempt to enculturate all students into the value system of Western science" (Aikenhead, 2001, p. 337). Lee and Fradd (1998) state that a more traditional view of science education has been to teach the subject expecting that all students will comprehend the content when it is presented in a scientifically appropriate manner by the teacher. Aikenhead (2001) warns us of the consequences of a Eurocentric curriculum for ELLs. He remarks that the enculturation into Western science is not problematic for the mainstream students but when it comes to those from diverse cultural and linguistic backgrounds, it is an attempt at assimilating them into the Western culture. In turn, he states that most students will reject the attempt at assimilation considering that they do not identify with the Western culture to begin with. This leads to their alienation from society which as adults, results in a lack of cultural capital for effective participation in the Western society in which they live. Lee and Fradd (1998) also agree that this perspective has little regard for students' literacy skills as well as their linguistic and cultural understanding which may

account "for the underrepresentation and alienation of diverse students in science" (p. 13). However, for pedagogy to be meaningful, it must take into account students' cultural and linguistic backgrounds (Gay, 2000, 2002).

Aikenhead (2001) outlines a cross-cultural approach of teaching science to all students. Although he speaks of how to do so in the context of the Aboriginal culture, I believe that these characteristics can really be embedded within any cross-cultural model of teaching science for two reasons: (a) I believe that similar to Aboriginal students, Western science can truly feel like a foreign culture to ELLs from different cultural and linguistic groups and (b) I agree with the author in that Western science is embedded within the science curricula across many (non-Western) countries as well. The author states that first and foremost, it should be known that Western science itself has descended from one of the many subcultures of Euro-American society. Similarly, individuals are also entities living amidst multiple subcultures which include language, race, gender and class among many others. science classrooms are also subcultures of the broader school culture and when individuals move from one subculture to another, the process is referred to as "cultural border crossing" (Aikenhead, 2001, p. 339). It is essential to be mindful of the fact that all individuals' cultural identities may not necessarily be commensurate with those of Western science. As a result, many students will experience a cultural shift in their move from their culture to the classroom culture of science. Therefore, it should be understood that learning science is really a cross-cultural phenomenon for many ELLs. Also, students experience success if they receive assistance when negotiating these "cultural border crossings" (p. 339). Aikenhead (2001) reiterates that students will only be successful in science when they have learned how to cross the

cultural borders smoothly. Boutte et al. (2010) also remark that the main goal of culturally responsive pedagogy is academic success for all students and not simply an affirmation of students' cultures and languages.

Ryu (2015) recognizes that "It is certainly not trivial for teachers to connect to students' languages and experiences when they are not from the same racial and/or linguistic groups of the students, particularly when multiple groups co-exist in a science classroom" (p. 366). However, a number of researchers have shared the ways in which instruction in science can be made congruent with ELLs' cultures and languages (Lee & Fradd, 1998; Boutte et al., 2010; Ryu, 2015). Mensah (2011) believes that in order for students belonging to diverse cultural and linguistic groups to learn in culturally relevant ways, it is important that their teachers first learn and understand the principles of culturally responsive pedagogy themselves so that they can teach appropriately. Aikenhead (2001, p. 339) uses the metaphor of a "culture broker" to describe a teacher and asserts that, similar to any broker, teachers must be familiar with the cultural borders that need to be crossed. Not only must they guide their students across those borders but also inform them of the challenges that might come their way and teach the students ways to tackle those difficulties. Boutte et al. (2010) note the importance of being mindful that culturally relevant teaching in science is not reduced to a step-by-step recipe but a comprehensive framework of converting theory into practice. I outline some of the ways as revealed in the literature on how the notion of culturally relevant teaching in the science classrooms can be tackled.

First, it is essential to increase teachers' awareness about the aspects of diversity among their students. According to Ryu (2015), one way to accomplish this is through

professional development or teacher education programs where teacher candidates are encouraged to focus on the similarities and differences among varying aspects of diversity including English language proficiency, socioeconomic status, cultural and linguistic backgrounds. For instance, in a professional development workshop, teachers could be asked to explore the ways in which ELLs could be different from other students and the strengths that they contribute to the classroom. Lee and Fradd (1998) also argue that even though there are differences between and among groups, there are also commonalities that exist across groups which must be recognized.

The second approach is to give teachers sufficient time and opportunities to learn more about their students from diverse backgrounds. Boutte et al. (2010) add that this might possibly require additional reading about the students' cultural and linguistic backgrounds. Lee and Fradd (1998, p. 18) outline "an understanding and appreciation of students' language and cultural experiences" as essential in establishing congruence between the content and students' backgrounds. Ryu (2015) further remarks that "Teachers should also recognize that science classroom discourses are full of cultural references and linguistic practices to which some have access and some do not" (p. 366). As a result, discovering information about students' home lives, funds of knowledge, their use of language and their language learning environments could aid teachers in providing targeted instruction to all.

The third step is for teachers to raise their awareness regarding issues of power dynamics and unequal privilege in the classroom. Acknowledging the issues of power and privilege is in fact a "key aspect of crosscultural science education" (Aikenhead, 2001, p. 341). Additionally, Ryu (2015) brings to attention that teachers must also disrupt

inequality in another slightly different context within the classroom. During her study, the researcher noticed the socialization practices of the different cultural and linguistic groups in the classroom as well as in the common areas such as the cafeteria and discovered that students from a particular cultural and language group tended to associate with others that were similar. As a result of their lack of English language proficiency, ELLs felt intimidated to socialize with those who were American-born which did not contribute to building a classroom community, an element at the heart of culturally responsive pedagogy. Hence, she states that when teachers recognize this, "they can destabilize such rigid grouping and power dynamics and create more integrated classroom learning environments" (Ryu, 2015, p. 367). Doing so could lead to a change in the structure of classroom participation and toward a legitimization of ELLs' ways of knowing and cultural and linguistic practices.

Finally, Boutte et al. (2010) state that teachers must engage in restructuring their beliefs about the capability of students from various culturally and linguistically diverse backgrounds. Although their study focused on incorporating culturally relevant teaching in a science classroom with African American students, the authors declare at the outset about the transferability of these tenets to any diverse classroom context. Lee and Fradd (1998) have also affirmed that instead of focusing on the outcomes, teachers must view the performance progress of ELLs along a continuum toward academic success.

Researchers have stated that culturally responsive pedagogy has been discussed extensively in theory but little research has looked into classroom models of culturally relevant teaching in science (Boutte et al., 2010). As a result, teachers are unaware as to how to incorporate tenets of culturally responsive pedagogy in the science classroom.

Culturally responsive pedagogy in a science classroom aids in "bridging the distances between school instruction and ways of knowing and realities within the homes and communities of culturally diverse students" (Boutte et al., 2010, p. 2). Even though research in this context is scarce, a few researchers have attempted to specifically show what practising culturally relevant pedagogy could look like in a science classroom.

Aikenhead (2001) discusses how a collaborative team of six teachers, the researcher himself and Elders of an Aboriginal community in Northern Saskatchewan joined forces to integrate Western science and Aboriginal traditional knowledge. Essentially, the units in science were modified to suit the culture of the community and the locals were viewed as important resources for doing so. The teaching of a unit titled 'Wild Rice' began with local harvesters speaking about their work and connecting the students with the local culture in the science classroom. Thereafter, the teacher conducted a systematic overview of the topic reinforcing the knowledge by the local harvesters. In the next step, the class went to a site to plant seeds which also legitimized a personal connection with the Earth which is an essential part of the Aboriginal culture. The Aboriginal knowledge was then integrated by crossing the cultural border into Western science through a study in Biology on the topic, thus abiding by the curriculum guidelines. As teachers learned from the community members, they successfully demonstrated cultural border crossing for the students between the two cultures. As a result, the classroom became a place where the students' Aboriginal identities were legitimized and where cultural negotiations could take place. Consequently, the power was evenly shared and no longer only resided with the teacher. Learning about as well as valuing diverse cultures and infusing them with the curricular guidelines while ensuring

the equal distribution of power provides one illustration of how culturally relevant pedagogical practices can be enacted within a classroom.

Boutte et al. (2010) conducted a study looking at a science teacher's efforts in terms of culturally relevant teaching for African American students through the teaching of three topics. In one lesson, the teacher taught the class about 'cells' using a culturally relevant methodology. She used examples and analogies from students' own lives in teaching the content-specific vocabulary. The teacher also provided narratives of scientists of colour and of the female gender. In particular, the class discussed an African American scientist who pioneered the research on cells but had to leave the United States in the 1930s on account of racism. By discussing issues of gender and race inequality in this way, connections can be made to the broader geopolitical and sociopolitical contexts thus, creating a critical consciousness among the students which is one of the key elements of culturally responsive pedagogy. The authors reiterate that this way of inquiry proves that science is not decontextualized and can be discussed in terms of culture, language and race among other elements of social identity. Even though this study only looked at one teacher, findings showed that students were more engaged and the passing rate increased as a result of practicing culturally relevant pedagogy.

Kelly-Jackson and Jackson (2011) conducted a case study exploring how culturally responsive pedagogy was enacted through the pedagogical beliefs of one African American science teacher in a rural, low socioeconomic, diverse school. They found that teachers who practice culturally responsive teaching demonstrate three beliefs in their teaching. First, they understand their purpose for teaching as well as show an awareness of the importance of effective teachers in their students' lives and their

communities. Second, they create social relations with their students which in turn supports collaborative learning. Finally, culturally relevant teachers build on their students' existing abilities by helping them learn additional skills. They also view their students as co-constructors of knowledge and view the notion of knowledge as continuous.

One study shows the consequences of not including culturally responsive teaching in the classroom. Ryu (2015) studied reasons that made Korean ELLs in an Advanced Placement (AP) Biology class feel unsuccessful and disempowered. She conducted a year-long ethnography through the theoretical lens of 'figured world' which entails a socially and culturally constructed context of interpretation where only particular actors, actions and outcomes are recognized as significant over others. In the localized figured world of the AP Biology classroom, high scores on tests and verbal participation were acts that were considered as "legitimate." Through this framework, she explains that certain Korean students felt disempowered since they did not perform the expected roles in the figured world of their Biology classroom. She found that the way the ELLs were positioned in terms of class achievement, verbal participation and cultural and linguistic backgrounds were all intertwined with one another. These students were not considered as legitimate participants since they did not engage in extensive verbal participation in English, a language in which they still lacked proficiency. Even though they engaged in classroom participation on their own terms through their L1 and by drawing on their transnational experiences among other ways, their methods were not considered legitimate. This led to further reluctance in classroom participation. Their reticence to participate verbally also arose from their lack of English language proficiency and

negative experience of using their L1 in the classroom. Lee and Fradd (1998) also state that ELLs' "academic participation is influenced by their literacy development in home languages and in English" (p. 14). But if their L1 is not legitimized in the classroom, this could lead to lack of motivation and possible academic failure for many. Cummins and Early (2015) have stated that it could take up to five years for ELLs to catch up to their proficient English-speaking peers in the classroom. As a result, they remark that students whose L1 is different from the medium of instruction are at risk of facing educational difficulties. Also, in order to promote culturally responsive pedagogy in the classroom, an exploration into teachers' self-efficacy perceptions regarding culturally responsive teaching is of utmost importance to which this study contributes.

Summary

This chapter discussed the theoretical foundation and reviewed relevant literature in the area of teachers' self-efficacy perceptions to teach science in diverse classrooms. I explored the theories of self-efficacy and culturally responsive pedagogy and discussed their integration to inform the goals of this study. I also presented a discussion on the controversy surrounding the concept of self-efficacy and clarified the stance this study took on the topic. Thereafter, relevant literature in the area was discussed. I focused on a number of themes including teachers' self-efficacy perceptions, teachers' attitudes toward ELLs and culturally responsive teaching in science. The next chapter discusses the methodology employed in the study including the methods, the data collection procedures, ethical considerations and data analysis.

CHAPTER 3 METHODOLOGY

Introduction

The purpose of this study was to investigate the self-efficacy perceptions of Ontario's science teachers to teach in diverse classrooms. This study was a mixed methods investigation employing survey questionnaires and semi-structured interviews. The methodology employed in the study is discussed in this chapter in terms of the following eight topics: (a) mixed methodology, (b) triangulation, (c) validity, reliability and generalizability, (d) positioning myself as a researcher, (e) the ethics review process, (f) methods including the Culturally Responsive Teaching Self-Efficacy (CRTSE)[4] scale (Siwatu, 2007) and semi-structured interviews, (g) the research participants and (h) data analysis procedures.

Mixed Methodology

Mixed methodology is situated between the qualitative and quantitative ends of the methodological spectrum and employs methods from both. Philosophically, it is influenced by the pragmatist orientation (Cherryholmes, 1999; Tashakkori & Teddlie, 1998). It is positioned between a singular approach to viewing the world characterized by universal truths and multiple ways of viewing the world constituted by relative truths. Johnson, Onwuegbuzie and Turner (2007) define mixed methodology as "an approach to knowledge (theory and practice) that attempts to consider multiple viewpoints, perspectives, positions, and standpoints (always including the standpoints of qualitative and quantitative research)" (p. 113). Creswell (2003) states that the tradition of

[4] From this point forward, I use the abbreviation "CRTSE" to refer to the "Culturally Responsive Teaching Self-Efficacy" scale (Siwatu, 2007) which is the survey I have used in this study.

combining different methods originated in 1959 when multiple methods were used to study the validity of psychological traits by Campbell and Fiske. However, Johnson et al. (2007) state that the term *mixed methods* was coined many years later.

Mixed methods research has been referred to as blended research, integrative research and multimethod research but the term *mixed methods research* has been popular in the recent times (Johnson et al., 2007). There are many advantages of employing mixed methods research in a study as outlined by Creswell (2003): (1) results from one method can help in informing or developing those from another method, (2) one method can be placed within another method to provide understanding into different levels of analysis and (3) the usage of different methods can serve a transformative purpose of advocating for marginalized groups. The author further states that using multiple methods allows the researcher to do a better job of advocating for research participants from marginalized groups and better understand the process which may be changing as a consequence of being under investigation. Having multiple methods at one's disposal gives the researcher the liberty to use any method depending on the demands of the situation faced by the population being studied. Angouri (2010) states that if the quantitative approach is useful in generalizing findings and if the qualitative methodology helps provide in-depth and rich data, then, mixing both methodologies would contribute to a much better understanding of the phenomenon under study. Gay, Mills and Airasian (2009) state that the main purpose of conducting a mixed methods study is "to build on the synergy and strength that exists between quantitative and qualitative research methods to understand a phenomenon more fully than is possible using either quantitative or qualitative methods alone" (p. 462). Since the issue of science

teachers' self-efficacy perceptions to teach in diverse classrooms is an area that is not studied extensively, employing multiple methods added depth as well as breadth to my study.

Creswell (2003) states that four decisions go into a mixed methods study: (a) the implementation sequence of the qualitative and quantitative data collection, (b) whether priority will be given to the qualitative data collection and analysis or the quantitative, (c) the stage at which the qualitative and quantitative data and findings will be integrated and (d) whether an overall theoretical perspective will be used in the study. Subsequently, he outlines three general strategies of mixed methods studies:

(1) Sequential procedures: The study occurs in phases where the researcher begins with a qualitative method for exploratory purposes followed by a quantitative method for explanatory purposes or vice versa.

(2) Concurrent procedures: The researcher converges both the qualitative and quantitative phases of the study to provide a comprehensive analysis of the problem.

(3) Transformative procedures: Either the qualitative or the quantitative method is employed first where priority is given to either or both methods but the aim of theory is more important in guiding the study than the methods alone.

This study followed concurrent procedures in which the quantitative and the qualitative phases were carried out simultaneously. Equal priority was given to both the qualitative and the quantitative methods. Both phases were also integrated during the data analysis and discussion stages. The study also drew on a theoretical framework but it did not supersede in guiding the study more than the methods. The theories operated as a guide to

prepare the survey and interview questionnaires, to understand the research context and to comprehend the data during the analysis stage.

Triangulation

Employing different methods within one study necessitates integrating them in a logical manner which is known as triangulation (Creswell, 2003; Gay et al., 2009; Angouri, 2010). Tashakkori and Teddlie (1998) and Angouri (2010) among others quote Denzin's (1978) conceptualization of triangulation consisting of four types: (a) data triangulation which involves the use of more than one data source[5], (b) investigator triangulation which involves the use of several different researchers, (c) theoretical triangulation which involves the use of more than one theory and (d) methodological triangulation which involves the use of multiple methods. Additional types of triangulation have also been added by other researchers: (e) interdisciplinary triangulation which involves utilizing perspectives from other disciplines (Janesick, 1994 as cited in Brown & Rodgers, 2002), (f) time triangulation which involves data gathering over multiple time periods (Brown & Rodgers, 2002) and (g) location triangulation which involves the use of multiple data gathering sites (Brown & Rodgers, 2002).

In this study, triangulation was achieved (at every level except investigator triangulation) in terms of data collection, theoretical stances, methodological approaches, interdisciplinary perspectives, time as well as location. I collected data from multiple

[5] I am aware that "data source/s" could also be understood as the different methods (e.g., survey and interview) used to collect data. However, in this case, the phrase "data sources" refers to "the application of more than one sampling method for data collection" (Angouri, 2010, p. 34). For instance, data sources in this study include school boards and family and friends.

sources including school boards and through family and friends. I have also drawn on two different theories which are Bandura's (1995) self-efficacy and Gay's (2000) culturally responsive pedagogy to frame this study and I explained how they integrate in the previous chapter. Since this is a mixed methods study, I employed two different methods which are survey and interview to collect data. Even though this study is largely situated within the context of Applied Linguistics, I have drawn on the Social and Applied Psychology disciplines to understand social cognitive theory in general and the concept of self-efficacy in particular. Data were collected over three academic years[6] lasting from June 2014 to December 2015 and I gathered data at different times throughout the academic year. For instance, I interviewed one participant in June 2014 (toward the end of the 2013-2014 academic year), another participant in May 2015 (toward the end of the 2014-2015 academic year) while yet another in September 2015 (at the beginning of the 2015-2016 academic year). Finally, the survey and interview data that I collected have come from teachers teaching in different locations including schools belonging to a number of different boards across multiple cities in Ontario.

Validity, Reliability and Generalizability

Brown and Rodgers (2002) state that the merit of research studies can be judged through establishing validity and reliability for quantitative studies and through credibility, transferability, dependability and confirmability for qualitative studies. Since

[6] Considering that an academic year is from September to June, teachers teaching during roughly three academic years (September 2013-June 2014, September 2014-June 2015 and September 2015-June 2016) were included in this study.

this study employed both quantitative and qualitative methods, I have addressed all of these measures.

Muijs (2011) states that "The measurement instruments must first of all measure what we want them to measure. This is known as validity" (p. 17). Brown and Rodgers (2002) state that in terms of qualitative research, credibility is comparable with validity and has to do with how believable the results are. Not only is it important to address that one is measuring what one set out to measure but also how well one is measuring what one wants to measure. Muijs (2011) states that validity is a multidimensional concept with three distinct types of measures: (a) content validity, (b) criterion validity and (c) construct validity.

Content validity has to do with whether the content of the variables (the survey items, in this case) rightly measures the concept (teachers' self-efficacy to teach in diverse classrooms) being measured. Muijs (2011) states that theory plays an important role in ensuring content validity. In this study, content validity is established by the fact that the CRTSE questionnaire is theoretically grounded in terms of both Bandura's (1995, 1997) theory of self-efficacy and Gay's (2000) theory of culturally responsive pedagogy which frame this study. It is also important to ensure what Muijs (2011) calls face validity which can be established by asking the respondents themselves whether the instrument is valid. He further states that it is beneficial to also have a panel of experts from the field to appraise the instrument. Even though I made a few contextual changes to the original survey, I made every attempt to ensure that it was a valid measure. I believe piloting this study with two science teachers helped establish face validity. Also, changes were made to the survey only after discussions with colleagues from the field.

The final version of the survey was approved by my supervisory committee consisting of three faculty members before it was administered to the participants.

Criterion validity is also intimately related to theory. Muijs (2011) states that "When you are developing a measure, you usually expect it, in theory at least, to be related to other measures, or to predict certain outcomes" (p. 58). Even though I did not personally develop the entire survey that I have used in this study, I have modified a few items to contextualize it to the specific purpose of this study. This version of the adapted survey has not been previously used and as such, there is no way for me to predict any outcomes of this survey. As a result, establishing criterion validity is beyond the scope of this study at this time.

Construct validity relates "to the internal structure of an instrument and the concept it is measuring" (Muijs, 2011, p. 59). The concept being measured may have a number of different dimensions or sub-scales. Conducting a principal components analysis to create underlying sub-scales within the survey did not yield successful results. Additionally, the internal consistency (described in the subsequent paragraphs) of this instrument was very high which means that all of the survey items were essentially measuring the same concept. Hence, construct validity cannot be addressed at this stage.

Brown and Rodgers (2002) define reliability as "the degree to which the results of a study are consistent" (p. 241). In terms of qualitative research, reliability is comparable with dependability. The authors state that credibility and dependability are improved when triangulation and member checking are implemented. Two types of reliability include internal and external. Internal reliability can be defined as "the degree to which we can expect consistent results if the data for the study were re-analyzed by another

researcher" (Brown & Rodgers, 2002, p. 241). While the data were not re-analyzed by another researcher, internal reliability has been addressed by the fact that I have employed multiple data sources as well as theories in this study and have achieved triangulation at different stages. I established member checking by sending copies of the interview transcripts to the participants to maintain trustworthiness by agreeing to honour any changes that they wished to make to their statements. External reliability is defined as "the degree to which we can expect consistent results if the study were replicated" (Brown & Rodgers, 2002, p. 241). One way that external reliability of this study is established is through a clear definition of the research context. This study looks at science teachers teaching in Ontario's diverse classrooms and data were collected from teachers teaching across the entire province.

The changes that I made to the survey (discussed in subsequent sections of this chapter) in turn changed the internal consistency reliability of the original version of the survey. Hence, it was essential to ensure that the adapted version of the survey was also reliable. Muijs (2011) states that internal consistency reliability applies to "instruments that have more than one item, as it refers to how homogeneous the items of a test are, or how well they measure a single construct" (p. 63). In order to examine the correlation between all of the variables, I implemented Cronbach's alpha. Muijs (2011) states that a high Cronbach's alpha indicates high levels of internal consistency and suggests that a measure above .7 is considered acceptable for research purposes. The internal reliability for the original CRTSE survey was .96 (Siwatu, 2007). After making appropriate modifications to the original survey, the Cronbach's alpha on my adapted survey was still high at .95 thus establishing a strong internal consistency reliability of the instrument.

It is also essential to establish generalizability[7] or transferability (comparable term used in qualitative research) in terms of the results of the sample to the larger population. Muijs (2011) states that one way to establish generalizability is to ensure that the sample is unbiased and in no way skewed toward a few particular groups. The sample that I have collected from the larger population of Ontario's science teachers for this study is random to a large extent. Even though I elaborate on this issue further later in the chapter, it is worthwhile mentioning at this point again that I recruited my participants through a number of different data sources. As such, the data that I collected were coming from multiple sources all at the same time. Also, the context of this research was the entire province of Ontario, not particular regions or cities. As a result, the data that I received were not concentrated in terms of participants from only a few areas in the province. I believe this helped strengthen the generalizability of the results of my study. Acknowledging my position as a researcher, a section to which I now turn, has also helped strengthen the merits of this study, overall.

Positioning Myself as a Researcher

Even though I have always been interested in the field of Education, I could never envision myself teaching in a K-12 classroom. My curiosity about the field arose from the differences I experienced between my elementary education in a Catholic school in India and my secondary education in a vastly different classroom in Canada. As I progressed academically, I became more and more astute in terms of the "pros" and "cons" of both systems. After completing my undergraduate education, I began a Master of Education program at UWO in Curriculum Studies to answer some of the questions I

[7] Generalizability is known as external validity by Brown and Rodgers (2002) and possibly others.

had. However, as my understanding of the field of ESL evolved, I noticed other issues in the context of culturally and linguistically diverse classrooms that were also worthy of investigation.

Having received all of my education in English prior to coming to Canada, I was not completely aware of the challenges faced by ELLs in the classroom. Under the guidance of my thesis supervisor, I chose to explore the discourse of science and the challenges that the scientific vocabulary poses for all students, especially ELLs. It was during my research in the Master of Education program that I decided that I would investigate issues more directly related to ESL and ELLs in science whenever I chose to pursue my doctoral studies. When I began my PhD in 2011, I was initially interested in looking at the issue of culture in the discourse of science. However, during my research, I discovered statistics discussing the lack of preparedness among Ontario's science teachers and I decided to investigate this issue further instead (Educational Quality and Accountability Office, 2012). As time passed, I came to realize that I was still addressing the role of culture in science through my investigation of science teaching in culturally and linguistically diverse classrooms of Ontario.

In the last year of my doctoral program, I had the opportunity to teach a course titled "Introduction to Teaching English as a Second Language (ESL)" in the Bachelor of Education program. Teaching this course and learning from my students only added to my interest in exploring the challenges teachers face in today's diverse classrooms. Even though the teaching opportunity contributed immensely to my understanding of the culturally and linguistically diverse context, I believe it also made me question how preservice teachers were being prepared for diverse classrooms not only at UWO but

everywhere. As far as the researcher's bias goes, this work is largely objective considering the fact that I have never worked as a K-12 school teacher myself. As a result, I did not bring in any particular biases based on my experience that I wished to explore further. However, my passion for this field and my experiences in academia (both as a student and as an instructor) allow me to sympathize with both teachers and ELLs. This affords me the privilege of being an insider while still being an outsider and removed from the context enough not to have any personal influence on the research. Regardless, this research is timely in that it explores the self-efficacy perceptions among Ontario's science teachers to teach in diverse classrooms. The findings from this study have huge implications for teachers, school boards as well as teacher education programs on issues of diversity and inclusion.

The Ethics Review Process

Since this research involved human subjects albeit in a non-clinical context, I required the permission of the Non-Medical Research Ethics Board (NMREB) at the University of Western Ontario (UWO) before beginning the process of data collection. My application was first approved in June 2014 (see Appendix F) with the understanding that I would complete the ethical formalities for any of the school boards from which I chose to recruit research participants. Participants were recruited from two main domains: (a) two school boards and (b) personal and professional contacts through friends and family.

Most of the school boards listed the procedure to gain approval for external research with their staff and/or students on their website. If this was not the case, I emailed their Research and Development Services division to gather information about

the research procedure and to procure appropriate paperwork. Some boards required multiple hard copies of the application via mail while electronic copies sufficed for others. Typically, I was required to complete an external application package which asked for a description of the research objectives and the methodological instruments as well as the data collection procedure among other details. I also sent them my letter of information and copies of the UWO ethics approval document (see Appendices E and F respectively). Since my research did not involve students or entering the school premises, I was not required to obtain a criminal background check. I applied to six Ontario school boards in total. My application was rejected by four and accepted by two of the boards. The first board informed me that they would send out my request for research to science teachers teaching at the secondary level only. I received official letters from the school boards' research division upon approval (see Appendices H and I). Fortunately, neither of the two boards that approved my research application required any changes to my survey or interview questionnaires.

As a result of the low approval rate from the school boards, the data that I was receiving were fewer than expected. During the course of my research, a few of my friends, colleagues and acquaintances had showed an interest in my study and some even fulfilled the criteria to participate in the research themselves. Others had personal and professional contacts that could become potential research participants and thus, offered to help me with recruitment. Hence, I requested the ethics board at UWO to grant me permission to recruit research participants through friends and family. I completed a revised application and I received the approval in April 2015 (see Appendix G). Following the amendment to my ethics protocol, I sent my letter of information via email

to all those who had either shown an interest in participating in my study or who knew others who would be willing to participate.

My research application was approved by the ethics review board at UWO with the agreement that the participants will not be asked to identify themselves by their name, the name of their school or board on the survey or during the interview. Hence, the exact number of participants recruited through each of the two sources cannot be known for certain. Also, the letter of information which contained the link to the online survey was distributed to all of my data sources at around the same time. Therefore, it was not possible to identify the exact number of respondents from any of the sources. As a researcher, it was vital to establish and maintain complete anonymity and confidentiality with my participants and I made every attempt to do so.

Methods: Survey and Interview

The Survey Instrument

Gay et al. (2009) state that "survey research involves collecting data to test the hypotheses or to answer questions about people's opinions on some topic or issue" (p. 175). Since, the primary concern of this study was to discover the self-efficacy perceptions of Ontario's science teachers, a quantitative survey questionnaire was the most appropriate method. Survey research is mainly used to gather information about a group's attitudes, behaviours and demographic composition (Gay et al., 2009). Berends (2006) states that survey research is one of the most important basic research methods of the Social sciences and that "the aim of survey research is to describe relevant characteristics of individuals, groups, or organizations" (p. 623). The numerical data

gathered from the survey describe the self-efficacy perceptions of Ontario's science teachers to teach in culturally and linguistically diverse classrooms.

The survey instrument that I have employed in this research is based on Siwatu's (2007) Culturally Responsive Teaching Self-Efficacy (CRTSE) scale (see Appendices A and C respectively for adapted and original surveys). In terms of measuring self-efficacy perceptions, Maddux and Gosselin (2012) suggest that "tasks and situations differ in the degree of challenge that they present, and self-efficacy measures should reflect these differences" (p. 202). Hence, this particular instrument was relevant since it is a 40-item survey which asks participants to appraise their level of self-efficacy on a wide range of culturally and linguistically responsive teaching practices that differ in the degree of difficulty and context. Siwatu (2007) has stated that the survey ranges on a spectrum from easy to difficult items with the easy items dealing with general pedagogical practices while the more difficult items dealing with culturally responsive pedagogical practices[8]. The researcher cites the paucity of self-efficacy measurement tools which assess teachers' self-efficacy to operate in diverse contexts and provides a rationale for the creation of his CRTSE scale (Siwatu, 2007; Siwatu & Starker, 2010). At this point, I explain some of his reasons and contextualize how they correspond with my own rationale for using his survey instrument in my research as well.

First, it is important to consider that "many teacher self-efficacy instruments do not assess teachers' sense of efficacy to teach in culturally and linguistically diverse educational settings and execute specific teaching practices that have been found to be effective when teaching culturally and linguistically diverse students" (Siwatu & Starker,

[8] I explain the general and culturally responsive pedagogical item categorization in Chapter 4.

2010, p. 15). Maddux and Gosselin (2012) state that "the measurement of self-efficacy should be designed to capture the important characteristics of the behavior and the context in which it occurs" (p. 202). Classrooms across North America have been seeing increasing amounts of cultural, linguistic, religious, ethnic and racial diversity. However, most of the extant self-efficacy measurement tools assess teacher efficacy in relation to classroom management, instructional strategies and student engagement (Izadinia, 2011). Recent statistics about the decreasing levels of feeling of preparedness only exacerbate the issue considering that preparedness is the most significant predictor of teachers' self-efficacy (Darling-Hammond et al., 2002; Peebles & Mendaglio, 2014). Hence, it has become necessary to examine how our teachers are coping with the challenges that arise in diverse classroom contexts. A reason as to why this survey tool is very well-suited for this study is because there is a paucity of research showing the self-efficacy beliefs of teachers *in relation to* the competencies of culturally responsive pedagogy. Hence, if culturally responsive pedagogy is essential in ensuring that ELLs succeed in academics and teachers' self-efficacy is an important construct in deciding whether ELLs will succeed, a survey tool that addressed both of these constructs was ideal in achieving the goals of this study.

Second, Siwatu (2007) states that this survey instrument has theoretical underpinnings and is firmly grounded within Bandura's (1995) theory of self-efficacy as well as Gay's (2000) tenets of culturally responsive pedagogy. This survey tool was appropriate for my study because like Siwatu (2007), I have also drawn on Bandura's (1995) theory of self-efficacy and Gay's (2000) conceptualization of culturally responsive pedagogy as framing devices for this research. Gay (2002) defines culturally

responsive pedagogy as "using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively" (p. 106). She states that when knowledge and skills are embedded within the lived experiences of students, their academic achievement will improve. The five culturally responsive teaching competencies are: (a) developing a cultural diversity knowledge base, (b) designing culturally relevant curricula, (c) demonstrating a cultural caring and building a learning community, (d) cross-cultural communications and (e) cultural congruity in classroom instruction. The items on the CRTSE survey are all based on these competencies, some more directly than others, thus, validating the use of this survey for my study. Hence, assessing teachers' self-efficacy in terms of these competencies allowed me to discover the answers to questions that have directed this study.

Third, this survey incorporates principles of critical pedagogy unlike most other self-efficacy survey measurement tools. Izadinia (2011) states that principles of critical pedagogy including freedom, equity and justice have been investigated quite extensively but have not been included in the study of teacher efficacy. In a broad review of the available literature and teacher efficacy measures to see how many of them included tenets of critical pedagogy, the author concludes that critical pedagogy principles were not the focus of most of the survey instruments. Siwatu's (2007) CRTSE survey was one of the very few that incorporated the issue of critical pedagogy. Since this survey measures teachers' self-efficacy perceptions on the principles of culturally and linguistically responsive teaching and learning, it automatically addresses the issue of critical pedagogy considering that "issues related to culture are among the premises of critical pedagogy" (Izadinia, 2011, p. 141). The CRTSE survey fulfills an important gap

in the literature by addressing the issue of critical pedagogy in light of self-efficacy which has largely been neglected.

Even though Siwatu's (2007) survey instrument is appropriate in many ways considering the objectives of this research, it is still important to explore the differences in the contextual details between his study and the Ontario context in which my research is set. The three contextual details of my study are: (1) It examines inservice teachers while Siwatu (2007) administered this survey to preservice teachers, (2) The notion of student diversity is different in Canada as opposed to the United States where Siwatu's (2007) study is set and (3) This study is domain-specific in that it looks at teachers of science while Siwatu's (2007) study looked at generalist teachers.

First, one of the reasons Siwatu (2007) provides for developing this survey instrument is that "despite the changing demographics of today's schoolchildren, little research has been done to examine preservice *and inservice* teachers' culturally responsive teaching self-efficacy and outcome expectancy beliefs" (p. 1089; emphasis added). Hence, the fact that this survey instrument was administered to preservice teachers does not mean that it is not applicable to inservice teachers considering that they were also the basis for the creation of his survey instrument.

Second, even though the proportion of student diversity in the United States might be varied compared to Canada in terms of a higher ratio of certain cultural and linguistic groups as compared to others (e.g., a high population of Hispanic students in certain areas), the survey items are not specifically geared toward particular cultural or linguistic

groups. For instance, an item on the CRTSE scale states "[I][9] Greet English Language Learners with a phrase in their native language" (Siwatu, 2007, p. 1093). It would be safe to assume that the term "native language" is inclusive of a wide range of linguistic backgrounds and can be utilized in any linguistically diverse context.

Third, even though Siwatu's (2007) study was general and this study looked at science in particular, it was not challenging to tailor his survey to the domain-specific context of this study. It was also important to make this study as context-specific as possible because as noted previously, self-efficacy is most accurately measured when studied under specific conditions. According to Maddux and Gosselin (2012, p. 202), "Specifying behaviors and contexts improves the predictive power of self-efficacy measures" and that "Self-efficacy measures can err in the direction of being not specific enough." Two of the original survey items are subject-specific; the first item states "[I] Teach students about their cultures' contributions to science" while the second one reads "[I] Design a lesson that shows how other cultural groups have made use of mathematics" (Siwatu, 2007, p. 1093). It must be noted that most of the survey items are generic in that they are not particularly geared toward subject-specific teachers. However, the simple fact that two of the items *are* subject-specific shows that there is room to contextualize any of his survey items in a similar fashion. For instance, the first item could very well be modified to replace science with any other subject while the second item could address how various cultural groups have made use of technology or music instead of Mathematics. As such, this also allows the largely general survey items to be modified to suit the contextual goals of this research.

[9] I have added the pronoun 'I' before every survey item to personalize it for my research participants.

It is also essential to understand that the crux of this research was to examine teachers' perceptions of *self-efficacy*. By stating this, I am not implying that the fact that the participating teachers in this study are *science* educators in particular is insignificant in any way. However, it is a contextual detail which was easy to add to any of the generic survey items to make them more domain-specific. The investigation of self-efficacy perceptions was still the main objective and thus, this survey instrument was very relevant. I now explain the different ways in which Siwatu's (2007) survey was modified in order to suit the goals of this domain-specific study.

A number of revisions were made to Siwatu's (2007) original survey over the course of a few months before the final version of the survey was administered to the research participants. Not only did I use my discretion based on my relevant research experience, but I also sought the guidance of colleagues and faculty members in this endeavour. Additionally, I attended a number of academic conferences during this time. Speaking with other professionals in the field provided more insight in terms of making appropriate revisions to the original survey. I have made as many changes as possible to the original CRTSE questionnaire without losing the essence of the author's original vision. The final version of the survey was approved by my thesis supervisory committee consisting of three faculty members.

Five different measures were taken to modify Siwatu's (2007) original CRTSE questionnaire. First, I briefly describe each of the categories and provide more substantial clarification subsequently. The original survey contains 40 items and even after the alterations, my survey which was administered to the science teachers still contained 40 items. The five ways in which each of the survey items was modified include: (a) No

change, (b) Combination, (c) Deletion, (d) Clarification and (e) Addition. Out of the 40 items, 25 items were left unchanged thus, leaving 15 items for modifications. From the remaining 15 items, six items were deleted due to their irrelevance and the remaining 10 items were modified in two different ways: (a) contextual details were added to eight items and (b) two of the items were combined into one item. An additional six items were added to the survey thus, bringing the total number to 40 items. Tables listing the survey items in each of these five categories follow (see Appendix D for a finalized table incorporating all of these modifications to the original CRTSE survey).

(a) No change: I left 25 items on Siwatu's (2007) original survey without making any modifications to them whatsoever. They assess teachers' self-efficacy perceptions on a series of culturally responsive teaching practices relating to the competencies outlined by Gay (2002) (which I have discussed in Chapter 2). Each of these items was clear and needed no further contextualization. Even though these items are general in their orientation, my research participants were aware that my study investigated the context of science education and hence, they appraised their self-efficacy perceptions on the following items with the appropriate context in mind.

Table 1

Unchanged CRTSE Survey Items (25)

Unchanged CRTSE Survey Items (25)
(1) [I] Adapt instruction to meet the needs of my students
(3) [I] Determine whether my students like to work alone or in a group
(5) [I] Identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture
(6) [I] Implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture
(7) [I] Assess student learning using various types of assessments
(8) [I] Obtain information about my students' home life
(9) [I] Build a sense of trust in my students
(10) [I] Establish positive home-school relations
(12) [I] Develop a community of learners when my class consists of students from diverse backgrounds
(13) [I] Use my students' cultural background to help make learning meaningful
(15) [I] Identify ways how students communicate at home may differ from the school norms
(19) [I] Design a classroom environment using displays that reflects a variety of cultures
(20) [I] Develop a personal relationship with my students
(24) [I] Communicate with parents regarding their child's educational progress
(25) [I] Structure parent-teacher conferences so that the meeting is not intimidating for parents
(26) [I] Help students to develop positive relationships with their classmates
(27) [I] Revise instructional material to include a better representation of cultural groups
(28) [I] Critically examine the curriculum to determine whether it reinforces negative cultural stereotypes
(30) [I] Model classroom tasks to enhance English Language Learners' understanding
(31) [I] Communicate with the parents of English Language Learners regarding their child's achievement
(32) [I] Help students feel like important members of the classroom
(35) [I] Use examples that are familiar to students from diverse cultural backgrounds
(37) [I] Obtain information regarding my students' academic interests
(38) [I] Use the interests of my students to make learning meaningful for them
(39) [I] Implement cooperative learning activities for those students who like to work in groups

(b) Combination: Two of the items on the survey were combined into a single item. Item 2 on Siwatu's (2007, p. 1093) survey reads "[I] Obtain information about my students' academic strengths" while item 21 reads "[I] Obtain information about my students' academic weaknesses". Obtaining information about a student's strengths automatically informs the teacher about his or her weaknesses as well and vice versa. Having these items remain separate made little sense and hence, they were combined into one. The modified survey item now read "I obtain information about my students' academic strengths and weaknesses."

Table 2

Combined CRTSE Survey Items (2)

Combined Survey Items (2)	Modification
(2) [I] Obtain information about my students' academic strengths (21) [I] Obtain information about my students' academic weaknesses	I have combined items (2) and (21) to now read: (2) I obtain information about my students' academic strengths *and weaknesses*

(c) Deletion: Six of the survey items were deleted for a number of reasons. Items 4, 36 and 40 were removed because they did not explicitly address the culturally or linguistically diverse context which is the main goal of this study. Item 21 was removed since it was combined with item 2 (see previous section). I felt that item 22 which reads "[I] Praise English Language Learners for their accomplishments using a phrase in their native language" was redundant in that it discussed the teachers' use of ELLs' L1 similar to item 18 which reads "[I] Greet English Language Learners with a phrase in their native language" (Siwatu, 2007, p. 1093). Additionally, based on my own experience as a multilingual, I assumed that the likelihood of knowing greetings in another language is much higher than knowing words of praise. A prototypical English-speaking monolingual

teacher is more likely to be familiar with greetings in an L2 considering the multilingual "Hello" and "Welcome" signs across schools in Ontario. Hence, item 22 was removed. Item 29 which states "[I] Design a lesson that shows how other cultural groups have made use of mathematics" was deleted because it related directly to Mathematics. I did not modify it to make it specific to science because item 17 (discussed in the next section) which reads "[I] Teach students about their cultures' contributions to science" was similar to it (Siwatu, 2007, p. 1093).

Table 3

Deleted CRTSE Survey Items (6)

Deleted CRTSE Survey Items (6)
(4) [I] Determine whether my students feel comfortable competing with other students
(21) [I] Obtain information about my students' academic weaknesses
(22) [I] Praise English Language Learners for their accomplishments using a phrase in their native language
(29) [I] Design a lesson that shows how other cultural groups have made use of mathematics
(36) [I] Explain new concepts using examples that are taken from my students' everyday lives
(40) [I] Design instruction that matches my students' developmental needs

(d) Clarification: I added contextual details to eight of the items in order to clarify them further. I added a few examples to items 11, 16 and 34 for clarification. For instance, item 11 originally read "[I] Use a variety of teaching methods" (Siwatu, 2007, p. 1093) which was changed to "[I] Use a variety of teaching methods *such as visual aids*". Item 14 was a general statement which originally read "[I] Use my students' prior knowledge to help them make sense of new information." It needed to be made more domain-specific to scientific topics and hence, was changed to "[I] Use my students' prior knowledge *of*

science to help them make sense of new information." Being informed about the challenges Ontario's science teachers face in diverse classrooms today, I wanted to ensure that the survey items did not in any way pressure them to adopt ESL-inclusive pedagogical practices with which they would not necessarily be familiar. As such, survey items 17 and 18 were modified with this understanding in mind. Item 17 originally read "[I] Teach students about their cultures' contributions to science." However, I felt that it was important to make this item more open-ended to mean "I teach students about their cultures' contributions to science *if the content and context permit*". Similarly, item 18 was changed based on a suggestion from a colleague at an academic conference. The survey item originally read "[I] Greet English Language Learners with a phrase in their native language" which was changed to "I greet English Language Learners with a phrase in their native language *if I am able to*" so that they did not feel inadequate if they were monolingual speakers of English. Item 23 originally read "[I] Identify ways that standardized tests may be biased towards linguistically diverse students." I contextualized this survey item to read "I Identify ways that standardized tests *such as the EQAO* may be biased towards linguistically diverse students" to provide an example of a standardized test used in Ontario with which the teachers would be familiar. Item 33 which originally read "[I] Identify ways that standardized tests may be biased towards culturally diverse students" was modified similarly.

Table 4

Clarified CRTSE Survey Items (8)

Clarified CRTSE Survey Items (8)	Modification
(11) [I] Use a variety of teaching methods	(11) I use a variety of teaching methods *such as visual aids*
(14) [I] Use my students' prior knowledge to help them make sense of new information	(14) I use my students' prior knowledge *of science* to help them make sense of new information
(16) [I] Obtain information about my students' cultural background	(16) I obtain information about my students' cultural background *such as their L1 or mother tongue*
(17) [I] Teach students about their cultures' contributions to science	(17) I teach students about their cultures' contributions to science *if the content and context permit*
(18) [I] Greet English Language Learners with a phrase in their native language	(18) I greet English Language Learners with a phrase in their native language *if I am able to*
(23) [I] Identify ways that standardized tests may be biased towards linguistically diverse students	(23) [I] Identify ways that standardized tests *such as the EQAO* may be biased towards linguistically diverse students
(33) [I] Identify ways that standardized tests may be biased towards culturally diverse students	(33) [I] Identify ways that standardized tests *such as the EQAO* may be biased towards culturally diverse students
(34) [I] Use a learning preference inventory to gather data about how my students like to learn	(34) I use a learning preference inventory to gather data about how my students like to learn *(e.g., are they visual, linear, kinesthetic or auditory learners?)*

(e) Addition: Each of the six items that were added to Siwatu's (2007) survey have all stemmed from my research findings in the Master's program which I completed in 2011. Even though the focus of my study was to examine the scientific discourse through

corpus analysis procedures, my data sources included interviews with a science teacher and classroom observations. I was very interested in the role that culture as well as language (both local and global) play in science education. Hence, items (a), (b) and (d) were inspired through my understanding of how cultural artefacts make their way into science instruction. During the interviews and observations in my MEd research, I realized the important role of the L1 in science education and how the science teacher is also a language teacher in addition to being a content teacher at the same time. I also became aware of the need for proper comprehension of content-specific vocabulary in science and hence, it became important to include items (c), (e) and (f) as well.

Table 5

Added CRTSE Survey Items (6)

Added CRTSE Survey Items (6)
(a) I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)
(b) I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)
(c) I give students the opportunity to improve their proficiency in English in my science class
(d) I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts
(e) I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better
(f) I encourage English Language Learners to use their L1 to define and understand content-specific terms and phrases

After making all the modifications described in the previous sections, the following table contains the final version of the adapted CRTSE survey which was administered to the research participants of this study. On the survey, they were asked to

judge their capabilities (appraise their level of perceived self-efficacy) to engage in 40 culturally responsive teaching practices in the science classroom on a scale of 0 meaning *no feelings of self-efficacy* to 10 meaning *high feelings of self-efficacy*. This adapted survey which measured teachers' self-efficacy perceptions is a Likert-type scale. I am aware of the ambiguity in terms of whether Likert-type items are considered ordinal or scale variables. Connolly (2007) asks the researcher to "apply your own judgement at times in relation to the specific nature of the analysis you are undertaking and whether you should treat the variable as scale or ordinal" (p. 41). I also agree with Tabachnick and Fidell (2007) who state that "continuous variables are measured on a scale that changes values smoothly rather than in steps" (p. 6). Hence, I have chosen to measure self-efficacy as a 'scale' or 'continuous' variable as opposed to an 'ordinal' variable considering that the difference between the values is not clearly defined even though the range (scale from 0 to 10) is in progression.

Table 6

Final Version of the Adapted CRTSE Survey (40 Items)

	Adapted CRTSE Survey
(1)	I adapt instruction to meet the needs of my students
(2)	I obtain information about my students' academic strengths and weaknesses
(3)	I determine whether my students like to work alone or in a group
(4)	I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture
(5)	I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture
(6)	I assess student learning using various types of assessments
(7)	I obtain information about my students' home life
(8)	I build a sense of trust in my students
(9)	I establish positive home-school relations
(10)	I use a variety of teaching methods such as visual aids
(11)	I develop a community of learners when my class consists of students from diverse backgrounds
(12)	I use my students' cultural background to help make learning meaningful
(13)	I use my students' prior knowledge of science to help them make sense of new information
(14)	I identify ways how students communicate at home may differ from the school norms
(15)	I obtain information about my students' cultural background such as their L1 or mother tongue
(16)	I teach students about their cultures' contributions to science if content and context permit
(17)	I greet English Language Learners with a phrase in their native language if I am able to
(18)	I design a classroom environment using displays that reflects a variety of cultures
(19)	I develop a personal relationship with my students
(20)	I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students

Table 6 Continued

Adapted CRTSE Survey	
(21)	I communicate with parents regarding their child's educational progress
(22)	I structure parent-teacher conferences so that the meeting is not intimidating for parents
(23)	I help students to develop positive relationships with their classmates
(24)	I revise instructional material to include a better representation of cultural groups
(25)	I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes
(26)	I model classroom tasks to enhance English Language Learners' understanding
(27)	I communicate with the parents of English Language Learners regarding their child's achievement
(28)	I help students feel like important members of the classroom
(29)	I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students
(30)	I use a learning preference inventory to gather data about how my students like to learn (e.g., are they visual, linear, kinesthetic or auditory learners?)
(31)	I use examples that are familiar to students from diverse cultural backgrounds
(32)	I obtain information regarding my students' academic interests
(33)	I use the interests of my students to make learning meaningful for them
(34)	I implement cooperative learning activities for those students who like to work in groups
(35)	I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)
(36)	I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)
(37)	I give students the opportunity to improve their proficiency in English in my science class
(38)	I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts
(39)	I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better
(40)	I encourage English Language Learners to use their first language (L1) to define and understand content-specific terms and phrases

Survey administration.

One of the methods employed in this study was an adapted survey instrument which was explained in the previous section (see Appendix A for final version). The survey was first piloted with two science teachers[10] belonging to varied educational, professional as well as linguistic backgrounds. One had 10 years of teaching experience and the other had over 25 years of teaching experience; one was a male and the other a female and one was a monolingual speaker of English and the other was a multilingual who spoke three languages in addition to English. One had been born, raised and educated in Canada and had only taught in Canada while the other had received education outside of Canada and had experience teaching in various countries prior to gaining teaching experience in Canada. The diversity of their educational and teaching experience as well as cultural and linguistic backgrounds helped me gain different perspectives regarding the survey. Upon completion, they were able to provide information about whether the survey items were clear and easy to comprehend. Neither of the teachers suggested any changes to the content or the phrasing of the survey items and stated that they had no trouble navigating through the questions. I provided them with paper copies of the survey and they sent scans of the completed questionnaires via email directly to me. Thereafter, I transferred the survey questionnaire online[11].

[10] The survey was piloted with Scott and Nora. I provide more information on each of the interview participants later in this chapter.

[11] Even though I gave the participants the option of contacting me if they required paper copies of the survey on the letter of information, none of the participants made any such requests. With the exception of the two teachers with whom the survey was piloted, all of the participants completed the survey online.

The online survey was initially created using "The UWO Web Surveys Tool" (https://surveys.adt.its.uwo.ca/default.aspx?surveyID=1590)[12] and the link to the survey was listed on the letter of information which was distributed among the participants. On this portal, the survey responses completed by the participants could automatically be downloaded onto a Microsoft Excel file and saved as either individual or multiple responses directly onto the computer. However, this particular web portal was only valid from June 2014 to March 2015. During this time, I collected 33 surveys out of which 21 responses were complete and hence, were saved and 12 could not be included in the data analysis due to severely incomplete information. The remaining survey responses have been collected from an alternate survey portal which I now describe.

In early 2015, I was notified by the staff at UWO's Information Technology Services (ITS) via email that the particular online survey tool that I was using was to be decommissioned by the end of March 2015. As a result, I had to recreate my online survey questionnaire using UWO's "MySurveys" portal which was now transferred to a new platform called Qualtrics (see https://uwo.eu.qualtrics.com/SE/?SID=SV_884D3MsXlFnR3fL). I made the appropriate changes to my letter of information which was then distributed after March 2015. Similar to the previous version, this platform also made it possible to save either single or multiple survey responses onto an easily downloadable Microsoft Excel file. I manually entered the 21 survey responses that I had downloaded from the previous survey tool onto Qualtrics in order to have the entire data set in one location.

[12] This was the web address of the online survey portal which I used from June 2014 to March 2015. However, following the decommissioning of this survey tool, this link has been deactivated.

This particular online survey portal was much more visually pleasing and made it easier for participants to access the survey on their mobile devices efficiently. Qualtrics also made it easy to maintain the anonymity and confidentiality of the survey participants. The responses of the participants were listed in order of their completion of the survey and each of the participants was identified by a "response identification number" (e.g., R_3oL26u). Even though I knew who some of the survey participants were, it was impossible for me to identify them from the entire data set considering that the portal assigned a random response identification number to each participant[13].

Both of the online survey platforms were regulated by UWO and hence, were extremely secure. I had to enter my valid UWO email and password in order to download the survey responses completed by the participants. However, neither of the survey portals required the participants to create any usernames or passwords hence, making the process easier for them. The survey was simply accessed by the participants using web links provided on the letter of information. They also had the option of not responding to any of the questions on the survey.

There were two main components to the survey. The first section consisted of 13 questions (Questions 1-13) which asked for the science teachers' demographic and background information including (but not limited to) their gender, educational background, years of teaching experience and the number of ELLs they taught. The second section was the adapted CRTSE survey (Siwatu, 2007) and consisted of 40 items (Questions 14-53) asking science teachers to rate their perceived level of self-efficacy on

[13] The only respondents who I could identify were those who were willing to participate in the follow-up interview and had provided their contact information on the survey.

various culturally and linguistically responsive teaching practices. The participants rated their self-efficacy level on a scale from 0 meaning *no feelings of self-efficacy* to 10 meaning *high feelings of self-efficacy*. In the last question (Question 54), I asked the teachers if they wished to participate in a 30-minute follow-up interview with me. If they stated "Yes" as their response, they could provide their contact information in a textbox provided. In total, I collected 76 completed surveys from my research participants.

Interviews

Out of 76 survey respondents, 16 teachers were interested in participating in a follow-up interview with me and provided either their phone number or email address on the online survey. I contacted each one and eight of them agreed to participate in the interview. Even though one teacher had initially indicated that he did not wish to participate in an interview on the survey, he emailed me soon after submitting his survey requesting to participate in an interview. Additionally, another survey respondent's relative informed me that she would also be interested in participating in the interview even though she had not indicated so on the survey. I made contact with her and conducted the interview. In total, I collected interview data from 10 of the survey participants. The interview data were collected between June 2014 and September 2015. Any requests for interviews after the deadline for data collection were gratefully and politely declined due to concerns of data manageability and time.

Upon initial communication with the interview participants, I informed them that the time, place and medium of the interview (e.g., telephone or face-to-face) would be of their choosing. Three of the participants requested to have the interview conducted in person and seven chose to have it over the telephone due to concerns of distance and

availability. Of the three face-to-face interviews, one was conducted in a local coffee shop, one in the teacher's classroom after school (with the Principal's permission) and one in a cafeteria at UWO. Even though the participants were made aware of the fact that the interview would be audio-recorded and transcribed for data analysis on the letter of information, I informed them again before commencing the interview in case they had any concerns. I also let them know that I would use pseudonyms chosen at random to protect their identity.

Fontana and Frey (2005) define the interview as a method of data gathering when "the purpose is to obtain a rich, in-depth experiential account of an event or episode in the life of the respondent" (p. 698). Interviews permit the researcher to acquire information about the meanings individuals attach to the settings in which they function (Patton, 2002). Most researchers describe the interview method as being either unstructured or structured (e.g., Patton, 2002; Gay et al., 2009; Fontana & Frey, 2005). According to Patton (2002), an unstructured interview does not consist of a predetermined set of questions but offers the flexibility to the interviewer to pursue information in any direction. According to Fontana and Frey (2005), a structured interview consists of a set of predetermined questions which the interviewer uses for all the respondents. My study consisted of a semi-structured interview questionnaire which was used uniformly for all participants but at the same time allowed them to venture into conversations beyond the scope of my questions.

During the semi-structured interview (see Appendix B for interview questions), I asked each of the participants questions about teaching science in culturally and linguistically diverse classrooms. I gave them the option to speak at length about any

issues that they wished to address. Broadly speaking, I asked them if they were aware of their ELLs' cultural (e.g., home country/community), linguistic (e.g., their L1) as well as level of English proficiency (e.g., beginner-, intermediate- or advanced-level proficiency) details. I also inquired about any accommodations and/or modifications[14] that they made for their ELLs. Challenges that the teachers faced in terms of teaching science to culturally and linguistically diverse students were discussed at length by each of the participants. I also asked the teachers to speak about the challenges that they thought the ELLs faced in their science classroom. I was interested in understanding whether their Bachelor of Education programs had prepared them adequately for teaching in today's diverse classrooms. Toward the end of the interview, I also inquired about specific survey items on which their appraisal of their self-efficacy was significantly lower in comparison to others. In closing, I gave them the opportunity to bring up any issues relating to the topic that we had not discussed during the interview. The interviews were a positive experience and the participants conducted themselves professionally and showed a great deal of enthusiasm about this research.

I used a generic audio-recorder which stored the recordings in mp3 format. The recorder had a connecting USB cable which helped transfer the recordings on to the computer for transcription. Each interview lasted between 30 and 45 minutes. All of the interview data were transcribed manually onto a Microsoft Word file. I transcribed each

[14] In their guidelines for an Individual Education Plan (IEP), the Ontario Ministry of Education (2004) defines accommodations as "special teaching and assessment strategies, human supports, and/or individualized equipment required to enable a student to learn and to demonstrate learning" (p. 25) while modifications as "changes made in the age-appropriate grade-level expectations for a subject or course in order to meet a student's learning needs" (p. 25).

of the interviews in full. Any direct quotes used throughout this dissertation are verbatim except in certain instances where I have added my comments in brackets to include missing information, that which sometimes gets lost during a semi-formal verbal conversation. Any grammatical errors as well as run-on sentences during the interviews were left unchanged. I have made every attempt to document the non-verbal communication and the idiosyncrasies of the teachers during the transcription of the interviews (e.g., pauses for thought and laughter). For instance, I have italicized text where certain words or phrases were emphasized by the participant. After the transcription, I sent each of the participants their interview transcript via email for review in case they wished to make any changes to their responses. They were informed that any changes they wished to make to their responses would be honoured. I did not hear back from all of the participants and those who replied back did not request any amendments to their transcripts. I present the profile of each of the 10 interview participants subsequently.

The Research Participants

The research participants in the study were science teachers teaching within the K-12 division in Ontario. Schools are divided in many different ways across Ontario[15] depending on the city and school board. Generally speaking, a secondary teacher would teach science (including Chemistry, Biology and Physics) as a subject exclusively. Elementary (Grades K-5/K-6/K-8) and intermediate (Grades 6-8) teachers may teach science among other subjects such as Language Arts, History and Mathematics. Either

[15] A discussion on this topic follows later in the chapter.

way, every single teacher in this study taught at least one science class. I describe the characteristics of the survey and interview participants in the sections that follow.

Survey Participants

In this section, I describe the general characteristics of the survey participants and offer a table highlighting essential statistics about the data set. Out of the 76 participants, 49 (64.5%) were female and 27 (35.5%) were male. Out of the total, 46 (60.5%) had been born, raised and educated in Canada and had also received their Bachelor of Education degree from a Canadian University. Ten (13.2%) had been born, raised and educated outside Canada and had a Bachelor of Education degree from an institution outside Canada but had completed their teacher certification process which qualified them to teach in Canada. Five (6.6%) had been born in Canada but had received some or all of their education including their teaching degree outside Canada but were now qualified to teach in Canada. Twelve (15.8%) had been born elsewhere but had come to Canada at a young age and had received their education including teacher certification in Canada. If the participants found none of the above statements applicable to them, they were asked to explain their educational experience in the textbox provided on the survey. There were three (4%) participants who stated that none of these statements were applicable to their educational experience. One had spent 15 years in Kuwait and had come to Canada in Grade 11, another participant had attained his or her first degree outside Canada but had come to Canada to pursue a Bachelor of Education and a third participant had been born and educated in Canada apart from having spent middle school years in Argentina.

On the survey, I had asked the teachers to choose the grade-level they taught by selecting one or more from three options: elementary, intermediate and/or secondary.

Some participants chose one option while others chose multiple options. In terms of the grade-levels they taught, 38 (50%) teachers out of 76 taught in the elementary division (K-5) and seven (9.2%) taught in elementary and intermediate (Grades 6-8). Nine (11.8%) teachers taught only in the intermediate grades and two (2.7%) taught in the intermediate and secondary (Grades 9-12) division. Twenty (26.3%) teachers taught in the secondary division. The survey respondents taught an average of 68.1 students in a year out of which 7 were ELLs. The average teaching experience was calculated to be 11.5 years ranging from zero to 35 years.

The teachers were also categorized as either novice or experienced depending on the years of teaching experience they listed on the survey. I have chosen to define novice teachers as those with teaching experience between zero and three years and experienced teachers as those who have teaching experience of five years and more.[16] As such, teachers who had listed as having four years of experience ($n = 3$) were removed from this particular categorization[17].

The teachers were also categorized based on their linguistic profile in terms of the languages they spoke. Out of the total, 35 (46.1%) teachers reported that they only spoke English and 41 (53.9%) listed the different languages they spoke in addition to English.

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[16] I explain my rationale for the definitions in a later section of this chapter.

[17] In this chapter, the participants with four years of experience ($n = 3$) have been removed from the novice-experienced categorization and in Chapter 4, they have been removed for the purpose of the *t*-test. However, I have included them for correlational analysis in Chapter 4. I have indicated this information at appropriate stages throughout this dissertation.

The languages reported by the teachers include English, French, Cantonese, Arabic, Spanish, Russian, Korean, Punjabi, Sinhalese, Hindi and Vietnamese among many others.

Table 7

Characteristics of Survey Participants (N = 76)

Category	Number (*N* = 76)	Percentage (%)
Gender		
Female	49	64.5%
Male	27	35.5%
Grade-Level		
Elementary	45	59.2%
Secondary	31	40.8%
Students		
Average number of students taught	68.1	-
Average number of ELLs taught	7	-
Linguistic Profile		46.1%
Monolingual	35	53.9%
Multilingual	41	
Teaching Experience		
Average	11.5	-
Novice	11	15.1%
Experienced [18]	62	84.9%

[18] Note that for the novice & experienced group, the total population was 73 (as opposed to 76). Three participants reported as having four years of experience and hence had to be removed for the consideration of this group. See subsequent paragraph for definitions of the terms novice & experienced.

Participant groups.

It was important to conduct quantitative analysis between different sub-groups within the survey participants in order to gain insight into whether self-efficacy perceptions differ among participants based on factors such as the grade-level they teach, their linguistic profile and the years of teaching experience they have. I have created three different groups according to the data provided on the survey. Now, I describe participant characteristics overall as well as based on the three groups within the entire data set: (a) elementary and secondary teachers, (b) monolingual and multilingual teachers and (c) novice and experienced teachers.

Elementary and secondary teachers.

In Ontario's public school system, classrooms are organized in a number of different ways (Settlement.Org., 2012). Some schools include Junior Kindergarten (JK) and Senior Kindergarten (SK) as well as Grades 1 through 6 in their elementary division while others do not include Grade 6. In these schools, students would have to change to what is known as middle (intermediate) school in Grade 6 or 7. Typically, a middle school would include either Grades 6 through 8 or Grades 7 and 8. Some elementary schools are set up to include Kindergarten through Grade 8. Secondary schools are commonly organized to include Grades 9 through 12.

As a result of the varied ways in which our school system is divided, the elementary and secondary teacher group had to be organized coherently. On the survey, teachers were given three options to select the grade level they taught: elementary, intermediate and/or secondary. I did not specify which grades were considered to be at the elementary, intermediate or secondary level considering how subjective the grade-

level organization across Ontario's school boards is. They also had the choice of selecting more than one option depending on the type of school in which they taught. Teachers who indicated that they taught both elementary and intermediate grades (by selecting the elementary and the intermediate options) were all included in the elementary group assuming that they taught in schools that were Kindergarten through Grade 8 as opposed to Kindergarten through Grade 5 or Kindergarten through Grade 6. Out of the 76 participants, 38 (50%) teachers chose the elementary option and seven (9.2%) selected both elementary and intermediate options and thus were included in the elementary group. Twenty (26.3%) teachers selected the secondary option only indicating that they taught Grades 9 to 12 and were included in the secondary group. Two (2.7%) teachers selected both the intermediate and secondary groups and were included in the secondary group. Nine (11.8%) teachers had only selected the intermediate option and hence were also included in the secondary group for two reasons. First, many schools do not recognize Grades 6 through 8 as elementary grades and second, teachers teaching in the middle/intermediate grades do not teach all of the subjects (e.g., History, Language Arts, Geography) like their elementary counterparts. Similar to secondary teachers, they only teach those subjects in which they have specialization. With this understanding, 45 (59.2%) participants were included in the elementary group and 31 (40.8%) in the secondary group.

Monolingual and multilingual teachers.

A question on the survey asked the participants to list the different languages they spoke. I did not ask them to rate the languages they spoke in terms of their proficiency level or if they considered themselves a native or non-native speaker of English due to

the complicated nature of the dichotomy. I wanted to rest the decision about what counts as proficiency with the participants themselves considering the varying perspectives on the notion of proficiency. If they only listed English, I considered them as monolingual speakers of English and if they listed other languages in addition to English, I considered them as multilingual. Out of the total 76 respondents, 35 (46.1%) teachers reported as speaking only English and hence were classified as monolingual teachers and 41 (53.9%) teachers listed the different languages they spoke and hence, were categorized as multilingual teachers.

Those teachers who did not clearly list the different languages that they spoke were treated on a case-by-case basis in order to group them appropriately. A few participants only answered "1" on this particular question. It was assumed that they meant they only spoke English considering that they were able to answer the questions on the survey and hence, were included in the monolingual group. A few listed the number of languages they spoke (e.g., 4 languages) without listing the actual languages. These were included in the multilingual group. One teacher reported his response as "English [and] 5 years of schooling in French" (Respondent R_2PnZMP)[19] and another as "some basic French and Spanish as well as [E]nglish" (Respondent R_7QcfwQ). Both of these teachers were included in the monolingual group for three reasons. First, there was no doubt that they both had an advanced proficiency in English. However, they clearly did not perceive their proficiency level in the other languages they listed as equally advanced

[19] Out of the total participants, only those who participated in the interview have been given pseudonyms. Survey respondents (who did not participate in the interview) are recognized by the response identification number assigned randomly by the online survey portal.

or they would have listed the language without having to contextualize the amount of fluency they had in it. Second, there were other teachers[20] who spoke additional languages (other than English) but only listed as having proficiency in English on the survey. Hence, since such teachers who only listed "English" despite having at least beginner-level proficiency in other languages were included in the monolingual group, I reckoned that it would be fair to include those with a few years of schooling or basic proficiency in additional languages in the monolingual group as well. Third, according to Cummins's (1979) BICS/CALP framework, it could take up to a decade for an individual to attain complete proficiency in a language. Hence, "five years of French" may possibly be insufficient to gain complete mastery in the language and "some basic French" does not indicate advanced proficiency. I understand that the representation of an individual as either monolingual or multilingual could be interpreted in a number of different ways depending on one's conceptualization of the meaning of proficiency but I have used my discretion in this matter and have made every attempt to remain just to all of the research participants involved.

I am aware that some of the multilingual teachers in this study could be characterized as Internationally Educated Teachers (IETs). Broadly speaking, an IET is a teacher who has attained education, lived and/or worked outside Canada for a significant period of time and "may have teaching experience and a teaching certificate from his/her

[20] For instance, Sawyer (see subsequent section on interview participants for additional information) stated during the interview that he had knowledge of Japanese and also spoke "a little French" but did not consider himself proficient in either of the two languages because he only listed English on the survey item asking him to list the number of languages he spoke.

country of origin" (Faez, 2010, p. 65). However, I chose not to define some of the teachers as IETs for two reasons. First, the definition of an IET itself is quite subjective and second, whether a teacher would be considered an IET also brings about a discussion on whether he or she is a native or non-native speaker of English. The goal of this study was to examine whether knowledge of an additional language (other than English) had an impact on their self-efficacy and did not involve delving into how these teachers learning additional languages. As a result, I defined the teachers as either monolingual or multilingual depending on the number of languages they listed.

Novice and experienced teachers.

On the survey, teachers were asked to report on their teaching experience on two questions. One question asked the teachers to state the number of years they had been teaching science and another asked them to state the number of years they had been in the teaching profession overall. The responses to these questions were not necessarily identical in every case. For instance, one teacher reported overall teaching experience of 20 years and science teaching experience of 15 years. In order to group the teachers as either novice or experienced, I considered their overall teaching experience.

I found a number of different ways in the literature in which the terms novice and experienced were defined. While some consider only those in their first year of teaching as novice (e.g., Weinstein, 1988; Devos, Dupriez & Paquay, 2012), there are others that consider those with three or fewer years of teaching experience (e.g., Tschannen-Moran and Woolfolk Hoy, 2007; Putman, 2012) or five or fewer years of teaching experience (e.g., Coady et al., 2011) as novice. Additionally, others have defined the term "novice" generally as teachers in their 'beginning', 'early' or 'first' years of teaching without any

specification (e.g., Onafowora, 2005). Following Tschannen-Moran and Woolfolk Hoy's (2007) definition, I defined novice teachers as those with three or fewer years of teaching experience. With regards to the definition of experienced teachers as well, there is variation in the literature. In their research studies, Putman (2012) defined experienced teachers as those with three or more years of experience while Tschannen-Moran and Woolfolk Hoy (2007) defined them as those with four or more years of experience. In his study, Chan (2008) defined experienced teachers as those with a range of three years to 19 years. Due to the inconsistency in the definition of the term, I chose to define experienced teachers as those who had been teaching for five years and more.

In this research, teachers who had teaching experience of three years or fewer were defined as novice teachers and those who had been teaching for five years or longer were defined as experienced teachers. After teaching for three years, a teacher would surpass the novice stage but would not be considered as experienced abruptly on the first day of the fourth year of teaching. As such, there were three respondents who reported that they had overall teaching experience of four years and were eliminated from the novice and experienced group. Out of the 73 participants[21], 11 (15.1%) were novice teachers and 62 (84.9%) teachers were experienced.

The Interview Participants

In this section, I first describe the general characteristics of each of the 10 interview participants and then provide a table highlighting the participants' positioning in the three groups explained in the previous section. In keeping with the anonymity and

[21] Since three participants were eliminated from this group, the population size for the novice and experienced group sample was 73 (as opposed to 76).

confidentiality clause of the UWO ethics protocol, each of the interview participants has been assigned a pseudonym chosen at random. Out of the 10 interview participants, six were females and four were males. Prior to conducting the interview, I perused their online survey responses in order to come up with specific questions to ask them during the interview in addition to the general interview protocol that I used for each of the participants. The characteristics that I present in the next section describe information collected at the time of the interview from both their survey and interview responses. It should be noted that statistical information (e.g., the number of ELLs in their classroom) provided by the participants holds true for the particular academic year during (or soon after) which the interview was conducted. There may or may not be changes to the grade-level and number of students they teach (among other information) in subsequent years after the interview. For instance, I interviewed Scott in June 2014. The information that he provided was true for that academic year (September 2013-June 2014) only. During the interview (off the record, however), he informed me that he would be teaching a different elementary grade in the next academic year following our interview.

Now, I present the profiles of the 10 interview participants.

Scott.

Scott had been teaching science at the elementary level for 10 years. He had been born and raised in Canada and had also completed all of his education including his Bachelor of Education qualification here. He taught 27 students in total, 17 of whom were ELLs. Scott was very interested in this research and had also invited me to observe his classroom on a number of occasions. He was a monolingual speaker of English. The average appraisal of his self-efficacy on the survey was 8.25.

Debra.

Even though Debra had been teaching for 14 years, she had been teaching science for the last 10 years. She taught at the intermediate and secondary levels. She had been born and raised in Canada and had also completed all of her education including her Bachelor of Education qualification here. None of the 25 students who she taught in total were ELLs. However, she informed me that even though she did not have any ELLs in her class in that particular year, she had gained considerable experience teaching in diverse contexts in previous years. She was a monolingual speaker of English. The average appraisal of her self-efficacy on the survey was 8.23.

Aubrey.

Aubrey had been born, raised and educated in Canada. She was a novice teacher who had been teaching in the elementary grades for three years. During the year in which this interview was conducted, she taught Grade 1. She taught a class of 22 students, 19 of whom were ELLs. She reported that she spoke English and Punjabi[22]. The average appraisal of her self-efficacy on the survey was 7.78.

Nina.

Nina had been born, raised and educated in India where she also worked as a teacher. After coming to Canada, she was re-credentialed with the appropriate Bachelor of Education qualification to teach in Canada. Even though she had 20 years of teaching experience in total, she had been teaching science at the elementary level for the last 15 years. Two of the 25 students in her Kindergarten class were ELLs. She was a

[22] Punjabi is one of the languages spoken in India.

multilingual speaker of English, Marathi[23] and Hindi[24]. The average appraisal of her self-efficacy on the survey was 9.08.

Katherine.

Katherine had been born, raised and educated in India where she was a teacher. She completed her recertification to be able to teach in Canada upon arrival. She had been teaching science in the elementary grades for 10 years but overall, she had 16 years of teaching experience. She taught 120 students out of which 30 were ELLs. She spoke English, Hindi and Marathi. The average appraisal of her self-efficacy on the survey was 8.13.

Alicia.

Alicia had been born in Kuwait where she lived for 15 years before coming to Canada for secondary school. All of her education since Grade 11 had been completed in Canada. She taught science at the elementary and intermediate levels. She stated that she had experience teaching diverse classrooms as approximately 15% of her students each year were ELLs. She had five years of teaching experience in total. She reported as speaking four languages but did not disclose which ones in particular. The average appraisal of her self-efficacy on the survey was 7.28.

Julian.

Julian had been born in Mauritius and had come to Canada at a young age during elementary school. He had received all of his education since then in Canada. He had

[23] Marathi is one of the languages spoken in India.

[24] Hindi is one of the official languages of India.

been teaching for 10 years in total but for nine years as a science teacher at the intermediate level. Julian taught in a French Immersion school. Ten out of 148 students who he taught were ELLs. In addition to science, he also taught Geography. During the interview, Julian informed me that he was always willing to help researchers like myself and even encouraged his family members to participate in research studies. He spoke English, French and Mauritian Creole[25]. The average appraisal of his self-efficacy on the survey was 5.68.

Sawyer.

Sawyer had been born and raised in Canada. He had completed all of his education including his Bachelor of Education in Canada. He had been teaching science at the elementary grade-level for nine years even though he had 10 years of teaching experience in total. He taught in a Catholic school. During the interview, he informed me that teaching was his second career. Out of a total of 27 students, he had no ELLs in his classroom in that year but was very interested in participating in the study regardless. Even though Sawyer had limited experience when it came to dealing with aspects of diversity such as culture or language, he spoke about an unusual diversity characteristic brought into his classroom by a new student. In the student's home country, he was used to the imperial system of calculation which is different from the metric system used in Canada[26]. As I spoke with Sawyer, I discovered that diversity is not only limited to observable issues of race, gender, ethnicity and language among others and that previous

[25] Mauritian Creole is one of the languages spoken in Mauritius. A Creole is "a pidgin [language] that has become the native language of a speech community" (Dictionary.com, 2015).

[26] I discuss this issue further in Chapter 5.

school cultures of students who are new to Canada (regardless of whether they are ELLs) also need to be viewed through this lens. Sawyer was a monolingual speaker of English. The average appraisal of his self-efficacy on the survey was 7.15.

Dillon.

Dillon had been born and raised in Canada. He had completed all of his education including his Bachelor of Education in Canada. He had 14 years of teaching experience in the elementary and intermediate grades. Out of 65 students in his class, one was an ELL. On the survey, Dillon had not indicated that he wished to participate in the interview. However, he contacted me about arranging an interview soon afterwards based on an interesting conversation he had with his spouse about the topic. He was a multilingual speaker of English, Italian and French. The average appraisal of his self-efficacy on the survey was 8.68.

Nora.

Nora had been born, raised and had completed all of her education in India. She had experience teaching in India and in the Middle East. She had completed the recertification process to be qualified to teach in Canada. Nora had over 25 years of teaching experience. Even though she had experience teaching across various grade-levels (Kindergarten through secondary grades) throughout her career, she taught at the elementary grade-level at the time of this study. Out of 26 students in her class, 15 were ELLs. She spoke English, Hindi, Tamil[27] and Kannada[28]. The average appraisal of her self-efficacy on the survey was 8.30.

[27] Tamil is spoken in India and Sri Lanka.

Table 8

Characteristics of Interview Participants (n = 10)

Participants	Grade-Level	Linguistic Profile	Teaching Experience
Scott	Elementary	Monolingual	Experienced
Debra	Secondary	Monolingual	Experienced
Aubrey	Elementary	Multilingual	Novice
Nina	Elementary	Multilingual	Experienced
Katherine	Elementary	Multilingual	Experienced
Alicia	Elementary	Multilingual	Experienced
Julian	Secondary	Multilingual	Experienced
Sawyer	Elementary	Monolingual	Experienced
Dillon	Elementary	Multilingual	Experienced
Nora	Elementary	Multilingual	Experienced

Data Analysis Procedures

In this section, I briefly describe the procedures I used to analyze the quantitative and qualitative data for this study. The survey data were analyzed for descriptive and inferential statistics using Microsoft Excel and IBM SPSS Statistics 23 (2015) and the interview data were analyzed to generate codes and themes using NVivo 8 (2009) software. At the end of the data collection period, I downloaded the final versions of the survey data from the Qualtrics portal onto Microsoft Excel. I separated the survey questionnaire data into two categories. The first part (Questions 1-13) asked about the teachers' demographic and background information. Responses to questions including their gender, educational background and years of experience among others were saved

[28] Kannada is one of the languages spoken in India.

onto a separate file in Excel. I calculated mean scores to discover the average years of teaching experience and the number of students that the teachers taught in a year. This way, I was able to group the teachers properly depending on whether they were novice (with less than three years of teaching experience) or experienced (with more than five years of teaching experience). I calculated percentages of teachers teaching at the elementary and secondary divisions in order to group them appropriately. Based on their reports of the number of languages they spoke, I also categorized each of them as either monolingual (speakers of English) or multilingual (speakers of multiple languages in addition to English).

The second part of the survey (Questions 14-53) asked the teachers to rate their perceived level of self-efficacy in terms of culturally responsive teaching practices on the adapted CRTSE questionnaire (Siwatu, 2007). I collected the numerical information of all the participants' (N = 76) appraisal of their self-efficacy on a separate Excel file. I calculated the means and standard deviations of their scores on the 40 items of the survey in two ways. First, I calculated the overall means and standard deviations for each of the participants. Second, I calculated item-specific means and standard deviations in order to find the highest- and lowest-rated items on the survey. Thereafter, I opened three separate files for each of the three groups in which the participants were categorized: (a) elementary and secondary teachers, (b) monolingual and multilingual teachers and (c) novice and experienced teachers. I also created another separate file for the interview participants (n = 10). I calculated the means and standard deviations of their self-efficacy measures for each of these groups as well. In order to calculate inferential statistics, I created a data set of the survey data in SPSS. First, I implemented independent samples t-

tests comparing the overall means of the three groups (grade-level, linguistic profile and teaching experience) as well as item-specific means to see if there were statistically significant differences. Second, I conducted a correlational analysis between experience and self-efficacy. Third, I conducted an additional *t*-test to see if there were statistically significant differences between general pedagogical practices and culturally responsive pedagogical practices.

As far as the interview data are concerned, I transcribed each of the 10 interviews onto separate Microsoft Word files. As I transcribed the data, there were instances when I typed up notes in the margins earmarking significant details. I began the data analysis phase by reading my interview transcripts for each participant. I brainstormed what could become possible codes based on my interview questions. Thereafter, I uploaded the transcripts onto the NVivo software program for further analysis. I began the formal coding process by analyzing the interview data in terms of identifying and categorizing the content based on codes and patterns. As Patton (2002) states, this phase of analysis forms a basis for data interpretation where "meanings are extracted from the data, comparisons are made, creative frameworks for interpretation are constructed, conclusions are drawn, significance is determined, and in some cases, theory is generated" (p. 465). By the end, I had created 23 codes including challenges posed by diverse classrooms, inclusive classroom design and roles of a science teacher. The codes that were generated during this phase helped elucidate the quantitative findings as well as examine significant issues within the interview data further.

Summary

In this chapter, I discussed the methodology employed in this study. I rationalized my choice of mixed methodology and relevant methods. The ethics protocol and data collection techniques were also detailed. Additionally, I described how triangulation was achieved as well as the measures taken to establish validity and reliability of the study results. I presented the characteristics of the survey and interview participants and briefly described the procedures for data analysis. In the next two chapters, I present the findings of this study. Chapter 4 presents the findings pertaining to the first and second research questions and Chapter 5 presents the findings pertaining to the third research question.

CHAPTER 4 SCIENCE TEACHERS' SELF-EFFICACY PERCEPTIONS

Introduction

This study investigated the self-efficacy perceptions of Ontario's science teachers to teach in diverse classrooms. In this chapter, I present the research findings related to the first and second research questions. I discuss the self-efficacy perceptions of science teachers to provide culturally responsive pedagogy in diverse classrooms in the following six sections: (a) a description of the data set, (b) descriptive statistics regarding teachers' self-efficacy perceptions, (c) a comparison of the three sub-groups (elementary and secondary, monolingual and multilingual as well as novice and experienced) through independent samples *t*-tests, (d) correlation between self-efficacy and teaching experience, (e) a comparison of survey items dealing with general and culturally responsive pedagogy through an independent samples *t*-test and (f) interview participants' voices.

The Data Set

In this section, I present a brief snapshot of the entire data set and the categories in which the participants have been grouped. The number of participants totaled 76, all of whom were included in the analysis of this study except for three participants who were excluded from the analysis of the novice and experienced group[29]. Out of the total number of participants, 49 (64.5%) were female and 27 (35.5%) were male. The participants taught an average of 68.1 students in a year out of which 7 were ELLs. The

[29] Recall that the total number of participants for the novice-experienced group was 73 (instead of 76) since three participants mentioned having four years of experience and thus, were eliminated for comparing the novice and experienced sub-groups for the independent samples *t*-test.

average teaching experience was calculated to be 11.5 years ranging from zero to 35 years. The participants were classified into the following three groups[30] based on the grade-level they taught, their linguistic profile as well as their teaching experience: (a) elementary and secondary, (b) monolingual and multilingual and (c) novice and experienced[31]. In terms of the grade-level they taught, 45 (59.2%) participants were included in the elementary sub-group and 31 (40.8%) in the secondary sub-group. In terms of the teachers' linguistic profile, 35 (46.1%) teachers reported that they were monolingual speakers of English and 41 (53.9%) were multilingual speakers based on the number of languages they listed on the survey. As far as their teaching experience was considered, 11 (15.1%) had experience between zero and three years and were considered novice teachers and 62 (84.9%) had been teaching for five years or more and were categorized as experienced[32]. Teachers who had between three and four years of teaching experience (n = 3) were eliminated from the novice-experienced group for the purpose of t-tests[33]. Interviews[34] were conducted with 10 of the 76 survey participants.

Science Teachers' Perceptions of Self-Efficacy

The findings in this section are presented in five sub-sections: (a) the overall findings of science teachers' self-efficacy perceptions to teach in diverse classrooms by

[30] I use the term "group/s" to refer to the three sub-samples (e.g., elementary & secondary group) and "sub-group" to refer to one faction within the group (e.g., elementary sub-group).

[31] See Chapter 3 for categorization criteria.

[32] I have discussed the definitions of novice and experienced in light of the literature in Chapter 3.

[33] See Chapter 3 for more information about the elimination of those participants with four years of teaching experience from the novice-experienced group for the t-tests.

[34] See Chapter 3 for profiles of the interview participants.

survey items[35], (b) by grade-level group (c) by linguistic profile group, (d) by experience group and (e) through interview participants' voices.

Overall

The adapted CRTSE survey questionnaire contained 40 items dealing with various culturally responsive teaching practices on which participants were asked to appraise their perceived self-efficacy on a scale of 0 meaning *no feelings of self-efficacy* to 10 meaning *high feelings of self-efficacy*. Frequency tabulations show that scores did not necessarily range from 0 to 10 on each of the survey items. For instance, on the survey item "I build a sense of trust in my students", participant scores ranged between 4 and 10 while on the item "I design a classroom environment using displays that reflects a variety of cultures", participant scores ranged between 0 and 10. Descriptive statistics show that item-specific mean scores ranged from the lowest mean 4.36 (SD = 3.03) on the item "I greet English Language Learners with a phrase in their native language if I am able to" to the highest mean 8.67 (SD = 1.40) on the item "I use a variety of teaching methods such as visual aids" among participants. Table 9 presents the descriptive statistics of each of the items on the adapted CRTSE survey for the entire population (N = 76).

[35] In this sub-section, I present how all the participants (N = 76) scored on each survey item separately (e.g., the mean score of 76 participants on item 4 of the survey).

Table 9

Descriptive Statistics for Items on the Adapted CRTSE Survey (N = 76)

Descriptive Statistics on Adapted CRTSE Survey		*M*	*SD*
(1)	I adapt instruction to meet the needs of my students	7.92	1.42
(2)	I obtain information about my students' academic strengths and weaknesses	8.30	1.36
(3)	I determine whether my students like to work alone or in a group	7.87	1.80
(4)	I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture	6.75	2.07
(5)	I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture	6.26	2.42
(6)	I assess student learning using various types of assessments	8.46	1.50
(7)	I obtain information about my students' home life	6.53	1.90
(8)	I build a sense of trust in my students	8.66	1.38
(9)	I establish positive home-school relations	8.01	1.39
(10)	I use a variety of teaching methods such as visual aids	8.67	1.40
(11)	I develop a community of learners when my class consists of students from diverse backgrounds	7.76	1.95
(12)	I use my students' cultural background to help make learning meaningful	7.13	2.21
(13)	I use my students' prior knowledge of science to help them make sense of new information	8.09	1.47
(14)	I identify ways how students communicate at home may differ from the school norms	6.47	2.10
(15)	I obtain information about my students' cultural background such as their L1 or mother tongue	6.88	2.32
(16)	I teach students about their cultures' contributions to science if content and context permit	5.17	2.72
(17)	I greet English Language Learners with a phrase in their native language if I am able to	4.36	3.03
(18)	I design a classroom environment using displays that reflects a variety of cultures	5.55	2.76
(19)	I develop a personal relationship with my students	7.93	2.06
(20)	I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students	6.16	3.06
(21)	I communicate with parents regarding their child's educational progress	8.32	1.41
(22)	I structure parent-teacher conferences so that the meeting is not intimidating for parents	8.53	1.56

Table 9 Continued

Descriptive Statistics on Adapted CRTSE Survey		*M*	*SD*
(23)	I help students to develop positive relationships with their classmates	8.47	1.37
(24)	I revise instructional material to include a better representation of cultural groups	6.21	2.18
(25)	I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes	6.19	2.69
(26)	I model classroom tasks to enhance English Language Learners' understanding	6.58	2.64
(27)	I communicate with the parents of English Language Learners regarding their child's achievement	6.86	2.87
(28)	I help students feel like important members of the classroom	8.66	1.48
(29)	I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students	5.87	2.95
(30)	I use a learning preference inventory to gather data about how my students like to learn (e.g., are they visual, linear, kinesthetic or auditory learners?)	6.84	2.41
(31)	I use examples that are familiar to students from diverse cultural backgrounds	6.45	2.13
(32)	I obtain information regarding my students' academic interests	7.76	1.59
(33)	I use the interests of my students to make learning meaningful for them	7.89	1.53
(34)	I implement cooperative learning activities for those students who like to work in groups	8.24	1.51
(35)	I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)	6.47	2.57
(36)	I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)	7.76	1.97
(37)	I give students the opportunity to improve their proficiency in English in my science class	7.38	2.22
(38)	I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts	7.24	1.97
(39)	I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better	7.42	2.36
(40)	I encourage English Language Learners to use their first language (L1) to define and understand content-specific terms and phrases	5.99	3.00

The overall mean (for all participants on the entire survey) was 7.20 (*SD* = 1.07). The three highest-rated[36] items were item 10 which reads "I use a variety of teaching methods such as visual aids" (*M* = 8.67, *SD* = 1.40), item 8 which reads "I build a sense of trust in my students" (*M* = 8.66, *SD* = 1.38) as well as item 28 which reads "I help students feel like important members of the classroom" (*M* = 8.66, *SD* = 1.56) and item 22 which reads "I structure parent-teacher conferences so that the meeting is not intimidating for parents" (*M* = 8.53, *SD* = 1.48). The three lowest-rated items were item 18 which reads "I design a classroom environment using displays that reflects a variety of cultures" (*M* = 5.55, *SD* = 2.76), item 16 which reads "I teach students about their cultures' contributions to science if content and context permit" (*M* = 5.17, *SD* = 2.72) and item 17 which reads "I greet ELLs with a phrase in their native language if I am able to" (*M* = 4.36, *SD* = 3.03).

Self-Efficacy by Groups

In addition to examining how Ontario's science teachers perceived their self-efficacy on culturally responsive teaching practices overall, I also wanted to explore how the sub-groups compared in terms of their self-efficacy perceptions. In order to discover whether there were any differences and if they were statistically significant, I conducted independent samples *t*-tests of the three groups. In the next section, I explain this process in detail.

[36] Although I present three highest- and lowest-rated survey items, it should be noted that there were four highest-rated items since two items (items 8 and 28) had the same mean score.

Grade-level group: Elementary & secondary teachers.

Mean scores and standard deviations by item on the adapted CRTSE survey for elementary and secondary teachers are shown in Table 10. Elementary and secondary teachers were also compared on their responses to the 40-item adapted CRTSE survey with an independent samples *t*-test. Total survey mean scores and standard deviations for elementary and secondary teachers were 7.34 (*SD* = 1.19) and 7.01 (*SD* = 1.34) respectively. Levene's test for unequal variances was conducted and it showed that the variances were not significantly different [$F(74) = 1.380$, $p = .244$]. The results of the *t*-test [$t(74) = 1.115$, $p = .268$] show that there were no statistically significant differences between the sub-groups.

Although conducting *t*-tests on individual items results in a high experiment-wise error rate, and hence, increases the likelihood of obtaining significant results by chance alone (Moore, McCabe & Craig, 2014), I chose to do this to determine if there were indeed any significant differences between the two sub-groups (see Table 10). Scores on several items significantly differed between the sub-groups. Levene's test for unequal variances was conducted for each of the survey items and it was found that the sub-groups had statistically significant mean differences on items 11, 18 and 19 (underlined in Table 10). Nonetheless, it is important to keep in mind that given the large number of *t*-tests, some of these differences may be due to chance alone rather than reflecting actual group differences.

Table 10

Survey Item T-Tests (Grade-Level Group)

		Elementary (n = 45)		Secondary (n = 31)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(1)	I adapt instruction to meet the needs of my students	7.87	1.62	8	1.1	.67
(2)	I obtain information about my students' academic strengths and weaknesses	8.47	1.47	8.06	1.15	.206
(3)	I determine whether my students like to work alone or in a group	7.93	1.98	7.77	1.52	.707
(4)	I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture	7.02	1.74	6.35	2.44	.196
(5)	I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture	6.69	2.08	5.65	2.76	.08
(6)	I assess student learning using various types of assessments	8.31	1.38	8.68	1.66	.299
(7)	I obtain information about my students' home life	6.64	1.73	6.35	2.14	.518
(8)	I build a sense of trust in my students	8.78	1.31	8.48	1.48	.365
(9)	I establish positive home-school relations	8.2	1.36	7.74	1.41	.16
(10)	I use a variety of teaching methods such as visual aids	8.64	1.58	8.71	1.1	.843
(11)	I develop a community of learners when my class consists of students from diverse backgrounds	8.13	1.78	7.23	2.09	.046
(12)	I use my students' cultural background to help make learning meaningful	7.42	2.11	6.71	2.31	.168
(13)	I use my students' prior knowledge of science to help them make sense of new information	7.96	1.77	8.29	0.86	.278
(14)	I identify ways how students communicate at home may differ from the school norms	6.56	2.05	6.35	2.2	.685
(15)	I obtain information about my students' cultural background such as their L1 or mother tongue	7.02	2.25	6.68	2.43	.527

Table 10 Continued

		Elementary (n = 45)		Secondary (n = 31)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(16)	I teach students about their cultures' contributions to science if content and context permit	5.02	2.65	5.39	2.84	.568
(17)	I greet English Language Learners with a phrase in their native language if I am able to	4.64	3.24	3.94	2.68	.319
(18)	I design a classroom environment using displays that reflects a variety of cultures	6.24	2.25	4.55	3.15	.013
(19)	I develop a personal relationship with my students	8.34	1.88	7.35	2.2	.041
(20)	I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students	6.31	3.31	5.94	2.71	.603
(21)	I communicate with parents regarding their child's educational progress	8.4	1.56	8.19	1.17	.533
(22)	I structure parent-teacher conferences so that the meeting is not intimidating for parents	8.6	1.72	8.42	1.31	.623
(23)	I help students to develop positive relationships with their classmates	8.66	1.38	8.19	1.33	.148
(24)	I revise instructional material to include a better representation of cultural groups	6.29	2.14	6.1	2.27	.709
(25)	I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes	6.34	2.46	5.97	3.01	.557
(26)	I model classroom tasks to enhance English Language Learners' understanding	6.67	2.76	6.45	2.5	.73
(27)	I communicate with the parents of English Language Learners regarding their child's achievement	6.96	3.03	6.71	2.67	.717
(28)	I help students feel like important members of the classroom	8.91	1.28	8.29	1.68	.071
(29)	I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students	6.09	2.92	5.55	3.01	.436
(30)	I use a learning preference inventory to gather data about how my students like to learn (e.g., are they visual, linear, kinesthetic or auditory learners?)	7.04	2.44	6.55	2.36	.381

Table 10 Continued

		Elementary (n = 45)		Secondary (n = 31)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(31)	I use examples that are familiar to students from diverse cultural backgrounds	6.53	2.11	6.32	2.18	.674
(32)	I obtain information regarding my students' academic interests	7.78	1.51	7.74	1.73	.924
(33)	I use the interests of my students to make learning meaningful for them	8.07	1.48	7.65	1.58	.24
(34)	I implement cooperative learning activities for those students who like to work in groups	8.2	1.73	8.29	1.16	.811
(35)	I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)	6.73	2.43	6.1	2.76	.291
(36)	I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)	7.76	2.23	7.77	1.54	.968
(37)	I give students the opportunity to improve their proficiency in English in my science class	7.42	2.19	7.32	2.3	.849
(38)	I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts	7.27	1.98	7.19	1.99	.875
(39)	I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better	7.58	2.29	7.19	2.48	.49
(40)	I encourage English Language Learners to use their first language (L1) to define and understand content-specific terms and phrases	5.89	3.16	6.13	2.81	.735

Note. Participants: N = 76; p < .05 are underlined.

Linguistic profile group: Monolingual & multilingual teachers.

Mean scores and standard deviations by item on the adapted CRTSE survey for monolingual and multilingual teachers are shown in Table 11. The two sub-groups were

also compared on their responses to the 40-item adapted CRTSE survey with an independent samples *t*-test. Total survey mean scores and standard deviations for monolingual and multilingual teachers were 7.07 (*SD* = 1.30) and 7.31 (*SD* = 1.22) respectively. Levene's test for unequal variances was conducted and it showed that the variances were not significantly different [$F(74) = .451$, $p = .504$]. The results of the *t*-test [$t(74) = -.825$, $p = .412$] show that there were no statistically significant differences between the sub-groups.

As previously mentioned, conducting *t*-tests on individual items results in a high experiment-wise error rate, and hence, increases the likelihood of obtaining significant results by chance alone (Moore et al., 2014). However, I chose to do this to determine if there were indeed any significant differences between the two sub-groups (see Table 11). However, Levene's test for unequal variances was conducted for each of the survey items and it was found that the sub-groups had no statistically significant mean differences on any of the items.

Table 11

Survey Item T-Tests (Linguistic Profile Group)

		Monolingual (n = 35)		Multilingual (n = 41)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(1)	I adapt instruction to meet the needs of my students	7.91	1.07	7.93	1.68	.97
(2)	I obtain information about my students' academic strengths and weaknesses	8.6	.95	8.05	1.60	.077
(3)	I determine whether my students like to work alone or in a group	7.94	1.96	7.8	1.68	.741
(4)	I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture	6.51	2.48	6.95	1.64	.377
(5)	I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture	5.94	2.69	6.54	2.16	.289
(6)	I assess student learning using various types of assessments	8.77	1.19	8.2	1.69	.095
(7)	I obtain information about my students' home life	6.31	2.03	6.71	1.79	.372
(8)	I build a sense of trust in my students	8.57	1.38	8.73	1.40	.617
(9)	I establish positive home-school relations	7.86	1.42	8.15	1.37	.37
(10)	I use a variety of teaching methods such as visual aids	8.63	1.29	8.71	1.50	.809
(11)	I develop a community of learners when my class consists of students from diverse backgrounds	7.54	2.13	7.95	1.79	.367
(12)	I use my students' cultural background to help make learning meaningful	6.94	2.09	7.29	2.32	.494
(13)	I use my students' prior knowledge of science to help them make sense of new information	8	1.35	8.17	1.58	.617
(14)	I identify ways how students communicate at home may differ from the school norms	6.26	2.27	6.66	1.96	.41
(15)	I obtain information about my students' cultural background such as their L1 or mother tongue	6.57	2.48	7.15	2.16	.284

Table 11 Continued

		Monolingual (n = 35)		Multilingual (n = 41)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(16)	I teach students about their cultures' contributions to science if content and context permit	4.71	2.93	5.56	2.49	.177
(17)	I greet English Language Learners with a phrase in their native language if I am able to	3.97	3.37	4.68	2.71	.319
(18)	I design a classroom environment using displays that reflects a variety of cultures	5.14	2.57	5.9	2.91	.235
(19)	I develop a personal relationship with my students	7.59	2.24	8.22	1.88	.189
(20)	I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students	6	3.40	6.29	2.78	.681
(21)	I communicate with parents regarding their child's educational progress	8.37	1.22	8.27	1.57	.752
(22)	I structure parent-teacher conferences so that the meeting is not intimidating for parents	8.8	1.11	8.29	1.85	.16
(23)	I help students to develop positive relationships with their classmates	8.35	1.39	8.56	1.36	.516
(24)	I revise instructional material to include a better representation of cultural groups	5.97	2.57	6.41	1.79	.381
(25)	I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes	5.91	3.09	6.41	2.31	.436
(26)	I model classroom tasks to enhance English Language Learners' understanding	6.06	2.62	7.02	2.60	.112
(27)	I communicate with the parents of English Language Learners regarding their child's achievement	7.26	2.48	6.51	3.16	.263
(28)	I help students feel like important members of the classroom	8.63	1.61	8.68	1.37	.874
(29)	I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students	6	3.07	5.76	2.88	.722
(30)	I use a learning preference inventory to gather data about how my students like to learn (e.g., are they visual, linear, kinesthetic or auditory learners?)	6.71	2.38	6.95	2.45	.672

Table 11 Continued

		Monolingual (n = 35)		Multilingual (n = 41)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(31)	I use examples that are familiar to students from diverse cultural backgrounds	6.03	2.40	6.8	1.82	.113
(32)	I obtain information regarding my students' academic interests	8	1.57	7.56	1.60	.233
(33)	I use the interests of my students to make learning meaningful for them	7.91	1.38	7.88	1.66	.919
(34)	I implement cooperative learning activities for those students who like to work in groups	8.2	1.53	8.28	1.52	.832
(35)	I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)	6.29	2.62	6.63	2.55	.559
(36)	I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)	7.4	2.29	8.07	1.60	.138
(37)	I give students the opportunity to improve their proficiency in English in my science class	7.29	2.11	7.46	2.34	.731
(38)	I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts	7.14	1.88	7.32	2.07	.704
(39)	I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better	6.97	2.49	7.8	2.21	.126
(40)	I encourage English Language Learners to use their first language (L1) to define and understand content-specific terms and phrases	5.8	3.30	6.15	2.76	.62

Note. Participants: N = 76

Teaching experience group: Novice & experienced.

Mean scores and standard deviations by item on the adapted CRTSE survey for novice and experienced teachers are shown in Table 12. Novice and experienced teachers

were also compared on their responses to the 40-item adapted CRTSE survey with an independent samples *t*-test. Total survey mean scores and standard deviations for novice and experienced teachers were 7.23 (*SD* = 1.06) and 7.17 (*SD* = 1.31) respectively. Levene's test for unequal variances was conducted and it showed that the variances were not significantly different [$F(71) = 1.144$, $p = .288$]. The results of the *t*-test show that there were no statistically significant differences between the sub-groups [$t(71) = .136$, $p = .892$].

As previously mentioned, conducting *t*-tests on individual items results in a high experiment-wise error rate, and hence, increases the likelihood of obtaining significant results by chance alone (Moore et al., 2014). However, I chose to do this to determine if there were indeed any significant differences between the two sub-groups (see Table 12). Scores on several items significantly differed between the sub-groups. Levene's test for unequal variances was conducted for each of the survey items and it was found that the sub-groups had statistically significant mean differences on items 6, 20, 22 and 29 (underlined in Table 12). Nonetheless, it is important to keep in mind that given the large number of *t*-tests, some of these differences may be due to chance alone rather than reflecting actual group differences.

Table 12

Survey Item T-Tests (Teaching Experience Group)

		Novice (n = 11)		Experienced (n = 62)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(1)	I adapt instruction to meet the needs of my students	7.45	1.64	8	1.40	.25
(2)	I obtain information about my students' academic strengths and weaknesses	7.73	1.85	8.39	1.27	.145
(3)	I determine whether my students like to work alone or in a group	7.27	2.80	7.97	1.58	.242
(4)	I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture	7.64	1.80	6.58	2.03	.111
(5)	I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture	6.64	2.06	6.16	2.45	.547
(6)	I assess student learning using various types of assessments	7.55	2.34	8.6	1.29	.033
(7)	I obtain information about my students' home life	6.82	1.33	6.5	1.93	.602
(8)	I build a sense of trust in my students	8.27	1.49	8.77	1.30	.252
(9)	I establish positive home-school relations	7.64	1.12	8.08	1.45	.339
(10)	I use a variety of teaching methods such as visual aids	7.91	1.45	8.81	1.39	.054
(11)	I develop a community of learners when my class consists of students from diverse backgrounds	7.45	1.64	7.85	2.02	.536
(12)	I use my students' cultural background to help make learning meaningful	7.36	1.91	7.08	2.31	.703
(13)	I use my students' prior knowledge of science to help them make sense of new information	8	1.27	8.08	1.54	.87
(14)	I identify ways how students communicate at home may differ from the school norms	7.09	1.45	6.35	2.22	.294
(15)	I obtain information about my students' cultural background such as their L1 or mother tongue	6.91	1.87	6.85	2.44	.944

Table 12 Continued

		Novice (n = 11)		Experienced (n = 62)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(16)	I teach students about their cultures' contributions to science if content and context permit	5.82	1.72	4.92	2.81	.31
(17)	I greet English Language Learners with a phrase in their native language if I am able to	5.27	2.76	4.19	3.09	.282
(18)	I design a classroom environment using displays that reflects a variety of cultures	6	2.19	5.58	2.79	.638
(19)	I develop a personal relationship with my students	8.36	1.21	7.95	2.16	.542
(20)	I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students	7.91	1.97	5.81	3.17	.008
(21)	I communicate with parents regarding their child's educational progress	8.18	1.40	8.31	1.44	.792
(22)	I structure parent-teacher conferences so that the meeting is not intimidating for parents	7.64	1.75	8.68	1.52	.004
(23)	I help students to develop positive relationships with their classmates	8.27	1.19	8.52	1.42	.582
(24)	I revise instructional material to include a better representation of cultural groups	6.18	1.89	6.15	2.25	.96
(25)	I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes	6	1.27	6.1	2.87	.854
(26)	I model classroom tasks to enhance English Language Learners' understanding	6.45	2.81	6.52	2.67	.944
(27)	I communicate with the parents of English Language Learners regarding their child's achievement	7.45	1.57	6.76	3.10	.268
(28)	I help students feel like important members of the classroom	8.09	1.38	8.71	1.50	.196
(29)	I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students	7.36	1.86	5.48	3.05	.012
(30)	I use a learning preference inventory to gather data about how my students like to learn (e.g., are they visual, linear, kinesthetic or auditory learners?)	7.55	2.21	6.69	2.46	.287

Table 12 Continued

		Novice (n = 11)		Experienced (n = 62)		p
Adapted CRTSE Survey Items		*M*	*SD*	*M*	*SD*	
(31)	I use examples that are familiar to students from diverse cultural backgrounds	6.82	1.94	6.34	2.16	.493
(32)	I obtain information regarding my students' academic interests	7.82	.75	7.69	1.70	.813
(33)	I use the interests of my students to make learning meaningful for them	7.64	1.43	7.89	1.56	.621
(34)	I implement cooperative learning activities for those students who like to work in groups	7.5	1.84	8.31	1.46	.122
(35)	I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)	6.73	1.85	6.39	2.71	.691
(36)	I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)	7.91	1.22	7.71	2.11	.762
(37)	I give students the opportunity to improve their proficiency in English in my science class	7.18	0.98	7.35	2.40	.815
(38)	I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts	6.82	1.66	7.23	2.03	.531
(39)	I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better	7	1.18	7.4	2.53	.408
(40)	I encourage English Language Learners to use their first language (L1) to define and understand content-specific terms and phrases	5.36	3.14	6.1	2.95	.454

Note. Participants: N = 73; p < .05 are underlined.

Correlation between Self-Efficacy and Teaching Experience

Out of the total number of participants in this study (N = 76), the grade-level and language groups had a substantial number of participants in each sub-group. For instance,

in the grade-level group, there were 45 elementary teachers and 31 secondary teachers while in the language group, there were 35 monolingual teachers and 41 multilingual teachers. The experience group was comparably uneven with 11 teachers having teaching experience between zero and three years (novice), 62 teachers with teaching experience of five years and more (experienced) and three participants with teaching experience of four years. In addition to comparing their overall as well as item-specific means, I was interested in exploring whether there was any relationship between teaching experience and self-efficacy. It should be noted that even though in the previous statistical analysis, participants that had four years of teaching experience ($n = 3$) were removed from the total population, I have included them in the correlational analysis. In order to examine whether the two variables associated with each other in any way, I generated a Pearson's *r* correlation coefficient in SPSS.

Muijs (2011) states that Pearson's *r* coefficients vary between -1 and +1 where +1 indicates a strong positive correlation and -1 indicates a strong negative correlation while 0 indicates no relationship whatsoever between the variables. Upon conducting the analysis, a Pearson's *r* revealed a positive but weak correlation ($r = .183$, $p = .114$) between self-efficacy and experience. Hence, it can be deduced that the correlation between self-efficacy and experience is not statistically significant meaning that teachers' self-efficacy does not increase as they gain more teaching experience. I contextualize this finding in light of the theory and literature in Chapter 6.

Now, I present a comparison between teachers' self-efficacy perceptions on items of general pedagogy and culturally responsive pedagogy.

General Pedagogy and Culturally Responsive Pedagogy

Researchers have stated that instruments measuring self-efficacy perceptions are most effective when the survey items range in degrees of task difficulty (Bandura, 1997; Siwatu, 2007; Maddux & Gosselin, 2012). As explained previously, the adapted 40-item CRTSE survey was most appropriate considering the context- and domain-specificity of this study. Additionally, the survey items also range in difficulty from those dealing with general pedagogy to the more difficult items dealing with culturally responsive pedagogy (Siwatu, 2007). I wanted to explore whether there were any statistically significant differences in terms of teachers' self-efficacy perceptions on general teaching practices as opposed to culturally responsive teaching practices and this was established through an independent samples *t*-test. Before classifying the survey items appropriately, it was essential to define general pedagogy and culturally responsive pedagogy. In the next section, I explain the process I undertook to categorize the survey items appropriately and offer a table showing the classification.

I have described the tenets of culturally responsive pedagogy in detail in Chapter 2 of this dissertation. Simply put, culturally responsive pedagogy takes ELLs' cultural and linguistic backgrounds into account in terms of the curriculum, instruction and teaching practices while general pedagogy involves teaching practices that are considered to be effective for all students, regardless of their cultural and linguistic backgrounds. The next step was to categorize the survey items into two groups: (a) general pedagogical practices and (b) culturally responsive pedagogical practices. In order to do so, first, I categorized the survey items according to the definitions based on my personal discretion which resulted in 19 items under the general pedagogy group and 21 under the culturally

responsive pedagogy group. Then, I requested two doctoral students (Student A and Student B) and one faculty member to categorize the survey items according to my definitions to check the level of agreement between our categorization. Interestingly, there was agreement on all but two of the survey items among the coders compared to my initial categorization. The faculty member and Student A had coded survey item 14 as culturally responsive pedagogy as opposed to general pedagogy while Student B had coded survey item 11 as general pedagogy as opposed to culturally responsive pedagogy (see Table 13). While I agreed with the coding of item 14 as culturally responsive instead of general upon consideration, I did not agree with coding item 11 as general. After a discussion, Student B agreed with categorizing item 11 as general instead of culturally responsive. Hence, after making the appropriate change, the final categorization included 18 items belonging to the general pedagogy category while 22 to the culturally responsive pedagogy category. Table 13 presents the categorization of the survey items as general pedagogy and culturally responsive pedagogy.

Table 13

General Pedagogy & Culturally Responsive Pedagogy Item Categorization

General Pedagogy (18)	Culturally Responsive Pedagogy (22)
1. I adapt instruction to meet the needs of my students	4. I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture
2. I obtain information about my students' academic strengths and weaknesses	5. I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture
3. I determine whether my students like to work alone or in a group	11. I develop a community of learners when my class consists of students from diverse backgrounds
6. I assess student learning using various types of assessments	12. I use my students' cultural background to help make learning meaningful
7. I obtain information about my students' home life	14. I identify ways how students communicate at home may differ from the school norms
8. I build a sense of trust in my students	15. I obtain information about my students' cultural background such as their L1 or mother tongue
9. I establish positive home-school relations	16. I teach students about their cultures' contributions to science if content and context permit
10. I use a variety of teaching methods such as visual aids	17. I greet English Language Learners with a phrase in their native language if I am able to
13. I use my students' prior knowledge of science to help them make sense of new information	18. I design a classroom environment using displays that reflects a variety of cultures
19. I develop a personal relationship with my students	20. I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students
21. I communicate with parents regarding their child's educational progress	24. I revise instructional material to include a better representation of cultural groups
22. I structure parent-teacher conferences so that the meeting is not intimidating for parents	25. I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes
23. I help students to develop positive relationships with their classmates	26. I model classroom tasks to enhance English Language Learners' understanding
28. I help students feel like important members of the classroom	27. I communicate with the parents of English Language Learners regarding their child's achievement

Table 13 Continued

General Pedagogy (18)	Culturally Responsive Pedagogy (22)
30. I use a learning preference inventory to gather data about how my students like to learn (e.g., are they visual, linear, kinesthetic or auditory learners?)	29. I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students
32. I obtain information regarding my students' academic interests	31. I use examples that are familiar to students from diverse cultural backgrounds
33. I use the interests of my students to make learning meaningful for them	35. I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)
34. I implement cooperative learning activities for those students who like to work in groups	36. I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)
	37. I give students the opportunity to improve their proficiency in English in my science class
	38. I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts
	39. I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better
	40. I encourage English Language Learners to use their first language (L1) to define and understand content-specific terms and phrases

The overall means and standard deviations for the general pedagogy items and culturally responsive pedagogy items were 8.06 (SD = 0.59) and 6.50 (SD = 0.83) respectively. Levene's test for unequal variances was conducted and it was found that the variances were not significantly different [$F(38) = 1.752$, $p = .193$]. The result of the t-test showed that there is a statistically significant difference between the teachers' self-efficacy perceptions on general pedagogy and culturally responsive pedagogy [$t(38) = 6.771$, $p = .000$]. Hence, it can be deduced that teachers feel a higher sense of self-

efficacy in terms of providing general pedagogy as opposed to culturally responsive pedagogy as demonstrated by the statistical analysis. Interestingly, as discussed earlier in this chapter, the three highest-rated survey items belonged to the general pedagogy category while the three lowest-rated survey items belonged to the culturally responsive pedagogy category.

Now, I present participants' voices gathered from the interview data based on the quantitative statistics presented in the previous sections of this chapter.

Interview Participants' Voices

In the previous sections, I presented the highest- and lowest-scoring survey items in terms of the overall population ($N = 76$) as well as a distinction between general pedagogy survey items and culturally responsive pedagogy survey items. In this section, I present the voices of the participants in relation to some of the most prominent survey items. First, I present interview data in relation to some of the high-scoring general pedagogy survey items and then, on the low-scoring culturally responsive pedagogy survey items.

High-Scoring General Pedagogy Survey Items

I use a variety of teaching methods such as visual aids.

This item had the highest mean across the entire survey ($M = 8.67$, $SD = 1.40$). The interview participants were very positive regarding the use of a variety of teaching methods in the science classroom. Katherine said, "I use a lot of visuals in science, especially when I'm teaching them about germs and hygiene... I try to pick up pictures from everywhere. […] I use charts along with the pictures so they know what it means."

Not only did the teachers agree on the advantages of using various pedagogical methods but also believed in providing the students with multiple ways of producing their assignments as well. Debra went a step ahead and acknowledged that implementing an assortment of methods benefits all students, regardless of their language proficiency level. She said, "I'll often give my students multiple choices of assignments… If we are doing book reports, then, they could create a song that the lead character would sing… Or, they could do a set design… that shows the depth of understanding." Dillon and Nora echoed Debra's beliefs and spoke about the importance of drawing on the Multiple Intelligences of the students. Dillon stated, "I am a big proponent of Gardner […] and Multiple Intelligences. […] And I like to see… they are not going to be the person to sit there and write me a report. They would rather videotape themselves doing the experiment and talking about it." Nora said, "We call for their Multiple Intelligences. Some of them are very kinesthetic, some of them are verbal. […] Like there are a few in my class who can't write. […] So, they start illustrating what they want to write." As mirrored by the interview findings, most of the teachers do feel highly capable in terms of utilizing a number of teaching methods according to the learning styles of their students. However, none of the teachers reported that they used a variety of teaching methods simply for the benefit of the ELLs, necessarily. Most of the teachers believed that every student has a unique learning style which makes it essential for them to use different pedagogical practices so that they can provide targeted instruction depending on how their students learn.

I help students feel like important members of the classroom.

This survey item was the second-highest scoring across the entire survey (M = 8.66, SD = 1.56). All of the teachers agreed upon the importance of making sure that the students felt comfortable in the classroom. Many of the teachers spoke directly about making all the students feel like significant members of the classroom community. Debra believed that having a background in ESL teaching afforded her a benefit in understanding the challenges ELLs go through and she tried hard to ensure that ELLs felt included in her classroom by providing materials for all students equally. She said it was important not only to create resources that ELLs could use but also to encourage other students to peruse them so as not to make ELLs feel inadequate and in need of special resources. According to Debra, "it becomes a normalizing factor" between all of the students in the classroom despite differing levels of language proficiency. Additionally, she spoke about the care teachers must take during group-work in the class. She said, "I always put them into groups…because if a student doesn't know anything, it's like living hell to sit there for 10 minutes with paper and know nothing and everybody else is madly writing. That's just crushing for a child." Dillon and Julian elaborated on how in order to make students feel like important members of the classroom, they learnt about other cultures and brought them into their classrooms. Dillon provided an example of Chinese New Year and stated "pyrotechnics[37] [is] a big part of their culture. We can find out how chemicals mix together. Anything we can do to make it interesting and give people a different perspective." Julian acknowledged that he used to always provide examples from the Western world considering that he had grown up here. One way that he said he

[37] Pyrotechnics is "the art of making fireworks" (Dictionary.com, 2016).

would like to make his students feel like important members of the classroom is by making connections with communities other than his own. He spoke about an experience he had recently had learning about charity initiatives in a community different from his own:

> With the school culture, we tend to focus a lot on diversity, on helping and making change within the community and that kind of examples are all I have. Examples I have is a very *Western* way of doing things. Just recently I learned that there was a group; I think it was the Sikh group who were giving free meals at a certain point in their religious holidays and so one of their task is to provide meals. It's not like I knew it. I just learned it this year. There is no way I could connect that to that world so when we do talk about charity-based [initiatives] and how we affect culture, a lot of my examples are very Western and I grew up here so I might have some from other places but I didn't know that. I didn't know that was happening… and I wish I could know more and so that I can then make those connections with them. (Julian)

Overall, all of the teachers felt positively about ensuring that their students felt included regardless of their cultural and linguistic backgrounds.

I build a sense of trust in my students.

This item also had the second-highest mean score across the entire survey (M = 8.66, SD = 1.38). I believe that the teachers' participation in this study which included completing the survey as well as the interview demonstrated their dedication to their profession. They were all committed to including students from diverse backgrounds in

their classrooms. Hence, the fact that they felt highly efficacious about building a sense of trust in their students did not come as a surprise. They all felt that it was important that their students, regardless of whether they were ELLs, trusted them as educators. Nina was one teacher who spoke at length about this issue during the interview. She informed me that after moving from a very diverse school board to the school board in which she was currently teaching, it was slightly more difficult for her to gain her students' and their parents' trust at the beginning. She told me her story:

> I used to teach in [name of board] which is very multicultural, so naturally people are very aware of each other's cultures because you never feel like you don't belong to a culture. But you know, I feel we need some more [diversity] in areas where there is no exposure to other cultures… I am in a school where… out of 42 teachers, I am the only person of colour. So, there is all the more need for them to trust me because there was also that little bit of hesitation in the beginning when I settled in that school. They said, "Oh, she is not from our culture. What is she going to teach my son?" […] Then, I explained to them that "I have been a teacher for 17 years and I have taught different cultures." (Nina)

Low-Scoring Culturally Responsive Pedagogy Survey Items

I design a classroom environment using displays that reflects a variety of cultures.

This item had one of the lowest means across the entire survey (M = 5.55, SD = 2.76). Interview participants' comments about designing a classroom environment reflecting a variety of cultures mirrored the comparatively low scores of the survey participants. Even though most of the teachers spoke about their classroom design, many

acknowledged that the displays did not necessarily reflect diversity. During the interviews, I also discovered that in order to have displays reflecting diversity around the classroom, teachers would have to bring the resources and design the classroom accordingly themselves. Even though there were cultural displays around his school, Scott acknowledged that there were none in his classroom by stating, "I've got certain narrow limited wall space." Considering the fact that Scott was an elementary teacher, he informed me that he had to share the wall space between multiple subjects including science. Aubrey also stated, "No, I don't have anything at all. It's all in English actually." However, as I brought up this issue during the interview, she liked the idea of including culturally and linguistically diverse visuals around the classroom especially for ELLs that were beginner-level language learners. Aubrey mentioned, "I think that's an interesting idea; like having it [in different languages] because there are kids that actually can't speak or read actual different scripts, you know?" On the other hand, Sawyer believed that it was important to ensure that classroom displays are in English considering that it is the official language of Canada and also due to the fact that he said he did not speak any other languages proficiently himself. He said, "[I]f you're going to work in Canada, I think that you need to be able to speak English. I don't have access. I don't speak other languages" (Sawyer). The interview data mirror the low level of self-efficacy science teachers felt in terms of designing a classroom space representing the diversity of their students.

I teach students about their cultures' contributions to science if content and context permit.

This survey item rated among the lowest means across the overall data set (M = 5.17, SD = 2.72). Even though the survey results show that teaching students about their cultures' contributions to science was one of the low-scoring items, most of the teachers I interviewed spoke positively about what the impact of doing so would have on all students, especially ELLs. Many of the teachers were quick to point out that despite what may be believed by some, science is not necessarily devoid of culture and that there is space for inclusion of diversity within the curriculum and pedagogy. Julian stated that even though he did not have any control in terms of the concepts themselves, he does make it a point to mention noteworthy individuals from different cultures when the context allows for it. Julian stated, "I try to get inventors from a global perspective anywhere from Nigerian engineers to people from Asia, South America and try to [teach] them that it's not just all White scientists but people all over the world do science." Debra also agreed with this perspective when she stated, "Highlighting some famous scientists who come from countries that my students are represented from… […] Talking about … certain inventions that have occurred in certain areas… […] I think science is not devoid of culture at all." Nina, a Kindergarten teacher, also spoke at length about bringing in students' cultures depending on the topic being studied. She said, "So, we explain to them that I grew up in a place where it is very hot and humid. […] and … so we talk about the weather patterns … about different diverse cultures a lot." By acknowledging his own Italian heritage, Dillon was able to understand personally, the feeling students

must have when their cultures are infused within the curriculum and are discussed explicitly. He spoke about his feelings in this way:

> Oh, yeah, there's a sense of pride there! All the time! Yeah, it makes awesome sense! I'm Italian so I kind of like it when everyone talks about Alexander Graham Bell or Marconi. I'm like, "*Who*?" (Laughs). So it's one of those things that as an Italian, I gravitate toward what the Italians did. They talk about John Cabot as an Englishman but he's really Italian so I think it's important- like those are my connections that I make. I think it's important that other people know about their people that they understand too actually from their own country or from their own cultural backgrounds. (Dillon)

On the other hand, Scott informed me that he does make attempts to connect his students' cultures to the scientific context but only in terms of certain aspects. Speaking in terms of teaching on the topic of *Energy*, he stated, "Where do we get our energy sources from here in Canada? [And] if it's the same as in India or Brazil. […] But in terms of that religious aspect, no, but just trying to get those outside connections, yeah." Hence, a number of teachers felt positively toward infusing students' cultures into the curriculum and instruction. Interview data show that teachers tried their best to negotiate the curriculum in order to make space for aspects of diversity in pedagogy.

I greet ELLs with a phrase in their native language if I am able to.

This survey item secured the lowest score consistently across all the survey participants ($M = 4.36$, $SD = 3.03$). Most of the interview participants' comments were commensurate with the survey respondents' scores. Even though some teachers were able

to speak additional languages, they did not necessarily believe in using them in the classroom. Most of the teachers believed that considering how linguistically diverse our classrooms are, bringing in one ELL's L1 in the classroom would mean ignoring the others'. Even though Scott reported that he was a monolingual speaker of English, I asked him if he would greet ELLs in their L1 if he were able to speak their languages. Scott informed me that there were 13 languages spoken in his class and was hesitant in using any of them for the benefit of those students who did not belong to any of those language groups in the class and stated, "the highest language is Urdu. So, if I were to speak a few words in Urdu, then, of course. If some of the other people say 'I didn't understand' and 'Why are you speaking that?' I can't exclude them." Sawyer shared a similar sentiment when he stated, "No, I think it's important that when we're in a group, we use English so that everybody understands but if they need some clarification, then, certainly if I have enough language base but then I'll always bring it back to English." Similar to Scott and Sawyer, upon being asked if she would use her ELLs' L1 in her classroom if possible, Debra stated, "No, just because I wouldn't always be familiar … there were seven languages and I felt overwhelmed to learn [them]… Now this student would sometimes teach me some words … but I wouldn't always do greetings that way." She also acknowledged that greeting one student in one way might have a negative impact on the other students being greeted in a different way. She mentioned, "[I]f I say 'Hey! How are you? How's it going?' *you* [student A] know that I mean [and] 'High-Five' and then, I greet *you* [student B] very differently, it can be ostracizing particularly at that age, you know?" With the existence of multiple languages in a single classroom, these findings reveal the overwhelming reality of including all of them on the part of the

teacher. Even though teachers did not necessarily believe in using their ELLs' L1 to greet them, they felt positively about encouraging ELLs to use their L1 on their own to comprehend the content[38].

Summary

This chapter discussed the findings pertaining to the first and second research questions. I presented descriptive statistics of each of the adapted survey items as well as discussed the highest- and lowest-scoring survey items. Thereafter, I compared the sub-groups through independent samples *t*-tests in terms of their overall self-efficacy as well as on each survey item. I also explored the correlation between self-efficacy and teaching experience. Additionally, I explored the comparison between teachers' self-efficacy perceptions on survey items dealing with general pedagogy and those dealing with culturally responsive pedagogy. I also presented interview participants' voices in terms of some of the more prominent survey items. In the next chapter, I present findings pertaining to the third research question.

[38] I discuss this issue in greater detail in Chapter 5.

CHAPTER 5 SCIENCE TEACHERS' ATTITUDES TOWARD DIVERSITY

Introduction

The aim of this study was to explore the self-efficacy perceptions of Ontario's science teachers to teach in diverse classrooms. An adapted survey questionnaire ($N = 76$) and semi-structured interviews ($n = 10$) were utilized to collect data from the participants. In this chapter, I discuss the findings pertaining to the third research question. As discussed in the theoretical framework as well as in the literature review, self-efficacy is not an isolated concept. There are a number of elements that influence teachers' self-efficacy perceptions considering the fact that efficacy beliefs have an impact on how individuals think, feel and act (Bandura, 1997). During the qualitative data analysis phase, a number of themes related to the context of culturally and linguistically diverse classrooms emerged. Teachers' attitudes toward diversity and other related factors could be potential contributors to their self-efficacy perceptions to teach in diverse classrooms which I discuss in this chapter.

Prior to discussing revelations from the qualitative data, I offer a table describing the interview participants' characteristics including their average self-efficacy measure on the adapted CRTSE survey questionnaire. As depicted in Table 14, most of the participants had high mean scores on the adapted survey measuring their self-efficacy perceptions on a series of pedagogical practices (see Chapters 3 and 4 for the adapted survey). The chapter is divided in terms of the following four topics: (a) Ontario's science teachers' attitudes toward diversity, (b) challenges posed by diverse classrooms for teachers and ELLs, (c) the role of a science teacher and (d) the negotiation of diversity within curriculum and instruction.

Table 14

Characteristics & Self-Efficacy of Interview Participants (n = 10)

Participants	Grade-Level	Linguistic Profile	Experience	Self-Efficacy[39]
Scott	Elementary	Monolingual	Experienced	8.25
Debra	Secondary	Monolingual	Experienced	8.23
Aubrey	Elementary	Multilingual	Novice	7.78
Nina	Elementary	Multilingual	Experienced	9.08
Katherine	Elementary	Multilingual	Experienced	8.13
Alicia	Elementary	Multilingual	Experienced	7.28
Julian	Secondary	Multilingual	Experienced	5.68
Sawyer	Elementary	Monolingual	Experienced	7.15
Dillon	Elementary	Multilingual	Experienced	8.68
Nora	Elementary	Multilingual	Experienced	8.30

Ontario's Science Teachers' Attitudes toward Diversity

All of the teachers who I interviewed were unequivocal in their positive attitude toward diversity based on their comments during the interviews that I conducted with them. Even though they acknowledged the challenges they faced in diverse classrooms, they were quick to point out that their context was no different and that challenges naturally existed in any classroom. Speaking of diverse classrooms, Debra mentioned, "I think they pose a great opportunity because there are students …who have different backgrounds. […] So, they come bringing something [and] so if you're talking about Biology or marine mammals, you can have a diversity they can bring in." Aubrey shared

[39] The self-efficacy score reported in Table 14 is the interview participants' overall self-efficacy perceptions on the 40 items of the adapted CRTSE survey where they were asked to appraise their self-efficacy on a scale from 0 to 10.

a similar perspective on the diversity of experiences that ELLs contribute to the classroom and believed that diverse classrooms can help everyone learn together. She stated, "I think that it's good to have… diversity in the class. Everybody has their own different experiences that they can … bring into the class and …we can all learn from it." Even though Sawyer taught in a Catholic school, it was important to him that all students, regardless of their religious background, found a common ground with his faith in terms of the content under study. He stated, "So, other world religious leaders … have also been talking about … the importance of saving the environment. So, it's not just a Catholic perspective, it's a global perspective… not just Catholic." Even though one might think that teaching in a faith-based school would make it difficult to bring aspects of other cultures such as religion in particular, Sawyer stated that he found ways to connect multiple systems of faith to the content under discussion.

Not only were the teachers positive toward diversity, many spoke about how advantageous elements of diversity can be in the classroom. In Dillon's case, having a diverse classroom was beneficial for himself as well. He stated, "I think diverse classrooms pose challenges everywhere. But I think they are positive challenges because they force us to look at everything we are doing in more inclusive light, with more open eyes to see if there's more out there." Debra optimistically mentioned that even though ELLs may not be proficient in English or the Western culture, they bring multiple other strengths to the classroom. She spoke about the benefit of having students and families from other countries inform her classroom about topics and issues that were specific to their cultures. She illustrated how it was done in her classroom:

> [O]ften I used to have parents who would come in and do guest speaking… Because if we were talking about well, let's say marine mammals, and I've never seen or witnessed some of these mammals but they are from a country that has lots of them, then, they have a history and they can share and then it helps support them… [T]hen, they can be the student who has more knowledge at one point of time instead of seeing it as a deficit. So, I think that's one of the things … often in Ontario schools; students who are ELLs in every subject and maybe even specifically in science are seen through that deficit model, … And it doesn't have to be that way because there are other ways of viewing their knowledge. Their cultural capital is high too; just in different ways. (Debra)

Hence, in Dillon's and Debra's experiences, a positive attitude toward diversity went a long way in broadening their own perspectives as teachers and focusing on ELLs' funds of knowledge as opposed to their limitations.

Kindergarten teachers Katherine and Nina spoke about the positive impact of diversity on other students who would be considered as belonging to the mainstream background. Katherine mentioned that even though negotiating multiple cultures and languages at the same time can create conflicts, it can also help in problem-solving. She further mentioned that "when they don't have the language, they don't know how to deal with others… Other people don't understand their culture. Then, the conflicts arise in the classroom but at the same time … they learn from each other." Nina took another approach to introduce diversity to her students and brought in elements from around the world into her classroom. She stated that she brought a globe into the class to teach them "that every part of the world is not the same; it's very different food-wise, weather-wise,

culture-wise, language-wise. […] So, they can experience that and they can understand that." Dillon also mentioned the added benefit of diversity for the entire classroom "[b]ecause it gives them a new perspective on... the concepts. They'll say, 'I remember when Ezra taught me about photosynthesis because she used a different word that I've never heard before', you know? It's just builds connections with them."

The interview data show that regardless of the grade-level taught or the population of ELLs in the classroom, all of the teachers viewed diversity positively and as a benefit. It is worth reiterating that the decision of these teachers to participate in the interview without any professional obligation or reward was indicative of their strong commitment to teaching, in my view. Not only did the teachers show a genuine willingness to participate in this research, but they were also very honest and forthcoming with their responses during our conversation. Hence, the fact that all of them viewed diversity in a positive light did not come as a surprise to me. As previously mentioned, individuals' thoughts, feelings and perspectives on issues have an impact on their self-efficacy and consequently, their actions and conflict-management strategies. As shown in Table 14, the teachers' high overall self-efficacy mean scores further justify their positive attitude toward diversity in their classroom.

Challenges Posed by Diverse Classrooms

During the interviews, I was interested in discovering whether diverse classrooms posed challenges on curriculum coverage, instruction and other factors in the science classroom. Even though the teachers were very committed to their profession and viewed diversity positively, they mentioned a number of obstacles that stood in their way of teaching science to the general student population as well as to ELLs. Many teachers also

spoke about their awareness of the challenges the ELLs in their classrooms faced in learning science. In the next few sections, I discuss some of these challenges that emerged out of the interviews. First, I present the interview participants' voices regarding the difficulties that aspects of culture and language among others bring in terms of teaching science and then, I discuss those that ELLs face in terms of learning science.

Challenges of teaching science.

Language barrier for teachers.

One of the challenges faced by many teachers which was mirrored in the literature on the topic was a language barrier between themselves and the ELLs. Generally speaking, classrooms such as those who have over 50% of students speaking an L1 other than English in some contexts and those who have ELLs who have differing proficiency levels in English are bound to be problematic for all teachers. Additionally, the fact that the content of science remains the same regardless of the language makes it even more challenging for ELLs since they have to access the same content but in a different language. As a result, ELLs who may have strong competence in science in their L1 may perform poorly in the science classroom in Canada and may experience academic failure which for some might be a first experience. Hence, the issue of a language barrier brings a number of related complications as well.

Out of the teachers who I interviewed, Scott, Debra, Aubrey, Nina and Julian considered the language barrier to be the most challenging aspect. Scott spoke at length about the difficulties he faced in teaching content vocabulary to the students. He said, "I would say teaching them content area is the most challenging… whether it's teaching renewable, non-renewable, photosynthesis… tension, compression. I mean those visuals,

pictures they are really good but I would say some of that is very tough." Also, Scott brought up an interesting misconception held by many in the field of ESL education who consider visual aids as the panacea for teaching content to ELLs. However, it should be noted that visual aids may only aid those whose preferred learning style is visual. Those who are auditory or linear or kinaesthetic learners may not necessarily benefit from the use of visual aids, regardless of their language proficiency level.

Debra recognized the uniqueness of language systems of each subject which is challenging for ELLs despite considering diversity as a benefit. She said, "[Diversity is] a great opportunity but there are challenges because there is not a common language. science has a very specific language just like Math but people don't realize that. They realize Math has a language but not necessarily science." She went on to say that in addition to a language barrier, ELLs may also face a conceptual barrier considering that the meaning and significance of many concepts also differ cross-culturally. She spoke of her experience as such:

> I also think linguistically, concepts also are a little different like 'hypothesis' and 'theory' may equate differently depending on [your culture]. So, it's not just understanding what the word means but what it means in our concept. Like we say something is 'theory'; in science, we really mean it's true. We use 'theory' because that's just the way it is but it means it's true. You know where any country may say, 'Well, I've looked up theory and theory means a possibility.' Well, that's not how we use it in our science class. Like the theory of gravity is a theory. It's good to go. So, I think conceptually, also the language is sometimes misleading to the students. (Debra)

Additionally, Aubrey also mentioned that, "Language barrier is a difficulty in terms of students being able to understand exactly. Mostly, the terminology in science… the words that they need to use … It could be very hard if they are not exposed to that." Nina echoed Aubrey's sentiment in stating, "The first challenge … is language. […] Especially for children with an ESL background, it's very difficult to explain to them… so we have to give them concrete examples and each time to come up with examples is very difficult." The challenge of a language barrier for Julian was even more complicated considering that he taught in a French Immersion school and as such not only had students who were ELLs but ELLs who were learning science in French in his class. He spoke about the issue at length:

> The biggest challenge recently has been those who have difficulty with the English language to begin with. If you had at least some skills in the English language, it makes that connection easier because that's the way I speak and I make those connections and that's how I was taught to teach French. It's making those connections through English. But if you are missing that piece, then, you are trying to find this additional connection to another third language which I am not proficient in and I have no other tools other than trying to beg other students who are proficient in that language to help me out. (Julian)

As revealed by the interview data, a language barrier is not simply the inability of the ELLs to access the content. The challenges that teachers face in terms of language run much deeper than the mere issue of translation and interpretation. As Debra astutely pointed out, in addition to words and phrases varying in their meanings cross-linguistically, concepts also vary in their definition cross-culturally. Visual aids and other

tools may be used for ELLs but they may not necessarily alleviate every challenge discussed by the teachers.

Lack of time.

Another challenge that many of the teachers stated they faced was the lack of time in the classroom to ensure that ELLs were keeping up with their proficient speaking counterparts. In particular, Debra was aware of the fact that the science curriculum largely catered to the mainstream students which exacerbates the impediment of a lack of time even further. She explained her conundrum:

> [T]o make sure that the vocabulary and the concepts are really well understood… takes time and everything is so rushed in Education right now. It's insanely crazy and it's rushed for the benefit of the middle-class, White, English-speaking student, for sure. And that's probably my biggest struggle is having time when I know I can see that they are *almost* there and they have *almost* got it but they need another two days for this concept and I have to move on. (Debra)

Scott and Sawyer echoed Debra's sentiment of "feeling rushed" and mentioned that it was difficult to allot additional time to ELLs' needs. Considering that a specific amount of time has to be shared between various subjects, the issue of time is even more problematic for elementary teachers. Scott mentioned, "[Y]ou have a limited 300 minutes in a day. Part of it is- they are gone to French… Music or Gym or Art so you've got to make the use of your time and feeling like you're rushed with them." Sawyer also mentioned that science is not given as much time as other subjects and stated, "I think there's so much [time] put into Math and language. It's important that … we have to

teach science through language and through Math but we can't because of time restraints- so many other things going on."

Aubrey was quick to point out that she would be more than willing to incorporate more culturally- and linguistically-inclusive pedagogical practices in her classroom if she had enough time considering that doing so may involve exploring outside the boundaries of the mandated curriculum and instructional guidelines. However, Aubrey pointed out that even though restricted time is a reality, it does not necessarily prevent teachers from making room for culturally responsive pedagogy altogether. She explained her perspective:

> I feel like if we had more time then we could kind of incorporate more things that are not part of the curriculum. […] That's what I find more challenging; finding time to do different activities. But I think there's definitely a way that you can incorporate more things into science to make it more … culturally appropriate and … more vibrant, you know? (Aubrey)

Dillon also mentioned that he suffered from a lack of time but for slightly different reasons than the other participants. He cited the labour strikes going on at the time of his interview as the reason for not being able to provide more inclusive pedagogy. He said, "I mean it all plays out and they are taking time away from us where we were able to make these connections but now we can't." The interview data reveal that a paucity of time was a reality in almost all of the teachers' professional experience. However, the participants' voices still brought forth their desire to find ways to work around the limitation and provide culturally responsive education to their students.

Lack of resources.

Many of the teachers also spoke about the shortage of ready-made resources that could be used; both generally, as well as in order to provide culturally and linguistically relevant pedagogy. Debra acknowledged very early on in the interview that as a result of the lack of resources, she had to develop many of her own based on her understanding of ELLs. Acknowledging "a poverty of diversity" in the resources, Julian stated that the Eurocentric nature of the science curriculum made it even more difficult for him to have culturally-inclusive resources. Speaking about the curriculum, he stated, "It's very Eurocentric so … I have to do a lot of research on my own. [T]he texts that they usually give me focus on European contributors. Even more than that, they also focus on male contributors to science." While Debra and Julian largely spoke about a lack of pedagogical resources, Sawyer brought up the issue of the shortage of tools in the science classroom. He mentioned that having additional resources would not only be helpful for all students regardless of cultural or linguistic diversity but that it would also make the content more appealing. He mentioned, "I would like to have more equipment in the classroom. It doesn't matter what your nationality is. [The challenge is] not having access to the equipment that would make it more interesting … to go out and explore."

Similar to Debra and Julian, Katherine spoke about the need to produce resources on her own which was challenging. She stated, "Sometimes… you don't always have appropriate resources; you have to use a lot of your own. […] … for a lot of other activities that I feel there are not enough resources in the public schools. So, that becomes one challenge." Not only did Nina echo Katherine's sentiment, but she also mentioned an additional challenge of having to create her own resources. She stated, "We conduct lots

of science projects in the class but the funding is a constraint because we can only get so much and if we want to go above and beyond then we have to spend from our pockets."

Nina elaborated on her comment and mentioned that, at times, one reason behind the unavailability of proper resources is the grade-level in question. She stated that in comparison to higher grade-levels, the school boards did not give the same amount of importance to resources for Kindergarten. She mentioned her experience at length:

> And what happens is that typically, you know, Kindergarten is always kind of looked at… as a very informal learning stage so they don't understand the importance of the foundation and we, in fact, pay more attention to this time because that's how you set a child [up] for better learning. Because either the child is going to be interested or the child is not going to be interested. So, if you want to make the school an interesting place, then, you have to pay more attention to this age. But unfortunately, still the board's whole approach is very flexible and … we are down the line as far as priority list is concerned. (Nina)

Even though the teachers mentioned a lack of resources to be a challenge, the fact that many of them took the time out to create their own is commendable.

Lack of ESL support.

I was aware of the fact that most of the teachers I interviewed did not have specialized qualifications in ESL teaching (with the exception of Debra and Nora). As a result, I was interested in asking them about the types of ESL support they were receiving or wished to receive in their classroom. Most of the teachers acknowledged that the support they received in terms of ESL was insufficient and infrequent and many reported

it as a challenge. Scott and Debra mentioned that elementary school did not have as much support compared to secondary schools due to limited funding. Scott mentioned, "We do have an ESL teacher in the school but they can only provide support once or twice a week. Because of funding, we don't have that many ESL teachers in the schools." He added, "I would like to see more allocation of funding from the government for Special Needs teachers, ESL teachers." Since Debra had taught across both elementary and secondary grades, she was well aware of the amount of ESL support higher grades received in comparison to the lower grades. She stated, "And in the elementary schools, you wouldn't have [ESL support] because at the High School level …they have the ELD and stuff of this nature. […] But in elementary school in Ontario, it's pretty well just pull-out." The *pull-out* type of ESL support consists of a student being pulled out of the regular classroom for a particular amount of time to receive one-on-one support with the ESL teacher. This is simply done on the basis of requirement and is not always a scheduled or regular appointment.

Sawyer and Dillon also spoke about the lack of ESL support they received in their school districts. Sawyer mentioned, "I want to talk with the ELL teacher and that's one… I suppose you had a question earlier about limitations and there's the limitation. We don't see the ELL teacher very often." Dillon informed me about other schools that have specialized ESL classrooms. Considering that his school was not one of them, they had other, slightly less convenient resources put in place for ELLs. Dillon mentioned, "Some schools have ELL classrooms. Our school is not one of them but we have a sister school and we'll send the kids there for special accommodations until they get proficient and then, they come back to their home school." Dillon added that when his students came

back after having received the ESL support, the transition was not always smooth and that it was challenging to continue providing appropriate language and content support to them.

Additional challenges for teachers.

Even though a language barrier, the paucity of time and shortage of appropriate resources were the most common challenges among the interview participants, there were other difficulties that were mentioned by a few of the teachers during the interviews as well. Katherine, Nina and Scott cited large class sizes as an additional challenge while Julian and Alicia spoke about confronting their own biases in the midst of multiple perspectives in the science classroom.

As an elementary teacher with a high ELL population in his classroom, Scott mentioned, "[T]he delivering of the curriculum [is challenging]; some days they are going to get it, some days they are not. With such a huge class, it's hard to meet the needs of a lot of the students." For Kindergarten teachers Katherine and Nina, a large class size brought on an additional challenge of accommodating students from different age groups in a single classroom. Katherine stated, "When I have 20 to 25 kids in a classroom, I'm not able to pay individual attention because everybody is at a different level because now the Junior Kindergarten and Senior Kindergarten is together and that is a challenge." Nina echoed Katherine's sentiment and mentioned that a large class size and different age groups brought an additional complication of inappropriate resources. She explained her experience:

> [Y]ou want to expose them to lots and lots of different science experiments but also sometimes… having a class size of 27 children [is challenging] [...] We have

> a mixed classroom of Junior Kindergarten and Senior Kindergarten so the age groups are different. So, sometimes the materials that we want to offer may not be age-appropriate for Junior Kindergarten but they are more age-appropriate for Senior Kindergarten. (Nina)

Even though a number of teachers brought up the issue of a large class size, it was most pertinent in the Kindergarten context. As stated by Nina earlier, the importance of laying a solid foundation for the children becomes difficult in a classroom where the teacher is unable to provide individual attention to the students.

Much of the prior knowledge ELLs bring with themselves on many scientific topics is rooted in their cultural values and beliefs which might not always be commensurate with the teachers' personal notions. Having to negotiate their own belief systems compared to those of their ELLs on issues causing controversy and contention in science could become a potential obstacle for teachers teaching in the higher grades in particular. Julian and Alicia acknowledged how science teaching in diverse classrooms at times challenged their own belief system. Regarding the matter, Julian explained his experience:

> [Diverse classrooms] pose challenges in the fact that they may bring concepts that you are not familiar with or that might challenge your own sort of beliefs and so that becomes challenging. Trying to separate yourself as an evaluator from what you believe in and the techniques that they are using and the skills that they are using versus the content of what they are saying. (Julian)

Alicia echoed Julian's belief and mentioned that diverse classrooms compel teachers to view their own position on certain issues. However, even though she recognized this as a challenge, she spoke positively about how such experiences can result in professional growth. Speaking from her own experience as an educator attempting to negotiate the cultural differences on certain topics, Alicia clarified her position:

> I think my recommendation would be that we look into our own biases and how we were taught because the way I was taught is not how I'd like to teach.… So, not to continue the cycle of learning that perhaps is outdated especially in the context of Ontario. So, I would say our biases always surface and present themselves in what we are teaching. So, it's good for us to catch ourselves and inform ourselves so that we are able to teach not only students with different cultural backgrounds and linguistic backgrounds but also to teach those that are born and raised [here] and you know are completely 'in' or 'with it' when it comes to curriculum… because ultimately they are going to [be] interacting with other people of difference so it's always good to be aware of your own biases so you are constantly learning and making paradigm shifts. (Alicia)

These challenges that a few of the teachers mentioned including large class sizes and having to face their own biases might not necessarily be common obstacles faced by the majority. However, I believe that they deserve to be mentioned even though they might not be high on the list of priorities.

Challenges of learning science.

In addition to speaking to the teachers regarding challenges that diverse classrooms posed on teaching science, I was also interested in understanding their perspective in terms of the challenges diverse classrooms posed on ELLs in terms of learning science. The teachers who I interviewed were all highly empathetic toward their ELLs and, as a result, were aware of the difficulties they faced. In this section, I present interview participants' voices on the challenges for ELLs in the science classroom.

Language barrier for ELLs.

While teachers spoke about the language barrier they faced with a large number of ELLs in their classroom, they were also quick to recognize the impact it had on the ELLs. The complications that ELLs faced as a result of the language barrier were three-fold: (a) the challenge of translating and interpreting the content correctly between English and their L1, (b) the challenge of gaining adequate proficiency in the academic genre of language in a short period of time and (c) the challenge of achieving proficiency in the Canadian variety of English.

In particular, Scott and Alicia were two teachers who spoke about the difficulty ELLs faced in the interpretation and reinterpretation of the content between languages. Scott stated that he was always trying to gauge how his students were interpreting the content. He explained why he considered it to be the biggest challenge for ELLs:

> I have a few students in my class who, when I talk to them, they are retranslating it in another language. So, is the message getting through to them? I would say that would be probably the number one [challenge] - if they are actually getting it

> or if they are retranslating it. So, I've got two or three that actually do that. They tell me that they have to reword it in their own language so they are understanding content. (Scott)

Alicia echoed Scott's sentiment in recognizing the challenge of double translation and explained it as "translating the content in their own language and then translating that into content. So, there's like two processes that go on in their mind as opposed to the English-speaking students. […] There's an additional step there. That's a challenge."

According to the teachers, challenges related to language were not only limited to the difference between the ELLs' L1 and the language of instruction. A number of them mentioned the difficulty that all students, especially ELLs have in their competence of the academic genre of language. In particular, Debra explained the misconceptions many teachers have about ELLs' language proficiency level. On many occasions, teachers mistakenly assume that ELLs are fully proficient in English based on their ability to carry on simple conversations and as a result, rescind language support to them even though they may not have achieved competence in using academic language by then. The teachers I interviewed recognized the fact that the domain of science does not only involve the use of content-specific terminology but it also has its own writing conventions which are difficult to master for all students, especially ELLs.

Regarding the importance of academic language repertoires, Debra and Katherine commented on this topic at length. Considering that Debra had had previous experience in ESL teaching contexts, she was particularly sympathetic about the issue of academic language competence for ELLs. She spoke about this issue in detail:

> And I think … particularly for science teachers; they may think, 'Well, this student orally has no needs so why can't they write or do this experiment and follow the process I've given them?' You know experiments are really defined like, 'For 3 seconds, I washed this and then I did this'. It's very, very defined what you're supposed to do and it's rigorous, right? Well, it's hard to be rigorous when the language is getting a little [complicated]… Yeah, so I think that makes it more challenging too in some ways. I think it's even harder for those students who are at that point where they don't get the ESL support anymore because they have either outgrown it years-wise or they don't feel they need it orally but their reading and particularly their writing [need support] because writing is always I think the last to be gathered into the fold. (Debra)

Even though Katherine was a Kindergarten teacher and did not necessarily have to deal with teaching expository writing, she was aware of the difficulties ELLs faced as she had taught across higher grade-levels in previous years. Not only was she mindful of the difficulties scientific writing presented for students, but she also mentioned the steps she took to help ELLs overcome the challenges. Katherine explained her experience:

> [W]hen you write an experiment, like your observations… [you have to] literally write in words so maybe it's not... [easy]... for the diverse classroom and people who don't know the language. What I do is, I ask them personally, "Tell me, what are the ingredients? What did you see? What was required for the experiment?" for example. So, they say, "Oh, this was required." That really helps in smaller classrooms. (Katherine)

A third aspect concerning the problematic nature of language was the cultural-specificity of English across the globe. Interestingly, a number of teachers were aware of the fact that not only do ELLs need to be proficient in English but "Canadian" English. Alicia mentioned that simply translating and retranslating the content between their L1 and English would not be helpful for ELLs unless it was done in the national variety of English. In this instance, Alicia is referring to the phenomenon of *World Englishes* which states that as a result of the worldwide spread of English, local and regional varieties of the language have developed especially in countries that were colonized by Great Britain (Kirkpatrick, 2010). She mentioned, "[T]hey have to be able to know the cultural translation of science *here*, right? So, it's not just English that they have to learn but the English of *Canada*; the English of the workbook or the textbook." Debra was also mindful of using culturally-specific terminology in her classroom but it was difficult at times. She provided a number of wonderful examples in her comment:

> I think … how many do I use all the time and not even know where that I used them. I think that's the thing because it's not like I have a checklist, right? Like if I called something a 'toque' like a hat but it's a very 'Canadian' term for it … […] Like I remember one day two years ago and I had the high ELL population, I said something about 'Is everyone going to bring pop to our party?' […] It was obviously confusing and then, I said 'soda' because … soda is what they use in the States, we use 'pop' in Canada. So, but I think it's hard to know those metaphors because you use them and they are part of who you are. (Debra)

Debra made an interesting point about her inability to be constantly mindful about using cultural metaphors found in the Canadian variety of English and culture in the classroom

since it was an innate part of her own language and upbringing. Even though it was Debra who mentioned it, her observation could easily apply to all of the teachers and for each of the challenges for ELLs identified in the previous sections. Despite the fact that the teachers mentioned that it was the ELLs that faced these challenges, the data reveal how they automatically brought forth challenges for the teachers as well. These challenges may not influence the teachers directly but they do require the teachers to be cognizant at all times to differentiate their instruction appropriately.

Cultural differences.

While research on the cultures and languages of the immigrants' home countries is abundant, little attention is paid to the cultural aspects that are unique to Canada in the literature. A number of teachers identified the difficulties ELLs face in terms of negotiating the differences between their culture and the Canadian culture. Aubrey mentioned that often times, in addition to being exposed to the English language for the first time, many ELLs may also experience their first exposure to content that is unique to the Canadian culture. She mentioned, "[S]tudents [who] are not familiar with … some parts of Energy, … windmills because in their country they never had that… Things like that; they are not really exposed to. Things like that could cause a little bit of difficulty."

Julian was quick to pinpoint the culture of Canadian classrooms which is quite different from other classroom contexts from which many ELLs (and other immigrant students who may have full proficiency in English) come. Interestingly, Julian explained the pedagogical culture of the Canadian classroom:

> Sometimes, especially in Ontario, we are moving toward more group work oriented, or increased style of learning. A lot of them [ELLs] are very used to a

> very Socratic system where there is a right answer and there is a wrong answer and so, they are always looking for that 'right' answer and there isn't, right? We are looking for the *process*… And so that... they have to move away from this sort of end-driven to the process-driven technique which … they are not used to. […] And so that shift is very difficult for them. (Julian)

Even though some immigrant students are proficient in English and, as a result, do not face language-related difficulties, they may still be unfamiliar with the teaching and learning context of Canadian classrooms. The concepts of group work and oral presentations are new to many. Hence, diversity in styles of pedagogy and cross-cultural communication may be subtle and may not have much to do with language proficiency but present a significant challenge for all students who are new to Canada, regardless of language proficiency level.

Additional challenges for ELLs.

In addition to the challenges posed by the difference in language and culture of the students and the school, there were many other impediments recognized by the teachers that ELLs faced. During the interviews, the participants revealed a number of challenges for ELLs including: (a) lack of parental involvement, (b) an identity crisis for ELLs and (c) lack of interest in learning.

Nina mentioned that the inconsistency between the home and the classroom was a significant challenge that ELLs faced. She explained her comment:

> We may… give them lots and lots of experience at school. If those experiences are not matched at home, then that becomes a challenge. …we teach them a lot of

> science experiments and we tell them, 'You can go home and tell your mom and dad about this experiment and you can maybe do this experiment at home also', but if there is no support at home in the same way that we expect, then … it also becomes a gap between the home learning and school learning. (Nina)

Often times, teachers fail to realize that in addition to their students, their families may also be facing a language barrier which causes an inconsistency in the ELLs' learning. Unfortunately, as a result, parents are unable to support their children's learning at home which could result in a tough transition for the ELLs. According to Nina, parental involvement was a necessity in order to close the gap between prior learning and the new content for ELLs.

Alicia mentioned that many ELLs may face an identity crisis as a result of the culture shock they experience when they come to Canada. Interestingly, she stated that this is not limited to the general academic atmosphere but may happen in the science classroom in particular. Regarding the challenges ELLs face in the classroom, after the issue of retranslation being the first, Alicia mentioned, "The second one I think [is] a false perception of who made science, right? Growing up, I always thought that science was made by the West so I thought… of the East as this dark place that hasn't produced much." She captured an essential point that many ELLs and other immigrant students might face in the classroom here. Even though Canada embraces multiculturalism, the curriculum being primarily Eurocentric might contribute further to the culture shock that many are already experiencing.

When asked about the challenge of learning science for ELLs, Dillon mentioned that many students may find it challenging to learn content that is uninteresting and

taught poorly. He stated that the biggest challenge any student faces regardless of language proficiency was the learning of the content itself. According to him, an interest (or the lack thereof) in the content has a much more significant impact on learning than language proficiency level. Dillon explained his perspective clearly:

> [Y]ou only learn what you want to learn, right? I mean we can teach whatever we teach until we're blue in the face but it's getting someone to learn something that's problematic always. Regardless of language, first or second language, I believe interest is the key and if they can be framed in a way, contextualized in a way that's interesting, it's going to be easy to pick up. If it's not interesting, they won't have any regardless of whether in their first language or second language. (Dillon)

Many of the challenges that the teachers mentioned are not necessarily specific to ELLs. An identity crisis, an inconsistency in learning between the home and school, becoming proficient in the academic language and cultural differences could be faced by any student regardless of their home country or language proficiency level. The data reveal that the teachers did not necessarily view the ELLs' linguistic and cultural barriers as the root causes of all the challenges they faced and, thus, did not see them from a deficit point of view. The fact that these teachers were able to speak about the challenges faced by their ELLs itself is indicative of reflexivity in their teaching.

Roles of a Science Teacher

As suggested in the literature, the role of any teacher is not confined to a particular subject he or she is teaching or to a particular classroom or context. There are multiple roles that teachers enact which become even more complex in the context of

diverse classrooms. I was interested in speaking to the teachers about how they perceived their role in addition to being a science teacher in the classroom. During our conversations, the teachers described a whole gamut of different roles that they played which I describe in this section including: (a) teaching language in addition to science, (b) gathering information regarding the ELLs' culture and language, (c) ensuring student interest and (d) bridging the classroom and the outside world.

A number of teachers were quick to point out their role as language teachers in addition to being content teachers in the science classroom. Even though many of them mentioned that they did not have specialized credentials as ESL teachers, they still understood the importance of navigating both language and content simultaneously. Kindergarten teacher Nora explained, "I'm not just doing science. science may be like one period per day. And yes, I would describe myself as a language teacher … see, even if I'm teaching science, it's basically the language that counts there." Julian's case was even more interesting considering that he taught in a French Immersion school. As a result, not only did he have to teach ELLs English but also French which was the medium of instruction in his classroom. He explained his experience of navigating between the two languages in the classroom:

> I teach it to them so that they need to have that familiarity with both languages. Often case, the successful student is the one that can have enough of English proficiency that they can see the connections where there are French root words that have synonyms. And so, if they understand that larger vocabulary then, they can make that connection to the French language. So, I have to make them aware of that and have them sort to figure out how those two can connect and so that at

> the same time I'm teaching them French and science but concurrently teaching them English as well. (Julian)

Dillon stated that there was no doubt that he was a language teacher in addition to being a science teacher because according to him, "language is everywhere." He further mentioned that understanding the content without a strong proficiency in the language has little meaning. Dillon illustrated an interesting example in regards to the importance of language in content learning:

> There's a guy that just won the French language scrabble competition who doesn't know a word of French but he could memorize the dictionary. Good for you! But when it comes to content, he doesn't understand the content! So, what good is it to have a photographic memory, right? You still have to understand that we are language teachers first and we teach the structures of language, of writing and reading and communication through the content. (Dillon)

Many of the teachers also considered gathering knowledge about their students' cultural and linguistic backgrounds as a significant part of their role as educators. Not only did the teachers feel the need to do so in order to be empathetic toward ELLs but revealed that understanding their students' backgrounds could unlock a number of questions in regards to differentiating their instruction appropriately. Even though Sawyer acknowledged that acquiring information about the students' backgrounds was not always a simple process, he still thought it was necessary. Similarly, Alicia mentioned, "I need to be more aware of the different cultures because, it's always good to know their cultural background because then, I kind of have a stepping stone as to where or how I can… support their learning." Scott echoed Alicia's belief and stated, "I think

that's important for any teacher to get to know your students because... first of all, like how the student learns is the most important. So, you need to see what drives them and how they learn best." Even though most of the participants agreed that understanding their students' backgrounds was essential, these three teachers in particular considered it an important part of their pedagogical role.

It is worth reiterating that the interviews revealed to me how incredibly dedicated all of the teachers were to their students. I was not surprised when a number of them stated that they considered it part of their job to ensure that the students were not only engaged but also enjoyed learning the content. Many of them informed me that ensuring that their students were enjoying the process of learning was proof of their comprehension of the content. In fact, many went out of their way to make the content and their teaching entertaining for all of their students, regardless of language proficiency level. Even though Julian, who was a French Immersion teacher, considered being a language teacher as one of his roles, he maintained that his primary role was student interest and engagement in the content. He stated, "The main [role] is to get them interested and engaged with science. Getting them to do activities and see demonstrations that sort of challenge their misconceptions. […] Then, the next level then is how do I communicate that in French?" Scott agreed with Julian's sentiment in stating, "You … make sure you try to deliver the curriculum the best you can. *How* is up to every teacher. I try to make it fun. You try to make it relevant." Sawyer reflected on his own experience as a student and spoke about how he taught the subject differently in comparison to how he was taught:

> I hope that when they study science, they actually enjoy science, so they can explore and they can apply it to their daily lives. I was always hesitant to teach science because I never thought that I would be very good at science because I had a science teacher… in elementary [who] never really promoted it and I always felt nervous in science. (Sawyer)

Additionally, a few mentioned that they considered being a bridge between their classroom and the outside world as one of their roles. The teachers were quick to mention the importance of their students being able to extrapolate what they were learning in science to other contexts. Scott explained his experience in detail:

> Learning content that is important but it's just more beyond content too; they have to make those rich connections to the outside world- why it's important to them. I always tell the students why we are learning this because it's important. Because if somebody asks why you're learning something- 'Why are you learning fractions right now? Why are you learning Government?' I don't want them to say, 'Well, the teacher said we have to.' It has to be relevant. (Scott)

While Scott mentioned the importance of making a strong connection between the classroom content and the broader context, Katherine mentioned the importance of bridging the gap between science and other curricular domains. She stated, "I think science is not a subject by itself. It can be included in a lot of other things like … Math… and History and Geography. So, in that context, it could be taught across the curriculum."

I framed the interview question regarding their roles as science teachers very broadly to discover the entire range of the different parts they played as teachers. While

many teachers thought of themselves as language teachers, others were more concerned about ensuring that their students enjoyed the learning process. Some maintained that developing a diversity knowledge base of their students was their primary role. It was also believed by many that their role was that of being pedagogical bridges between the content and the outside world. As the interview data have rightly revealed, the role that teachers play is multilayered. Interestingly, the roles portrayed by the interview participants were not necessarily for the benefit of the ELLs but for all the students.

Negotiating Diversity in Pedagogy

Considering the positive attitude the teachers had toward diversity in their classroom, I was naturally interested in inquiring about how each of them incorporated aspects of the ELLs' languages and cultures within their instruction. However, I wanted to ease into the conversation by exploring a few other foundational factors prior to it. First, it was essential to understand their perspective regarding Ontario's science curriculum itself. Second, I wanted to find out about whether they faced issues of controversy in their classrooms in terms of the content and diverse cultural beliefs. Finally, I asked them about specific ways in which they included their ELLs' cultures and languages in their instruction.

Ontario's science curriculum.

Many of the teachers recognized that the nature of our science curriculum was such that not every student necessarily found it accessible. The curriculum was not only found to be irrelevant to many in terms of its cultural and geographical homogeneity but also in its overrepresentation of one particular gender. When I asked Debra about her take

on the curriculum, she was quick to point out the groups that were more heavily recognized over others:

> White, dead, Eurocentric men, right? (Laughs). I mean not even women, right? And let alone other cultures! I mean we don't look at certain aspects of that at all. But it would be great to have more materials to use even if you are using literature to bring it in because you can bring in a story about a scientist in literature in the classroom into science. You know if you are doing a certain type of science about inventions or creations of things because we have a view of when things are created that is not true. It's only a Eurocentric positionality. (Debra)

Similar to Debra, Julian was also mindful of the Eurocentric nature of our curriculum. He spoke about the negative impact it had on the content considering that topics in science need to be taught from their true origin which may not necessarily be the beginning of the Western civilization. Julian explained his experience:

> Often, the timelines start where Greek philosophers start. When I did my research and when I start my timeline now, it goes all the way back to the Chinese, the Arabic insurgence of science in Persia… [S]o, when you sort of understand where science is coming from and where it evolved to try to get them to think beyond just the European contributions. (Julian)

Alicia also echoed the sentiments shared by Debra and Julian and shared her own experience from when she was a student herself:

> [T]he science that we teach or we are taught or what I was taught is extremely Eurocentric giving me the impression that all science was really the making *of* the

> West or making *from* the West... You've got to [find out] what the cultural backgrounds of my students are. Even if I don't really have much diversity in my classroom…, I would still ensure that they know that it's not Western or European or Eurocentric [perspective]… dominating the content. (Alicia)

Even though many of the teachers mentioned the lack of gendered diversity in the curriculum and content implicitly, Sawyer and Julian pinpointed the imbalance in particular. Julian described his classroom design which included a skeleton that they renamed as a class each year. In his attempt to give his students a more gender-balanced perspective, he said, "[T]his year, I did a French name for it; Emilie Chateaulaise to let them [know] as a reminder that science is not just a White, male career path which is difficult because they see that image everywhere else." Similarly, Sawyer spoke passionately about the unequal importance placed on STEM education for girls which could be a possible consequence of the incessant image of the "male scientist" as Julian mentioned. Sawyer stated, "I also think that there's a lot more emphasis put on science and boys learning science. There's some issues with girls learning science."

I believe that if teachers are expected to provide culturally inclusive education to their students, a re-examination of the curriculum and consequent teaching practices is an essential step. I was pleasantly surprised at how analytical they were about the nature of the science curriculum. Not only were the teachers astute in their observations of the curriculum but as the data reveal, they also found interesting ways to cope with the challenge of the overrepresentation of one particular culture and one particular gender.

Controversy in science.

There are a number of elements that make science unique in comparison to other domains. Not only does science include a heavy concentration of content-specific and content-relevant vocabulary[40], but it is also unique in terms of controversy which surrounds certain issues. Before speaking to the teachers about how they brought students' cultures and languages into the classroom, it was important to ask how they felt about differing points of view in terms of the scientific content. I wanted to have a sense of their perspective regarding how ELLs' backgrounds and beliefs realigned not only with our curriculum and instruction but the Canadian culture as well.

Even though contested issues may not come up very often in a K-12 classroom setting, I wanted to ask the teachers about their experience with any such incidents. Depending on their age, ELLs may not necessarily have formed strong opinions on every issue by the time they arrive in our classrooms, but at times their families may have beliefs that are unparalleled with the Canadian culture. Interestingly, many spoke candidly about the controversies that emerged in their science classrooms. There were a number of topics (e.g., evolution) on which there were differences of opinion depending on the cultural backgrounds of their students. Debra captured the intersection between the differing views in science accurately when she stated, "science is one of those topics people don't think will be contentious but it has a lot of moral claim to it when you talk

[40] McDonnough and Cho (2009) define content-specific vocabulary as that which is specific to science and that which is only be used in the scientific context (e.g., Sodium Bicarbonate) while content-relevant vocabulary as vocabulary that has multiple meanings out of which only a few may be applicable to science (e.g., tissue).

about what you believe and what you don't believe." In addition to being a country that welcomes immigrants from all over the world, secularism and marriage equality among numerous others are also important values in the Canadian culture. However, on occasion, immigrants from other countries as well as some citizens themselves struggle with aligning their personal values with some Canadian values. During a lesson on Canadian families, novice teacher Aubrey informed me about how the parent of a child in her class took umbrage to the inclusion of a homosexual family in the discussion. She spoke about her unpreparedness in dealing with the parent who had a different perspective on this issue considering that conceiving of a family with two mothers or two fathers was perfectly normal according to Aubrey's own Canadian upbringing. Nevertheless, she mentioned that the incident was a learning experience for her and stated, "[N]ow I know that I have to be very careful about what I do teach and … it has to be culturally sensitive too." Experienced teachers Scott and Dillon had witnessed many such incidents and over time, had developed a strategy of dealing with them. Scott stated, "I try to say that there are some things you may not believe in. If you don't, you don't have to contribute. I can make an accommodation. You don't have to answer or participate but still stay in the classroom."

A number of teachers identified the topic of "evolution" which was contested not only by ELLs and newly arrived immigrant families but many Canadian students and their families as well. I was interested in asking the teachers about the strategies they used to deal with the controversy. Debra and Alicia stated that they presented the topic of evolution as one among other frameworks of understanding the world. Debra stated, "I had to talk to the principal and it was a little challenging. So, I was really instructed to

frame it like, 'These are theories and we are going to study some theories. There are other theories.'" Alicia believed that it was important to present multiple perspectives in the classroom regardless of her personal beliefs. She stated, "I think students should be exposed to both creationism and evolution. I think it's important for them to know the science behind evolution or what scientists believe and what they believe when it comes to evolution."

While Debra and Alicia included contrasting issues on the topic in their classrooms, Julian and Sawyer had a slightly different strategy. According to them, the students' ability to explain their reasoning behind their belief in a particular theory was much more important than the theory itself. Speaking about a student who was a staunch believer of creationism, Julian stated, "So, [we are]… looking at her observation, her argument and trying to fine-tune it. So, that's what we're sort of evaluating her on instead of what my personal belief is or and trying to crush her ideas." Sawyer echoed Julian's comment and stated, "There are many different beliefs, and what's more important to me is the ability to defend your opinion. […] 'Let's research. Can you defend what you believe in and are you open to looking at different ideas and different opinions?'" Both Julian and Sawyer were sensitive toward their students' perspectives no matter how divergent they were from their own. Julian ensured that he was focusing more on the students' analytical and critical thinking skills despite the content of their beliefs. Sawyer added that regardless of the multiplicity of the students' belief systems, he welcomed an open discussion so long as the students felt comfortable sharing their perspectives in that space.

Incorporating elements of diversity in pedagogy.

I have discussed the interview participants' perspectives on ELLs' cultures and languages in the previous chapter during the discussion on relevant survey items. In this section, I discuss specific ways in which the teachers incorporated aspects of language and culture in the content and in their instruction.

The inclusion of ELLs' languages.

As mentioned in the previous sections of this chapter, all of the teachers spoke positively about aspects of diversity. Even though there was a lack of appropriate resources that the teachers could use, they all spoke about the importance of recognizing the students' backgrounds and finding ways to include them in the curriculum and instruction. I was interested in speaking to the teachers about particular ways in which they infused ELLs' language in science. Even though he did not always know how to do so, Julian acknowledged the importance of incorporating the L1 of the students by stating, "There are [etymological] roots everywhere! The European world is not the primary source… There were other cultures and they contributed to science … And sometimes, it has to be self-taught and I don't always get it quite right." Despite his hesitation in using his students' languages to greet them in particular as described in the previous chapter, Sawyer was quite enthusiastic about using other languages to address his entire class. He stated, "I speak a little French so … I always try to change to French. Actually, I've lived in Japan for a year so every once in a while, I throw in some Japanese words that I know."

On the other hand, Dillon and Debra provided illustrations of specific lessons that they conducted in their classroom by incorporating various languages. Dillon particularly

encouraged his students to use their L1 when teaching them content-specific vocabulary. He stated, "We ask them to share all the time; 'This is how we say it in English. How do you say it in Serbian?'" He added that he encouraged his students to write the terminology in their language on the board for everyone to see. Dillon stated, "[I]t's putting it up on the board saying, 'What does it look like in your language? […] Put it up on the board in Arabic script so we can see all the different ways we can write the word photosynthesis.'" According to Dillon, this did not only help in making the content linguistically-inclusive but also interesting for his students. Debra also spoke at length about how she brought multiple languages in the classroom especially when teaching content-specific vocabulary. She explained the process she undertook during a lesson on Flight:

> There is a lot of vocabulary in Flight when you look at 'turbulence' and 'Bernoulli Effect' and 'drag and lift' and 'thrust.' […] [W]e built airplane models but I asked the students to label the models … in at least two languages. So, my students who were not ELL students; most of them did English and French … And the students who were ELLs, most of them chose to use their home language. […] So, it was interesting to see all these models hanging with dual languages really of labelling of all the parts and pieces and then, we went in to start teaching and when I would teach I would [be] pointing to this model, 'Oh this word is this. Now, what is this in Tamil? What is that? Oh, ok.' So, we were starting to bring in those factors and letting students have different ways of knowing. (Debra)

In the previous chapter, I discussed relevant findings revealing that many teachers were hesitant about using the ELLs' home languages as greetings. Some stated that they

chose not to include the L1 of ELLs based on the unmanageability of bringing in multiple languages while others mentioned that they chose not to do so in order to be fair to those students who did not belong to those L1 groups. However, interview data reveal that the teachers were more than willing to accommodate if the ELLs themselves wished to use their L1 in the class in order to comprehend the content or for any other reason.

The inclusion of ELLs' cultures.

I believe that language is at the cornerstone of culture and the two are inseparable. However, I did not expect the teachers who I interviewed to be aware of the anthropological underpinnings on the topic of language and culture. From a broader perspective, it would be safe to assume that when individuals think of someone's "language", they do not necessarily tie connotations of religion or sartorial choices or race or nationality (which are other important aspects of culture) to it. Hence, I kept the concepts of language and culture separate for the sake of simplicity and clarity. When I mentioned language, I expected the teachers to consider the written, aural and verbal aspects of it and when I mentioned culture, I expected the teachers to think about every other aspect of one's identity, (e.g., religion, race, attire) barring language. Considering the fact that none of the participants showed any confusion especially during the interviews, it is evident that their understanding of the concepts was commensurate with my expectation.

I asked the teachers about specific ways in which they brought their students' cultural identity into their pedagogy and many of them spoke passionately about the steps they took to do so. Canada celebrated Asian heritage month around the time of my interview with Scott. Hence, he spoke about how he based his teaching on the event:

> [W]e always say that everyday is multicultural day. You celebrate diversity. We do that. So, for this month, of course, it's Asian heritage month so we've been doing a lot of things as a school ... and school culture around Asian heritage this month… whether it's with Social Studies, with Government, whether, people are allowed to go to school or not- in some countries they are, in some countries they are not; whether in science, the environment- how they treat it, if there are laws and all that too. So, they can bring that in to their background because... quite a few students are not born here so they can bring that rich experience from their home country and bring that here. (Scott)

Similar to Scott, Debra also spoke passionately about the importance of including other cultures into the content. She mentioned that doing so served a dual purpose. Infusing other cultures did not only make the learning more enriching for the students who identified with those cultures but also, so that the class could discover how much of the content is not necessarily the product of the West. She explained her experience to me:

> Like I really strive to use examples from different areas, you know what I mean? So, we are talking about inventions and creations in Grade 4, right? Well, I can talk about Gutenberg and the printing press or I can talk about when China invented it like 2,000 years earlier! Hello! […] And we'll talk about often we'll read [a] story in [a] language like I usually connect mine and I'll say, 'I wonder why the difference and let's be critical about this.' So, I think giving those opportunities to show, you know, we don't need to study every North American scientist or European scientist. (Debra)

Before my interview with Sawyer, he stated that he was unsure if he would qualify to participate in the interview considering that he did not have any ELLs in his class in that particular year. Regardless, he told me that he was very interested and wished to participate if possible. I informed him that this study was an exploratory study examining Ontario's science teachers' perceptions and hence, he would qualify as a participant. I asked him to simply bring his experience of teaching ELLs as best as he could during the interview. He mentioned to me that even though he did not have any ELLs in his class, he did have students who were new immigrants to Canada and that their cultures did play a role in the decisions that went into the lesson planning. As I spoke to him, I discovered that at times, we reduce an individual's cultural identity to aspects that are easily discernible. Sawyer spoke about an uncommon cultural difference that a new student brought to his classroom. He illustrated the example during the interview:

> I did have a student last year; the family was from India, and the first test that we did [was] measurement. He did everything in feet and inches. So, we had a little chat. Actually, I did talk to his parents, 'You know, it's not wrong. I'm quite comfortable in talking feet, inches so I marked everything correct but I want him to start to learn the metric system because that's important for what we do.' So, he and I had a little conversation and we talked a little bit more about the metric system but then, on the other hand I also think it's unfortunate that we don't teach the metric system because if you work in construction, so many people work in feet and inches. So, I think you have to be open to those conversations. (Sawyer)

While Debra and Scott brought aspects of cultures that might be considered obvious in their classrooms, Sawyer spoke about the more subtle nuances that set us apart culturally.

On the other hand, Julian looked to popular culture and the media to help his students understand the diversity of our world. In addition to bringing elements of diversity in pedagogy himself, he mentioned that teachers should include role models and spokespersons from diverse groups. According to him, this could have a positive influence in broadening their perspective in particular fields. He provided a wonderful example during the interview:

> You hear about some of the big spokesmen for science, they are trying to show that science isn't what it was, what we think of it as. So, the prejudice we normally sort of associate with [is] who are the scientists and what drives science. I think it was Neil De Grasse Tyson; [he] is a big example. He's a spokesperson but when he talks about science, he isn't focused just on the contributions of the Western world; he talks about science from a broad perspective, an international perspective. And I remember him having a discussion about the names of stars and a lot of the stars have Arabic names and … he's saying what's driving that so he was trying to explain the force behind science so that was very interesting and not all science teachers know that kind of stuff. (Julian)

Since the goal of this study is to explore Ontario's science teachers' perceptions of self-efficacy to teach in diverse classrooms, it was essential to understand how the teachers in this study perceived diversity. As the interview data revealed, the teachers viewed diversity positively and even considered it to be an advantage for every student in the class, regardless of their background. Data also revealed that even though the teachers

did not feel very efficacious about using the ELLs' L1 in the class, they were more than willing to encourage the ELLs to use their L1 themselves. The teachers were also very empathetic and mindful about the challenges that ELLs faced in our classrooms. Their critical thinking regarding the curriculum and the initiative they took in negotiating diverse languages and cultures in their instruction is evident of their high self-efficacy.

Summary

In this chapter, I discussed the findings pertaining to the third research question guiding this study. I explored Ontario's science teachers' attitudes toward diversity and other relevant factors that emerged during the interviews. Interview data revealed the challenges posed by diverse classrooms on both teachers and the ELLs. I also presented the teachers' voices on how they conceived of their role as science teachers. Finally, I discussed how they incorporated aspects of language and culture in pedagogy after exploring their perspectives regarding Ontario's science curriculum and the nature of controversy in science. In the next chapter, I consolidate the survey and interview findings in light of the theoretical framework and relevant literature on the issue of science teachers' self-efficacy perceptions to teach in Ontario's diverse classrooms.

CHAPTER 6 DISCUSSION

Introduction

In this chapter, I discuss the main findings of this study in light of the theoretical framework as well as relevant literature in the field. The first research question asked about science teachers' self-efficacy perceptions to teach in diverse classrooms. The sub-questions asked whether there is a correlation between self-efficacy and the grade-level they teach, their linguistic profile and their teaching experience. The second research question asked whether there were differences between teachers' self-efficacy perceptions on general pedagogical practices as opposed to culturally responsive pedagogical practices. The third research question broadly asked about the teachers' general attitudes toward diversity and ELL inclusion. The sub-questions asked about the challenges that diverse classrooms pose on science teaching and learning, about their role as science teachers as well as how they incorporate elements of language and culture in their teaching.

Science Teachers' Perceptions of Self-Efficacy

Overall, the science teachers in this study had a considerably high sense of self-efficacy with a mean of 7.20 (*SD* = 1.07). The three highest-rated survey items were item 10 which read "I use a variety of teaching methods such as visual aids", item 8 which read "I build a sense of trust in my students" as well as item 28 which read "I help students feel like important members of the classroom" and item 22 which read "I structure parent-teacher conferences so that the meeting is not intimidating for parents". In contrast, the lowest-rated items were item 18 which read "I design my classroom environment using displays that reflect a variety of cultures", item 16 which read "I teach

students about their cultures' contributions to science if content and context permit" and item 17 which read "I greet ELLs with a phrase in their L1 if I am able to". Siwatu (2007) has mentioned the importance of item-specific responses in addition to the overall global score on self-efficacy measures. In fact, the researcher posits that global self-efficacy scores mask the particular areas in which participants have low efficacy which need to be targeted by appropriate stakeholders such as teacher education programs or school boards. These findings clearly point out that teachers have low self-efficacy on pedagogical practices that are directly related to teaching culturally and linguistically diverse students. The highest-rated survey items are more general in nature and do not quite deal with issues of diversity directly. These findings are in alignment with previous research which shows that culturally responsive pedagogy has been discussed extensively within research communities but the practical aspect of the theory does not effectively reach the practitioners (Boutte et al., 2010). Hence, teachers' low self-efficacy on these items shows that they may be unsure in terms of how to enact these practices in the classroom.

According to social cognitive theory (Bandura, 1997), self-efficacy is a future-oriented concept but efficacy beliefs also contribute to performances in the present. As a result, the highest- and lowest-rated survey items tell us about these participants' behaviour in the present as well as in the future. Research on teachers' perceptions tells us that beliefs have a tremendous impact on teachers' thought process as well as their behaviour (Ashton, 2015; Fives & Buehl, 2008). The literature also tells us that teachers' perceptions involving pedagogy, epistemology and self-efficacy among others act as filters and guides for how they interpret experiences, address challenges and take actions

(Levin, 2015). Knoblauch and Hoy (2008) have stated that teachers' self-efficacy has a fundamental influence on pedagogical practices. Teachers in this study are more likely to enact pedagogical practices on which they felt highly efficacious (e.g., items 10, 8, 28 and 22) as opposed to those on which they had low efficacy (e.g., items 18, 16 and 17). A high-scoring (item 28) and a low-scoring (item 17) items are in accordance with the results from Siwatu's (2007) study measuring preservice teachers' self-efficacy perceptions on culturally responsive teaching practices in the American Midwest. Even though the context of his study is vastly different from the current study, the similarity of the results is interesting to note. Self-efficacy theory is a future-oriented concept which tells us how individuals will act when they take on certain activities (Bandura, 1997). If preservice teachers in Siwatu's (2007) study felt most efficacious about helping students feel like important members of the classroom and least efficacious about greeting ELLs with a phrase in their L1, it has rightly predicted how they will feel when they begin to teach. Even though the participants in this study were inservice teachers, it could be predicted that even as preservice teachers, their self-efficacy appraisal on these items would possibly have been the same.

The number of ELLs varied in each of the teachers' classrooms; some had as low as one ELL whereas others taught a classroom where over 25% of the students were ELLs. Although it is difficult to assume an average number of ELLs in every classroom, generally speaking, diversity in Ontario classrooms is considerably higher than other provincial contexts. Considering that teachers in this study felt least efficacious regarding teaching practices dealing with aspects of diversity more directly, the "diverse" context could be an influential factor. Social cognitive theory tells us that efficacy beliefs operate

depending on the situational requirements as opposed to in a general, decontextualized manner (Bandura, 1997). Previous studies have explored the impact of the external context on teachers' self-efficacy perceptions. Siwatu's (2011) study examined teachers' perceptions of self-efficacy in an urban school compared to a suburban school. The urban school had more students belonging to visible minority groups while the teachers were predominantly White whereas in the suburban school, most students and teachers were White. The results from the study shows that preservice teachers felt more efficacious to teach in a suburban school compared to an urban school. Self-efficacy theory also tells us that mastery experiences are the most significant source of self-efficacy perceptions (Bandura, 1997). Considering that teachers felt highly self-efficacious about general pedagogy compared to culturally responsive pedagogy, it could be assumed that their overall teaching experience regardless of the student composition influenced their general teaching efficacy.

Bandura (1997) has stated that not only are individuals likely to enact their beliefs when they feel highly self-efficacious about them but that they will put forth more active effort in those activities. Hence, it is possible that as a result of their low efficacy on pedagogical practices dealing directly with diversity, perhaps, teachers do not generally adopt culturally responsive teaching practices in their classrooms. Even if they do, they may not expend a large amount of effort in incorporating more inclusive teaching practices in the classroom.

Self-Efficacy by Groups

The first sub-question investigated the comparison between elementary and secondary teachers' self-efficacy perceptions. Findings show that elementary teachers (*n*

= 45) scored an overall mean of 7.34 (*SD* = 1.19) and secondary teachers (*n* = 31) had an overall mean of 7.01 (*SD* = 1.34). Results from the *t*-tests in terms of overall findings show that the difference in the mean scores was not statistically significant. However, item-specific *t*-tests showed that there were statistically significant differences on three items. As mentioned in Chapter 4, I understand that conducting *t*-tests on individual items results in a high experiment-wise error rate, and hence, the likelihood that significant group differences may be due to chance. Even though I have chosen to analyze these differences, it should be noted that they need to be interpreted with some caution. Elementary teachers scored much higher than secondary teachers on item 11 which reads "I develop a community of learners when my class consists of students from diverse backgrounds", item 18 which reads "I design a classroom environment using displays that reflects a variety of cultures" and item 19 which reads "I develop a personal relationship with my students."

There is a severe lack of research specifically looking at teachers' self-efficacy perceptions depending on the grade-level that they teach. However, these findings are in line with anecdotal evidence which points to why secondary teachers may have low efficacy compared to elementary teachers especially in terms of creating a classroom community and developing a personal relationship with students. Elementary teachers generally teach all the subjects while secondary teachers teach a few specialized subjects. Broadly speaking, an elementary teacher would teach language arts, science, math, social studies and visual art among others while a secondary teacher may only teach science (and possibly one or two other subjects). As a result, elementary teachers spend a considerable amount of time with their students and therefore, may get to know their

students better than secondary teachers thus, raising their self-efficacy level. Also, parental involvement decreases at the secondary level compared to the elementary level. Additionally, the interview data showed that elementary teachers may have considerably more autonomy in terms of decisions about schedule organization and time management. An elementary teacher may choose to teach science two or three days in a week while a secondary teacher may not have that choice. Also, elementary teachers teach students of a comparatively younger age than secondary teachers. As a result, their students may be able to catch up to their proficient English-speaking peers in terms of language development much quicker in comparison to students of an older age. Elementary teachers may not have to expend a lot of effort in terms of activating their students' prior knowledge when it comes to science teaching and learning in comparison to secondary teachers.

The second sub-question investigated the comparison between monolingual and multilingual teachers' self-efficacy perceptions. Findings show that monolingual teachers (n = 35) scored an overall mean of 7.07 (SD = 1.30) while multilingual teachers (n = 41) had an overall mean of 7.31 (SD = 1.22). Previous studies have shown that most of the teachers in schools across North America are monolinguals (Fehr, 2010; Coady et al., 2011). The metadata from this study has been in contrast with previous research in the sense that there were more multilingual teachers than monolingual teachers who participated in this research. However, whether having a larger composition of multilingual teachers necessarily has a positive influence on their self-efficacy to teach in diverse classrooms is worth questioning. Results from the t-tests in terms of overall findings show that the difference in the mean scores between monolingual and

multilingual teachers' self-efficacy perceptions was not statistically significant. Also, item-specific *t*-tests did not yield any statistically significant differences between the sub-groups on specific items either.

Previous research exploring the impact of teachers' language background on issues of diversity and inclusion, preparedness and self-efficacy has shown inconsistent results. A study by Coady et al. (2011) stressed that certain background characteristics can have an impact on teacher preparedness in terms of teaching ELLs and found that "LOTE proficiency" ["language(s) other than English" proficiency] was a particularly significant variable which had a positive correlation with teacher preparedness for teaching ELLs. In their study, García-Nevarez et al. (2005) also found that Spanish-speaking Latino teachers had more positive attitudes toward using ELLs' L1 in the classroom than non-Latino teachers who did not speak Spanish. Bilingual teachers believed using Spanish in the class elevated the ELLs' self-esteem especially considering that they could relate to the ELLs due to their own experiences of learning an L2.

The findings from this study support the literature on how the language background of teachers has no impact on their sense of self-efficacy to teach ELLs. Flores and Smith (2008) have found that previous research fails to prove "teacher ethnicity or language abilities as possible mediators of attitudinal beliefs about language and cultural diversity" (p. 331). Also, it cannot be assumed that multilingual teachers will necessarily have a higher sense of empathy toward multilingual students. Flores and Smith (2008) also tell us that teachers from minority backgrounds can also perceive ELLs from a deficit perspective and that those who view language-minority students negatively are not always European-Americans. In her study, Faez (2012) has also shown that even

though internationally educated teacher candidates (IETCs) shared a common background with the students and hence, by virtue had a higher sense of empathy and understanding, it did not automatically translate to increased preparedness to teach in diverse classrooms. Even though there have been numerous calls made to diversify the teacher population in the hopes that they will be better equipped to provide culturally responsive pedagogy to all students, findings from this study are consistent with previous research which shows that simply increasing the population of diverse teachers may not necessarily be the only answer. All teachers, regardless of their own linguistic background need proper preparation to teach in diverse classrooms.

The third sub-question investigated the comparison between novice and experienced[41] teachers' self-efficacy perceptions. Findings show that novice teachers (n = 11) scored an overall mean of 7.23 (SD = 1.06) and experienced teachers (n = 62) had an overall mean of 7.17 (SD = 1.31). Even though the sample size of this group was uneven, my attempt to include the variable of teaching experience in the context of self-efficacy at all is noteworthy considering the paucity of research in this area. Putman (2012) has stated that "Less is known about the efficacy beliefs of preservice and novice teachers, especially in comparison to each other and more experienced teachers" (p. 29) while Chan (2008) mentions that "there is little data about how efficacy beliefs change at different stages of a teacher's career" (p. 1059).

Results from the t-tests in terms of overall findings show that the difference in the mean scores was not statistically significant. However, item-specific t-tests showed that

[41] The novice-experienced group was drawn from 73 participants as opposed to 76 participants for the purpose of the t-tests. See Chapters 3 and 4 for more information.

there were statistically significant differences on four items. As mentioned in the Chapter 4, I understand that conducting *t*-tests on individual items results in a high experiment-wise error rate, and hence, the likelihood that significant group differences may be due to chance. Even though I have chosen to analyze these differences, it should be noted that they need to be interpreted with some caution. Findings showed that experienced teachers had higher efficacy on item 6 which read "I assess student learning using various types of assessments" and item 22 which read "I structure parent-teacher conferences so that the meeting is not intimidating for parents." Novice teachers had higher efficacy on item 20 which read "I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students" and item 29 which read "I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students".

Employing different types of assessment techniques and structuring parent-teacher conferences in approachable ways are practices that take time and experience to learn. Bandura (1997) has revealed that mastery experiences are the most significant source of self-efficacy. It is possible that experienced teachers feel highly self-efficacious in terms of these survey items considering that they have accumulated more mastery experiences over the years as compared to novice teachers. It could be assumed that as a result of experimentation and iterations over time, experienced teachers are better able to adopt appropriate assessment procedures depending on the students' capabilities as well as organizing meetings that are welcoming for parents.

Novice teachers had higher self-efficacy in terms of being able to identify ways in which standardized tests may be biased toward culturally and linguistically diverse students. The reasoning behind this could be three-fold. First, during the interviews that I

conducted with science teachers in this study, I was informed by most experienced teachers that no courses in terms of teaching ESL or diverse classrooms were offered during their teacher education qualification. It seems as though courses on how to teach ELLs have only been offered within the past decade or so. As a result, it is possible that novice teachers have had the opportunity to take a course on ESL and diversity-related issues and hence, are better able to understand biases against ELLs on standardized tests. Second, it is also possible that novice teachers are more sensitive considering the increasing proportions of ELLs in Ontario classrooms in the more recent past. Some experienced teachers in this study have been teaching for over two decades when the proportion of ELLs was perhaps, not as large as it has been in the past few years. Consequently, novice teachers have had the opportunity to teach more diverse classrooms from the start of their career which may have resulted in a higher sense of self-efficacy regarding biases against ELLs. Third, standardized tests may not be updated very often. As a result, experienced teachers may have become immune to the content, especially if these tests have been used reused for many years and novice teachers may have the advantage of a fresh perspective which may have resulted in their sensitivity.

A correlational analysis was also conducted which showed that there was no statistically significant correlation between teaching experience and self-efficacy[42]. Findings from this study are in line with previous research which shows that teaching experience is unrelated to self-efficacy. Tschannen-Moran and Johnson (2011) have stated that teachers who commence their teaching careers with a high sense of self-

[42] Even though three participants were eliminated from the novice-experienced grouping to conduct *t*-tests, I included all of the participants ($N = 76$) for the correlational analysis.

efficacy generally continue their high efficacy through motivation and perseverance while those who begin with a low self-efficacy will continue the cycle by engaging in destructive activities which reinforce their negative beliefs. Woolfolk Hoy and Spero (2005) believe that preservice teachers have a high sense of self-efficacy when they begin teaching and then, a decrease in their self-efficacy will generally occur during their first year of teaching from which they recover in their second year. Since this study defined novice as those between zero and three years of teaching experience, it is likely that most teachers had recovered from their initial low efficacy level. Even though the findings from this study are aligned with previous research, it is possible that a larger as well as a more even sample of participants would yield different results.

Social cognitive theory states that aspects including individuals' self-efficacy interact with the external environment and the two have a reciprocal influence on each other which makes it important to examine such relationships (Tschannen-Moran & Woolfolk Hoy, 2007). Aspects such as the grade-level, linguistic profile and teaching experience "may be elements that teachers consider in their assessment of the difficulty of the teaching task in determining how successful they expect to be at that task" (Tschannen-Moran & Woolfolk Hoy, 2007, p. 945). Consequently, I set out to discover the correlation between factors such as the grade-level taught by the teachers, their own language background as well as their teaching experience and their self-efficacy perceptions. Even though there were item-specific differences in terms of some of the sub-groups (which should be interpreted with caution), overall, the findings from this study showed that the three demographic variables had no influence on the teachers' sense of self-efficacy to teach in diverse classrooms. These findings are in accordance

with previous research by Tschannen-Moran and Woolfolk Hoy (2007) who claim that "Demographic variables have typically not been strong predictors of the efficacy beliefs of teachers" (p. 952). Flores and Smith (2008) have also found that the research on teachers' beliefs regarding culturally and linguistically diverse students does not clarify how factors including the teachers' own cultural and linguistic backgrounds have on those beliefs. As discussed in the previous sections of this dissertation, researchers have spoken about the shortage of research on a number of issues in the context of self-efficacy. Perhaps, further research on how demographic factors influence teachers' self-efficacy and attitudes toward diversity will help fulfil more gaps in the field. In any case, this study contributes to the existing research examining the relationship between teacher characteristics and self-efficacy.

Teachers' Self-Efficacy Perceptions on General Pedagogy and Culturally Responsive Pedagogy

The second research question was aimed at discovering how the teachers' self-efficacy perceptions differed on general teaching practices as opposed to culturally responsive teaching practices. I describe in Chapter 4 how the survey items were categorized as general pedagogy and culturally responsive pedagogy items[43]. General pedagogy involved teaching practices that are considered to be effective for all students, regardless of their cultural and linguistic backgrounds while culturally responsive pedagogy included survey items which took ELLs' cultural and linguistic backgrounds into account in terms of the curriculum, instruction and teaching practices. Overall, the mean score on general pedagogical items (M = 8.06, SD = 0.59) was not only much

[43] See Chapter 4 (Table 13) for complete categorization.

higher than culturally responsive pedagogical items (M = 6.50, SD = 0.83) but the difference was also statistically significant as evidenced by the t-test. I contextualize these findings in light of self-efficacy theory, culturally responsive pedagogy theory as well as relevant literature.

The statistically significant difference between teaching practices of general pedagogy and culturally responsive pedagogy in this study supports the theoretical understanding concerning the nature of self-efficacy beliefs which tells us that general beliefs of self-efficacy do not generate self-efficacy beliefs in specific tasks (Bandura, 1997). Teachers had a considerably higher sense of efficacy on general pedagogical practices but they did not have high efficacy on culturally responsive pedagogical practices. Evidently, their high efficacy on general pedagogy did not automatically translate to a high efficacy on culturally responsive pedagogy. Hence, in my attempt at examining self-efficacy in specific contexts, these findings support the fact that self-efficacy beliefs are truly context-specific in nature.

At the outset, it should be noted that self-efficacy does not equate to skill. Simply because teachers have low efficacy on culturally responsive teaching practices does not mean they do not possess appropriate skills. As explained in Chapter 2, even those who are skilled at particular tasks may experience failure on occasion. Clearly, there are other factors involved which have resulted in a low efficacy on culturally responsive teaching practices in this case. It is possible that the teachers' doubts and insecurities in terms of providing culturally responsive pedagogy have resulted in their low efficacy (Bandura, 1997). It is also possible that the type of teaching experience they have had has resulted in their low efficacy. Social cognitive theory tells us that mastery experiences are the

most significant source of self-efficacy perceptions (Bandura, 1997). Considering that teachers felt more highly efficacious about general teaching practices shows that they had gained enough mastery experiences engaging with general pedagogical practices but not enough with teaching practices involving culturally responsive pedagogy.

Research on teachers' perceptions tells us that investigating the nature of an individual's beliefs helps us understand their resulting behaviour considering that thoughts and beliefs precede actions (Bandura, 1997; Buehl & Beck, 2015). As a result, these findings can be linked to teachers' behaviour in the present and the future. Self-efficacy beliefs are predictors of future performances but they also contribute to those performances in that individuals are not simply onlookers but have a hand in the outcome as well (Bandura, 1997). Hence, it can be understood that perhaps, teachers may have experienced failures and setbacks in enacting culturally responsive teaching practices in the past which may have led to their low efficacy in the present. This also has an enormous influence on the enactment of culturally responsive teaching practices in the future. Bandura (1997) states that individuals who doubt their capabilities in a particular activity will hesitate to take on difficult tasks. Self-efficacy beliefs affect one's choice of activities and coping efforts during obstacles and the stronger one's self-efficacy perceptions, the more active the efforts (Bandura, 1997). As a result, it can be deduced that teachers have largely favoured and may continue to favour general pedagogical practices even in times of obstacles considering their high efficacy on them. Additionally, the theory helps us understand that as a result of their low efficacy on culturally responsive pedagogy, even if teachers do enact culturally responsive teaching practices, they are not likely to engage more effort in them.

These findings are also in accordance with previous research showing a lack of preparedness on the part of the teachers to teach in culturally and linguistically diverse classrooms (e.g., Lucas et al., 2015). Proponents of culturally responsive pedagogy including Gay (2000) have stated that general pedagogy does for mainstream students what culturally responsive pedagogy does for ELLs. Evidently, these findings reiterate the fact that curriculum, instruction and pedagogy are largely geared toward students who belong to the mainstream culture of the society (Gay, 2000; Howard, 2010; Coelho, 2012). Mensah (2011) has pointed out that in order for students to learn in culturally relevant ways, it is important that their teachers first learn and understand the principles of culturally responsive pedagogy themselves so that they can teach appropriately. Culturally responsive pedagogy theorists have mentioned that student failure is attached to the teacher (Collier, 2005). This helps us understand that if ELLs belonging to diverse cultural and linguistic groups are underperforming, one possible way to help them succeed in their academic work would be to provide appropriate culturally and linguistically responsive pedagogy to them.

A study conducted by Boutte et al. (2010) sheds light on these findings in its explanation that culturally responsive pedagogy has been discussed extensively in theory but it does not always reach the practitioners effectively. As a result of the lack of translation between theory and practice, teachers do not quite know how to enact such practices in their classroom. The researchers also report on their experience of conducting professional development sessions with teachers who largely have believed that culturally responsive pedagogy is apropos to language arts, fine arts and social studies but not the hard sciences. It is possible that the teachers in this study may be unaware as to how to

incorporate culturally responsive teaching practices in their instruction in specific ways. Almost all of the teachers who I interviewed were quick to point out the lack of ESL training they had in their teacher education programs. In fact, when asked about a recommendation they would like to make to teacher education programs, most of them suggested more support for preservice teachers in terms of diversity education as well as more practicum teaching experience in diverse classroom settings.

Previous research has illustrated the lack of teacher engagement in culturally responsive pedagogical practices in the classroom. Developing a classroom community especially when there are ELLs in the classroom is at the cornerstone of culturally responsive pedagogy. If this is not taken into account, an unfortunate consequence could be an unbalanced power structure in the classroom. During her observation of a Biology classroom which included Korean students, Ryu (2015) noticed that students tended to socialize with others similar to themselves in terms of cultural and linguistic backgrounds. She concludes that the teacher must consider these socialization practices of ELLs (e.g., with only those from their own cultural and linguistic group) as a personal and professional responsibility in the classroom because they may be pointing toward a power differential in the classroom. Another essential component involves identifying the difference between communication styles in school as opposed to the ELLs' homes. Based on the findings from their study, Coady et al. (2011) have remarked on the need to increase teachers' knowledge about how ELLs communicate at home since their way of communication might be very different depending on their background and so that it can be used as a resource for learning. They also acknowledge that this is essential especially

considering that a framework based on the tenets of monolingualism is the guiding force for current teacher education programs.

Ontario's Science Teachers' Attitudes toward Diversity

The third research question sought to discover teachers' attitudes toward cultural and linguistic diversity in their classrooms. Overall, interview data showed that teachers had positive attitudes toward diversity and ELL inclusion in their classrooms. These findings are consistent with the perspective of Walker et al. (2004) who note that attitudes that the broader society has on diversity can have an impact on teachers' perceptions on diversity in the classroom and that negative attitudes could result in detrimental consequences. Considering that Ontario is the most diverse province in the country, the overall attitudes of Ontarians toward diversity are generally positive. Canada is known the world over as a haven for immigrants and this is mirrored in our school systems as well. As a result, teachers may share the broader citizenry's perspective on the cultural and linguistic diversity in our classrooms. The willingness of the teachers to participate in this study is another reason that serves as proof of their positive attitude toward diversity in their classrooms. There were a number of teachers (e.g., Simon and Sawyer) who emailed me after their survey completion about wishing to participate in the interview even though they did not have a large number of ELLs in their classrooms. There were others who even though did not have the time to participate in the interview sent me emails requesting me to share the findings of my study upon completion. The fact that nothing was offered to these teachers in exchange for their participation in the study shows their passion and dedication toward their profession.

In terms of the literature in this area, findings from previous studies conducted in North America have shown inconsistencies in teachers' attitudes toward diversity in mainstream classrooms. Walker et al.'s (2004) study conducted in an American state revealed that the overall nature of teacher attitudes toward ELLs ranged between neutral to strongly negative across different demographic categories and schools within diverse community contexts and the majority was not actively interested in having ELLs in their classrooms. Reeves's (2006) study found that even though overall, teachers held a welcoming attitude toward ELL inclusion, nearly half of the teacher participants did not believe that all students benefitted from the inclusion of ELLs in their classrooms and the majority believed that ELLs should not be in mainstream classrooms without having attained a minimum proficiency in English.

Challenges Posed by Diverse Classrooms

The first sub-question sought to discover the challenges that teachers experienced in terms of teaching science in diverse classrooms. The interview data found that the most common challenges that teachers encountered in the science classroom included the language barrier between ELLs and themselves as well as the challenge of learning the academic language of science for ELLs, a lack of time, a lack of appropriate resources and differing cultural views in science.

The most obvious challenge that teachers stated they faced was the language barrier between themselves and their students. This finding is consistent with current research showing a cultural mismatch between the student and teacher populations as well as with previous research which states that with multiple cultures and languages in one classroom, it is not always easy for teachers to connect to their students' experiences

(Lee & Fradd, 1998; Boutte et al., 2010; Ryu, 2015). Especially in Ontario where this study is based, over one hundred L1s have been reported as students' home languages in some school boards, none of which are English or French (Toronto District School Board, 2013) which brings forth obvious obstacles for the teachers. Interestingly, in addition to pointing out the language barrier between the students and themselves, the teachers also spoke about the challenge of teaching the academic language of science to ELLs. A number of teachers spoke about how in order to succeed in science, students have to learn the scientific ways of thinking and operating. These findings reveal that teachers seem to be familiar with theories of language acquisition by Cummins (1979) which show the distinction between the everyday language (BICS) and academic language (CALP) and the time that it takes to master the academic genre of language for all students, especially ELLs.

Teachers in this study also pointed out a lack of time as a challenge in the diverse science classroom. These findings are in line with previous studies by Reeves (2006) and Walker et al. (2004) who found that a lack of time was a challenge commonly brought forward by the teachers in their research. Interestingly, the participants in Reeves's (2006) study had a positive and welcoming attitude toward ELLs but claimed that they did not have enough time to meet ELLs' needs. In contrast, those who cited a lack of time as a challenge in Walker et al.'s (2004) study had largely negative attitudes toward ELL inclusion in their mainstream classrooms. Even though it was not brought up by all the teachers I interviewed, a few spoke about large class sizes as an additional challenge. These findings are in alignment with Lee and Fradd (2008) who have stated that large class sizes may be a particular challenge faced by teachers teaching in increasingly

diverse classrooms. A large class size might exacerbate the challenge of limited time on the teachers even further. Considering that the teachers in this study had ELLs who belonged to many different backgrounds, giving individual attention to ELLs along with the rest of the students is definitely a large demand placed on the teachers.

The teachers in this study all had differing levels of ESL support for the ELLs in their classroom. Some had scheduled time with an ESL teacher while others had the option of sending their ELLs to a different school for specialized support. On average, most of the teachers had very limited ESL-specific support for their ELLs. Cummins and Early (2015) have remarked that as a result of funding restrictions, ESL support is limited in most school systems. As a result, ESL support is provided to newly arrived ELLs whose needs are more pressing than others. However, this support is temporary and does not extend to the time it takes them to acquire sufficient academic proficiency in English. Consequently, many spoke about how the mandated curriculum was largely Eurocentric and cited the lack of appropriate resources for ELLs as an additional challenge. Although the research tackling this issue directly is limited, these findings are consistent with Lee and Buxton (2008) who have remarked on the challenge of using culturally responsive curricular materials considering the state of ESL-specific resources available for teachers especially in science. The researchers claim that there is an insufficient knowledge base about the relationship between cultural values and the scientific community which results in worries about generalizing cultural stereotypes for teachers who do wish to provide culturally responsive pedagogy in their classrooms. The researchers further remark that linguistically speaking, the extant curriculum materials in other languages are not only limited but are also incommensurate with the current state of English language use in that

the type of language used in these resources is outdated. Moreover, new and innovative curriculum materials that are developed by research communities are not likely to be translated into other languages. As a result, many teachers I interviewed mentioned that due to the lack of available resources, they developed their own even if they had to pay out of pocket.

Another challenge that teachers brought up was that of the difference in perspective on issues in science between ELLs and themselves. The concept of inquiry which is at the cornerstone of science teaching in Ontario is quite difficult for many ELLs to negotiate due to their unfamiliarity with it as a result of their previous educational experiences. In particular, Julian spoke about how a number of ELLs in his class, as a result of their previous school culture, looked to him as the expert in science who would provide them with the *one* right answer. These findings are commensurate with Lee and Fradd (1998) who have noted that "Students from cultures that respect authority may be receptive to teachers telling and directing them, rather than to inquire, explore, and seek alternative ways" (pp. 16-17).

Roles of a Science Teacher

The second sub-question asked how the teachers in this study perceived their role as a science teacher. A few of the roles mentioned by the teachers included being a language teacher in addition to a content teacher, developing a knowledge base about ELLs' cultures and languages, activating their prior knowledge as well as being a bridge between the science classroom and the outside world.

During the interviews, a few teachers stated that they considered themselves as language teachers in addition to being content teachers. However, not every teacher

necessarily believed that it was their responsibility to provide language instruction to ELLs in their classroom in addition to providing science instruction. These findings are in line with a study by Coady et al. (2011) in which content teachers largely felt inefficacious to teach language to ELLs. The researchers claim that their low efficacy in this aspect "may be linked to a sense of discomfort in assuming the traditional role of a language teacher" (p. 235). Aubrey was one teacher who believed that her ELLs' language learning was a more appropriate task for the language arts or ESL teacher and did not quite see it as her personal responsibility as a content teacher. Her belief could be linked to the fact that as a novice teacher, she had not yet had the opportunity to accumulate enough mastery experiences in terms of teaching ELLs. Cummins and Early (2015) agree that it is not realistic to expect content teachers to become specialist language teachers. However, the authors do state that content teachers can learn to identify the particular linguistic characteristics of the language in the specific subject they teach so that they can increase their ELLs' awareness of them. Hence, it could be predicted that Aubrey may begin to think of herself as a language teacher in addition to being a content teacher with increasing teaching experience.

The teachers who I interviewed were quick to mention that acquiring adequate knowledge about their students including their cultures and language backgrounds was their primary role as educators. They mentioned that learning about the students' cultural and linguistic backgrounds was a gateway to understanding how they learned. This finding is commensurate with previous research which shows the importance of doing so (Ryu, 2015; Gay, 2002; Howard, 2010; Siwatu, 2007; Cummins & Early, 2015). Lee and Fradd (1998) have remarked that doing so can help teachers to discover the

commonalities that exist within the differences that their students bring into the classroom. Fehr and Agnello (2012) have remarked that it is essential to know all different types of diversity because "each type of diversity creates its own culture" (p. 34). This finding is also in accordance with the tenets of culturally responsive pedagogy theory. Researchers including Ryu (2015) and Gay (2000, 20002) have stated that developing a diversity knowledge base is the first step toward providing culturally responsive pedagogy. The importance that the teachers in this study placed on learning about their students' cultural and linguistic backgrounds echoes previous research which shows how developing a knowledge base about their students' backgrounds can help teachers understand how the students will learn (Howard, 2010). These findings were not only limited to teachers who were multilinguals themselves. Howard (2010) among other researchers has pointed out that a willingness in learning about their students' backgrounds was more essential than having a shared background with them. The teachers who I interviewed agreed that acquiring a cultural diversity knowledge base can further aid them in activating their students' prior knowledge on particular topics in science. These findings are in alignment with previous research which acknowledges that all students bring their prior knowledge gathered during experiences in their homes and communities to school and that learning occurs best when their prior knowledge intersects with the new knowledge they learn in the classroom (Lee & Fradd, 2008; Lee & Buxton, 1998).

The teachers also considered bridging the classroom and the outside world for their students as one of their roles as educators. These findings are in alignment with a number of researchers who have remarked on the importance of bridging in-class

learning to the broader context (Lee & Fradd, 1998; Aikenhead, 2001). Aikenhead (2001) has noted that the realm of science education is indeed an entirely different culture with which the nonmainstream students cannot identify and it is the role of the teacher to help all students navigate between the classroom and the outside world. If the students cannot connect the world of science with the world outside the classroom then achieving academic success will not be easy for them.

Negotiating Diversity in Pedagogy

The third sub-question dealt with negotiating aspects of diversity within the curriculum and instruction in the science classroom. The main findings in this section showed the teachers' perspective on how they dealt with controversy in the science classroom and how they included the ELLs' languages and cultures within the curriculum and instruction. I discuss these three findings in light of the theory and literature in this section.

In this study, the teachers acknowledged the nature of controversy on a number of topics in science. The interview data found that each of the teachers was sensitive and made accommodations for those students who did not have the same perspective on certain topics of contention in science (e.g., the creation-evolution debate). These findings are aligned with Lee and Fradd (1998) who have stated that "Cultivation of the scientific world view, while recognizing and respecting alternative views, requires a great deal of sensitivity and consideration for both teachers and students" (p. 18). As a result of their empathy and understanding of differing cultural views, the teachers in this study could be called what Lee and Buxton (2008) have termed "multicultural science educators" (p. 126). According to the authors, the universal view of science consists of

rigid scientific tenets that transcend language and culture and posit science as culturally empty while a multicultural perspective rejects the universality of science and views it as a social and cultural construction which allows for the voices and traditions of the nonmainstream groups (Lee & Buxton, 2008). As I have presented in the previous chapter, even when the teachers (e.g., Julian, Debra, Alicia) did not agree with some of the students' viewpoints, they evaluated them based on their ability of effective reasoning and justification for their perspective rather than on the views themselves.

In relation to the use of ELLs' home languages in the classroom, two important findings emerged in terms of: (a) allowing ELLs to use their L1 to learn the content and (b) the teachers' use of ELLs' L1 as greetings. First, with regards to allowing ELLs to use their L1 to learn content, there was a contrast between the interview and survey responses. The interview participants were open about permitting the ELLs to use their L1 in the classroom as evidenced by their comments in Chapter 5. Many acknowledged the importance of ELLs using their home languages in any way that they could to understand the content. However, the overall mean score on the corresponding survey item which read "I encourage ELLs to use their first language (L1) to define and understand content-specific terms and phrases" was considerably low (M = 5.99, SD = 3.00). It is possible that teachers are well-intentioned about allowing ELLs to use their L1 but unfortunately, good intentions regarding issues of culturally- and linguistically-inclusive practices do not necessarily have an impact on the students' learning (Gay, 2000). This contradiction reveals the possibility that teachers may think of ELLs' use of their L1 to learn content as a good idea in theory but may be unsure toward its practice. This finding can be contextualized within the research on the nature of beliefs which

points out the difference between belief and knowledge in that belief is based upon appraisal and judgement while knowledge is based on empirical fact. In this case, teachers who were interviewed seem to be knowledgeable about the importance of maintaining their ELLs' L1 in theory but might still hold the belief that ELLs should restrict their use of L1 in the classroom.

This finding is also in accordance with a number of previous studies in which participants held negative beliefs about the use of ELLs' L1 in the classroom (Lee & Fradd, 1998; Walker et al., 2004; Lucas et al., 2015; Lee & Oxelson, 2006; Webster & Valeo, 2011). A study by García-Nevarez et al. (2005) shows that mainstream teachers were against using students' L1 for instructional purposes and had most negative attitudes toward using and teaching the L1 in the class. They believed that elementary grades should be taught exclusively in English and that English should be the language taught in the curriculum to all students. It is possible that the teachers in this study may be unsure about the role of L1 in the learning of L2 in the classroom. This belief is in contrast with various theories of language acquisition which state that using the L1 in the classroom does not prevent ELLs from learning the L2 and in fact, the use of L1 can be even more beneficial toward L2 learning and SLA (Cummins, 1979). However, it is interesting to note that many teachers who were interviewed in this investigation acknowledged how ELLs feel a sense of pride when their L1 is utilized in the classroom. This finding is incommensurate with Dooly's (2005) study in which the teachers did not see incorporating the ELLs' L1s as a positive factor contributing to the students' self-confidence in the classroom. Interview data have shown that some teachers did believe that the use of ELLs' L1 is beneficial for every student in the classroom including those

who belong to different linguistic backgrounds. The teachers' beliefs are also in line with Lee and Fradd (1998) who have remarked that in addition to ELLs, using various languages in the classroom can benefit other students who may be proficient speakers of English and/or belonging to other language groups.

A second finding in terms of the ELLs' L1 was related to the teachers' use of their L1s to greet them if they were able to. The corresponding survey item which reads "I greet English Language Learners with a phrase in their native language if I am able to" had the lowest overall mean of 4.36 (*SD* = 3.03). Previous research looking at teachers' use of the ELLs' L1s in the classroom have yielded various results. A study by Walker et al. (2004) has shown that dominant societal attitudes about diversity could be the source of the teachers' own perceptions on this issue. While most of the teachers did not speak to me about their personal beliefs on linguistic diversity in particular as well as about using multiple languages in their classrooms, it is possible that their personal opinions on the issue might be the reason for their low efficacy and their uncertainty to use their ELLs' L1. It is a possibility that the teachers in this study are more lenient toward allowing their ELLs use their L1 to learn the content but are unsure about attempting to speak a few words and phrases in another language in the classroom to greet their ELLs.

Many teachers cited the large number of L1s in their classroom as the reason for not using them to greet their ELLs; some stated that they found it overwhelming to learn so many languages while others stated that using one L1 might lead to ignoring the others. Although it is possible, this finding does not necessarily prove that the teachers consciously avoided using their ELLs' L1 because they did not believe in inclusion, practicing culturally responsive pedagogy or had negative attitudes toward diversity.

Other findings have already shown their open-mindedness and enthusiasm about the inclusion of diverse cultural and linguistic elements as discussed in the previous sections. For instance, a major finding of this study was the high priority that the teachers placed on the importance of learning about their students' cultural and linguistic backgrounds in order to provide appropriate instruction. Howard (2010) has claimed that at the heart of culturally responsive pedagogy lies the willingness on the part of the teachers to learn about the students' cultural and linguistic backgrounds. The teachers in this study seemed more than willing to understand their ELLs' backgrounds. However, this might be one particular topic that warrants further investigation. This finding is in line with Siwatu's (2007) study in which he claims that while a global self-efficacy score may show teachers' overall self-efficacy, it does not identify the specific areas in which teachers require more support. Also, Coady et al. (2011) make a recommendation involving "a need to increase teachers' knowledge of and competence in the use of students' home languages as resources for communication, connection, and instruction" (p. 237).

Findings also show how teachers incorporated aspects of the ELLs' cultures into their pedagogy. A number of the participants spoke about the importance of discovering the sources of their students' knowledge so they could include appropriate cultural elements in their teaching. This finding is corroborated by the corresponding high-scoring survey items which read "I use my students' cultural background to make learning meaningful" ($M = 7.13$, $SD = 2.21$) and "I use my students' prior knowledge of science to help make sense of new information" ($M = 8.09$, $SD = 1.47$). This finding is in line with Lee and Fradd (1998) among others who have stressed the importance of creating a bridge between students' cultural knowledge and the new knowledge. Teachers also

spoke about how bringing students' prior experiences to the classroom could result in rich learning in the science classroom. Another interesting finding was that the teachers were quick to mention the different ways in which they drew on their ELLs' cultures in their instruction. They spoke enthusiastically about how including scientists from their ELLs' home countries and celebrating cultural festivals rouses a sense of pride within the ELLs. However, the corresponding survey item which reads "I teach students about their cultures' contributions to science if content and context permit" had a very low overall mean (M = 5.17, SD = 2.72). This contradiction shows that similar to their views of including the ELLs' L1 in the classroom, the teachers may think of including their cultures in curriculum and instruction as effective in theory but overall, feel a low sense of efficacy in terms of doing so. As discussed in Chapter 5, interview findings show that teachers made it a point to include cultural markers from their ELLs' backgrounds. These findings can be viewed in light of culturally responsive pedagogy in that theorists warn practitioners against reducing the concept to mere name-dropping and tokenism. While a mention of cultural aspects from the ELLs' home countries may be validating experiences for them, they do not necessarily equate to good pedagogical practices. Ladson-Billings (1995) as well as Boutte et al. (2010) have mentioned that the main goal of culturally responsive pedagogy is the academic success of all students which goes well beyond simply affirming their cultures and languages.

Overall, teachers' beliefs about incorporating the ELLs' cultures and languages in the classroom are diverse depending on the individual. There are also inconsistencies regarding their survey item scores and the comments on related topics during the interviews. However, it is worth reiterating that teachers in this study are dedicated

professionals who are passionate about teaching. Even though they might have low self-efficacy in terms of providing culturally responsive pedagogy and may not be sure about how exactly to incorporate their ELLs' languages and cultures in the curriculum and instruction, a number of other findings have shown that they are heading in the right direction. Most of the teachers placed importance on learning about their ELLs' backgrounds. A number of them also made attempts to create their own inclusive resources for their students. Many also mentioned the research they undertake before introducing many of the topics in their classrooms. Despite the overwhelming nature of diversity in Ontario classrooms, this study points to the fact that generally speaking, teachers in this study are doing their best to provide targeted instruction to all students, including ELLs.

Summary

In this chapter, I discussed the main findings of this research in light of the theoretical framework and relevant literature. In the first section, I addressed the findings related to the first research question. I discussed issues regarding teachers' overall self-efficacy perceptions to teach in diverse classrooms. I also addressed the sub-questions which asked whether teachers' self-efficacy perceptions were correlated with demographic factors such as the grade-level they taught, their linguistic background as well as the amount of teaching experience they had. The next section of this chapter discussed the research findings related to the second research question looking at teachers' self-efficacy perceptions on teaching practices in terms of general pedagogy and culturally responsive pedagogy. The last section discussed findings related to the third research question which asked about teachers' attitudes toward diversity and ELL

inclusion in their classroom. I also addressed findings of the sub-questions including the challenges that teachers faced, how they perceived their role as science teachers as well as how they negotiated aspects of cultural and linguistic diversity in their curriculum and instruction. In the next chapter, I conclude this dissertation by providing a summary of the major findings, discussing the limitations and implications of this study as well as making recommendations for future research in this field.

CHAPTER 7 CONCLUSION

Introduction

The purpose of this study was to examine Ontario's science teachers' self-efficacy perceptions to teach in diverse classrooms. In the previous chapters, I have examined the theoretical framework, relevant literature, methodology, research findings as well as a discussion of the findings. In this chapter, I reprise each of the research questions and briefly discuss the major findings. Then, I discuss the implications that this study has for various stakeholders as well as state the limitations of this research. After providing recommendations for future research, I conclude this dissertation. This chapter is divided into the following five sections: (a) a summary of the major findings, (b) implications of the study, (c) limitations of the study, (d) recommendations for further research and (e) concluding remarks.

Summary of Major Findings

Three research questions guided this study. The first research question asked about teachers' self-efficacy perceptions to teach in diverse classrooms. The participants' overall self-efficacy mean score on the survey was 7.20 (*SD* = 1.07). However, item-specific scores show that teachers had the highest efficacy in terms of using a variety of teaching methods such as visual aids and the lowest self-efficacy regarding using ELLs' L1 in the classroom to greet them. The findings of the sub-questions show that there were no statistically significant differences in teachers' overall self-efficacy perceptions regardless of whether they were: (a) elementary or secondary teachers, (b) monolingual or multilingual teachers or (c) novice or experienced teachers. These findings are in line with previous research showing that teachers' demographic characteristics do not have a

significant impact on their self-efficacy perceptions (e.g., Flores & Smith, 2008). The findings are also in alignment with previous research especially in terms of showing that since self-efficacy beliefs are largely stable, there is no correlation between self-efficacy and teaching experience. Also, even though the sample in this study was limited, it responded to the call of including teachers from diverse cultural and linguistic backgrounds. Although the findings cannot be generalized across all contexts, they do show that multilingual teachers did not necessarily have an enhanced sense of self-efficacy to teach in diverse classrooms.

The second research question focused on exploring if there were any differences in teachers' self-efficacy perceptions on specific teaching practices related to general pedagogy as opposed to those related to culturally responsive pedagogy. Upon careful perusal of the survey, there were 18 items that dealt with general pedagogy and 22 with culturally responsive pedagogy. The findings showed that with an overall mean of 8.06 (SD = 0.59) on teaching practices involving general pedagogy compared to a mean of 6.50 (SD = 0.83) on items of culturally responsive pedagogy, teachers' perceptions of self-efficacy on general pedagogical teaching practices were much higher. Results from t-tests further show that the overall difference was in fact, statistically significant. These findings are in line with research suggesting that teachers are unsure of enacting specific culturally responsive practices in the classroom considering the lack of knowledge and resources they have as well as the large disconnect between theory and practice (Boutte et al., 2010).

The third research question broadly asked about teachers' attitudes toward diversity. Interview data show that overall, teachers felt positively about having ELLs in

their classrooms. However, a closer examination of the survey data found that even though teachers may have open-minded attitudes toward ELL inclusion, they had low efficacy especially in terms of involving ELLs' cultures and languages in the classroom thus creating an inconsistency in their overall beliefs about ELLs. These findings are in accordance with a number of research studies showing inconsistencies in teachers' attitudes regarding aspects of diversity (Walker et al., 2004; Reeves, 2006). Findings also brought forth information about the challenges that teachers faced with regards to teaching in culturally and linguistically diverse classrooms as well as how they perceived their role as science teachers. Additionally, findings revealed that teachers may be unsure about how exactly to negotiate aspects of culture and language within the curriculum and instruction.

Implications of the Study

The findings from this investigation have implications for: (a) teachers, (b) school boards and (c) research and theory. First, teachers must realize that as our classrooms become culturally and linguistically diverse, aspects of curriculum and instruction must mirror the diversity and be appropriately inclusive. Consequently, it is important to know if ELLs' cultures and languages are not affirmed in the curriculum, instruction and pedagogical practices, this could have a direct impact on their performance. Second, it is important that teachers examine their underlying beliefs regarding student diversity in the classroom. This study has shown that even though overall, teachers had positive attitudes toward diversity, their attitudes about incorporating their ELLs' L1s and cultures in the classroom are inconsistent. Regardless of whether their attitudes are positive or negative, beliefs affect their self-efficacy which in turn influences student performance in the

classroom. Third, theories of L2 acquisition also show that allowing ELLs to use their L1 in the classroom will not prevent them from learning English. In fact, using their L1 could enhance their L2 learning even further. However, having said that, ELLs' languages and cultures should not only be affirmed for the sake of doing so and that proper culturally responsive pedagogy that leads to academic success for all students should be provided. Teachers who are motivated to provide culturally responsive pedagogy in the classroom should not feel discouraged if they do not share a cultural and linguistic background with their students. A shared background is not a prerequisite for being able to provide culturally responsive pedagogy to ELLs and that their willingness in wishing to include ELLs' cultures and languages is more important than a common background between themselves and their students. I have discussed a number of examples (e.g., Aikenhead, 2001; Boutte et al., 2010) of how culturally responsive pedagogy can be enacted in the classroom in Chapter 2.

I also offer two suggestions for school boards based on this research. As this study has shown, teachers have a significantly higher self-efficacy on general pedagogy than they do in terms of culturally and linguistically responsive pedagogy. The findings clearly reflect the lack of preparedness teachers feel about providing culturally responsive pedagogy in the classroom. Previous research has shown that there is a gap between culturally responsive pedagogy theory and its practice and as a result, teachers have a number of misconceptions regarding culturally responsive pedagogy (Boutte et al., 2010). First, school boards should look into making inclusive pedagogical resources available for teachers. Through the teachers' voices, this study brought a concern about the lack of appropriate resources to the fore. Research has shown that resources that are available are

outdated and incommensurate with the current educational objectives (Lee & Buxton, 2008). Even though there are numerous resources that can be found on many ministry webpages (e.g., www.edugains.ca), the teachers in this study cited a lack of resources as one of the challenges, regardless. Perhaps, the resources need to be disseminated and distributed in more effective ways. Second, school boards should be more open and welcoming toward researchers wishing to conduct research in this area. More research would highlight the specific areas in which school boards need to provide diversity training to their teachers.

There are a few implications for research and theory as well. First, this study answered the call to study teachers from diverse backgrounds by including 41 multilingual teachers. However, the findings show that teachers' multilingual backgrounds do not necessarily result in an increased self-efficacy to teach in diverse classrooms. Perhaps this call made by previous researchers needs to be reconsidered. Second, an abundance of research on teachers' self-efficacy looks at preservice teachers due to the ease of recruitment and inservice teachers are very rarely studied (Levin, 2015; Gay, 2015). In spite of the challenges in participant recruitment, this study still ventured into studying inservice teachers. One resulting recommendation that I make is to urge researchers to endeavour into areas that may be difficult to navigate. Only then, can we, as a research community study issues of importance that are of concern in the field.

Limitations of the Study

There were a number of restrictions posed on this study including control over participation, access to the research sites as well as the amount of data that was collected. I had applied to six school boards out of which only two boards accepted my application

to conduct research with their teachers. Even though the staff at both of these boards (which had over 80 schools each) had forwarded my letter of information to all of their teachers on a number of occasions, I did not receive the expected quantity of data. Also, a number of elementary and secondary school boards across Ontario went on strike for a number of months during the course of this study thus, limiting the amount of participation even further. I had also made requests to the school boards to attend their professional development sessions to recruit teachers personally but I was not allowed to do so. More data would have led to a greater sample size overall as well as more even participation in the sub-groups[44].

Issues related to technology may also have posed a few limitations on this research. It is possible that I may have lost a few survey respondents due to the abrupt decommissioning of the online web platform on which my survey could be found before I transferred it onto the new web portal[45] as required by the university. The participants that had the letter of information prior to March 31, 2015 only had access to the survey on the old platform which had become inaccessible at that point. Consequently, it is plausible that I failed to collect many interested participants' responses due to their inability to access the survey. Since this survey was anonymous and confidential and hence, did not ask for any participants' contact information, there was no way of contacting any of them in order to provide the revised online address of the new survey webpage.

[44] Recall that the teaching experience group had 11 novice while 62 experienced teachers.

[45] See Chapter 3 for more information.

There are limitations posed by the methodology as well. The survey that was administered to the teachers consisted of 13 questions which gathered demographic information in addition to the 40-item adapted CRTSE survey (Siwatu, 2007). Initially, the plan was to investigate the perceptions of culturally responsive teaching outcome expectancy (CRTOE) in addition to self-efficacy through an additional 26-item survey (Siwatu, 2007). Studying outcome expectancy would have helped in understanding the concept of self-efficacy more fully. However, a reason that the first school board rejected my research application was that two surveys (in addition to a demographic questionnaire) would be too time consuming for the teachers considering their professional schedules. As a result, in order to prevent further rejection from other school boards, I chose to eliminate the CRTOE survey.

Recommendations for Further Research

There are multiple avenues for future research in this area. First, in terms of studying teachers' self-efficacy, research studies could incorporate classroom observations in order to see the difference between teachers' self-appraisal and the actual enactment of those teaching practices. Observing teachers in the classroom would help explain contradictions that arise between theory and practice. This could also lead researchers to develop more effective self-efficacy measurement tools.

Consistent with much of the previous research, this study did not find statistically significant correlations between teachers' overall self-efficacy perceptions and the grade-level they taught, their linguistic backgrounds and teaching experience. However, it is possible that other aspects of teachers' identities correlate with their self-efficacy perceptions. Future research should consider examining the correlation between self-

efficacy and issues such as the teachers' level of education (e.g., undergraduate and graduate degrees), their experiences in the teacher education programs (e.g., teacher education at a Canadian university as opposed to an international university) as well as the teaching context (e.g., classrooms in urban as opposed to rural areas). Further research on self-efficacy is also warranted in terms of different times within a teacher's career. For instance, a longitudinal study could be designed which measures teachers' efficacy in their first year of teaching, after five years of experience and after ten years of teaching experience.

A final area of further research that I recommend would be to examine self-efficacy perceptions of teachers teaching other content subjects such as Mathematics, History and Social Studies. Similar to science, each subject brings with itself its own set of complications, especially for ELLs. It would be interesting to examine the self-efficacy perceptions of these teachers as well. In addition to content teachers, examining the self-efficacy perceptions of language teachers (e.g., ESL and FSL teachers) would also make for interesting research.

Concluding Remarks

The purpose of this research was to examine the self-efficacy perceptions of Ontario's science teachers to teach in diverse classrooms. The study sought to answer three research questions relating to teachers' self-efficacy perceptions and the correlation between demographic factors and self-efficacy, a comparison between self-efficacy on general pedagogy and culturally responsive pedagogy as well as teachers' attitudes toward diversity. This investigation was situated within the theoretical framework of self-efficacy (Bandura, 1997) and culturally responsive pedagogy (Gay, 2000) as well as

amidst literature in the area of teachers' beliefs, teachers' self-efficacy perceptions, teacher preparedness, teachers' attitudes toward diversity and ELL inclusion as well as science education in diverse classrooms. Broadly speaking, this study has revealed three main findings: (a) The grade-level taught by the teachers, their own linguistic profile as well as teaching experience have no correlation with their self-efficacy perceptions, (b) Teachers have a considerably high sense of self-efficacy in terms of teaching practices involving general pedagogy as opposed to culturally responsive pedagogy and (c) There is a discrepancy between teachers' overall positive attitude toward diversity and specific beliefs about the use of ELLs' L1 and culture in the classroom.

Despite the limitations of this study, this research has attempted to fill a number of gaps in the field and has contributed to the existing literature in many ways. First, this research responds to the call to investigate the self-efficacy perceptions of inservice teachers as opposed to preservice teachers (Gay, 2015). Second, this research also heeded the call to study diverse participants in terms of language backgrounds (Levin, 2015) as well as teaching experience (Putman, 2012). Third, considering the importance of studying self-efficacy in specific contexts, domains and tasks, this study has been geographically contextualized in Ontario, involved teachers of science and has studied their self-efficacy perceptions in terms of providing culturally and linguistically responsive pedagogy. In addition to adding to the extant literature, this study has also outlined implications for a number of different stakeholders. Overall, this study has presented a unique perspective on the topic of teachers' self-efficacy perceptions and it is my hope that this research serves as a starting point for further research in this field.

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APPENDICES

Appendix A Survey Questionnaire

Survey Questionnaire

Section A: Background Information

(1) What is your gender? MALE FEMALE

(2) In which country were you born? _____

(3) In which country were you raised? _____

(4) In which country were you educated (Elementary/Middle/Secondary)?

_____ (Specify each country if different)

(5) In which country did you acquire your teaching certification (B.Ed)?

_____

(6) To which of the following groups do you belong?

(a) I was born, raised and educated in Canada. I have a Bachelor of Education degree from a Canadian university.

(b) I was born, raised and educated outside Canada. I have a Bachelor of Education degree from an institution outside Canada but I have completed my teacher certification process which qualifies me to teach in Canada.

(c) I was born in Canada but I have received some or all of my education including my teaching degree outside Canada but I am now qualified to teach in Canada.

(d) I was born elsewhere but I came to Canada at a young age and have received my education including teacher certification in Canada.

(e) None of these apply to me. Please specify:

_____

(7) For how long have you been teaching science? ____ years

(8) What grade level do you teach?

___ Elementary ___ Middle ___ Secondary

(9) How many science classes are you teaching this year? ____ classes

(10) How many students do you teach in total? ____ students

(11) How many years of teaching experience do you have? ____ years

(12) Approximately, how many ELLs are in your class? ____ students

(13) How many languages do you speak? (Please list each language) _____

Section B: Culturally Responsive Teaching Self-Efficacy (CRTSE) Scale

Please judge your capabilities to engage in the following teaching practices in the science classroom on a scale of 0 meaning *no feelings of self-efficacy* to 10 meaning *high feelings of self-efficacy*.

(1) I adapt instruction to meet the needs of my students

(2) I obtain information about my students' academic strengths and weaknesses

(3) I determine whether my students like to work alone or in a group

(4) I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture

(5) I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture

(6) I assess student learning using various types of assessments

(7) I obtain information about my students' home life

(8) I build a sense of trust in my students

(9) I establish positive home-school relations

(10) I use a variety of teaching methods such as visual aids

(11) I develop a community of learners when my class consists of students from diverse backgrounds

(12) I use my students' cultural background to help make learning meaningful

(13) I use my students' prior knowledge of science to help them make sense of new information

(14) I identify ways how students communicate at home may differ from the school norms

(15) I obtain information about my students' cultural background such as their L1 or mother tongue

(16) I teach students about their cultures' contributions to science if content and context permit

(17) I greet English Language Learners with a phrase in their native language if I am able to

(18) I design a classroom environment using displays that reflects a variety of cultures

(19) I develop a personal relationship with my students

(20) I identify ways that standardized tests such as the EQAO may be biased towards linguistically diverse students

(21) I communicate with parents regarding their child's educational progress

(22) I structure parent-teacher conferences so that the meeting is not intimidating for parents

(23) I help students to develop positive relationships with their classmates

(24) I revise instructional material to include a better representation of cultural groups

(25) I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes

(26) I model classroom tasks to enhance English Language Learners' understanding

(27) I communicate with the parents of English Language Learners regarding their child's achievement

(28) I help students feel like important members of the classroom

(29) I identify ways that standardized tests such as the EQAO may be biased towards culturally diverse students

(30) I use a learning preference inventory to gather data about how my students like to learn (e.g., are they visual, linear, kinesthetic or auditory learners?)

(31) I use examples that are familiar to students from diverse cultural backgrounds

(32) I obtain information regarding my students' academic interests

(33) I use the interests of my students to make learning meaningful for them

(34) I implement cooperative learning activities for those students who like to work in groups

(35) I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (e.g., using a potluck dinner analogy to teach digestion)

(36) I understand that English Language Learners' cultural beliefs regarding certain scientific concepts may differ from my own (e.g., the evolution-creation debate)

(37) I give students the opportunity to improve their proficiency in English in my science class

(38) I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts

(39) I repeat content-specific terms and phrases multiple times so that English Language Learners can comprehend them better

(40) I encourage English Language Learners to use their first language (L1) to define and understand content-specific terms and phrases

(41) Are you willing to participate in a 30-minute follow-up interview with me? If so, please provide your phone number or email address in the textbox provided.

Yes_____ No

Appendix B Interview Questionnaire

(1) Are you aware of the ELLs' linguistic and cultural backgrounds? Do you think it is important for you to, as a teacher, to get to know your ELLs' cultural background and linguistic backgrounds?

(2) Are you aware of their differing levels of proficiency?

(3) How do you perceive your role as a science teacher other than being a content teacher?

(4) Do you consider it important to build on your students' prior knowledge with the new knowledge they learn in your science class? How do you do that?

(5) How do you deal with controversial issues in science such as the evolution-creation debate? What do you do when your ELLs' knowledge on certain issues is deeply rooted in their culture which may be different from here? Do parents ever come to see you about topics of controversy?

(6) Please describe your classroom to me. What does your classroom look like?

(7) How do you infuse elements of language and culture in the curriculum and instruction?

(8) Do your expectations change for ELLs as opposed to proficient speakers? Do you make accommodations and/or modifications?

(9) Are you aware of your students' specific learning styles? How do you manage to cater to each student's differing ways of learning?

(10) Do you think diverse classrooms pose challenges especially for science teachers?

(11) What challenges do you think aspects of diversity such as language and culture pose to teaching science? What would you say is the biggest challenge?

(12) What challenges do you think aspects of diversity such as language and culture pose to learning science for ELLs?

(13) You rated yourself as _____ on the adapted CRTSE survey item(s). Would you explain your reasoning?

(14) During your Bachelor of Education program, were there any courses on teaching diverse classrooms offered at your institution? If so, did you take any? Did they prepare you adequately to teach in diverse classrooms?

(15) Do you have any recommendations for Bachelor of Education programs?

Appendix C Original CRTSE Survey

(1) I adapt instruction to meet the needs of my students

(2) I obtain information about my students' academic strengths

(3) I determine whether my students like to work alone or in a group

(4) I determine whether my students feel comfortable competing with other students

(5) I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture

(6) I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture

(7) I assess student learning using various types of assessments

(8) I obtain information about my students' home life

(9) I build a sense of trust in my students

(10) I establish positive home-school relations

(11) I use a variety of teaching methods

(12) I develop a community of learners when my class consists of students from diverse backgrounds

(13) I use my students' cultural background to help make learning meaningful

(14) I use my students' prior knowledge to help them make sense of new information

(15) I identify ways how students communicate at home may differ from the school norms

(16) I obtain information about my students' cultural background

(17) I teach students about their cultures' contributions to science

(18) I greet English Language Learners with a phrase in their native language

(19) I design a classroom environment using displays that reflects a variety of cultures

(20) I develop a personal relationship with my students

(21) I obtain information about my students' academic weaknesses

(22) I praise English Language Learners for their accomplishments using a phrase in their native language

(23) I identify ways that standardized tests may be biased towards linguistically diverse students

(24) I communicate with parents regarding their child's educational progress

(25) I structure parent-teacher conferences so that the meeting is not intimidating for parents

(26) I help students to develop positive relationships with their classmates

(27) I revise instructional material to include a better representation of cultural groups

(28) I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes

(29) I design a lesson that shows how other cultural groups have made use of mathematics

(30) I model classroom tasks to enhance English Language Learners' understanding

(31) I communicate with the parents of English Language Learners regarding their child's achievement

(32) I help students feel like important members of the classroom

(33) I identify ways that standardized tests may be biased towards culturally diverse students

(34) I use a learning preference inventory to gather data about how my students like to learn

(35) I use examples that are familiar to students from diverse cultural backgrounds

(36) I explain new concepts using examples that are taken from my students' everyday lives

(37) I obtain information regarding my students' academic interests

(38) I use the interests of my students to make learning meaningful for them

(39) I implement cooperative learning activities for those students who like to work in groups

(40) I design instruction that matches my students' developmental needs

Appendix D Modifications to the CRTSE Survey Questionnaire

The table below illustrates the modifications made to Siwatu's (2007) CRTSE survey questionnaire.

Original CRTSE Survey Items (40)	Modifications
(1) I adapt instruction to meet the needs of my students	No change
(2) I obtain information about my students' academic strengths	(2) I obtain information about my students' academic strengths *and weaknesses* I have combined item (2) with item (21) which says 'I obtain information about my students' academic weaknesses'. Item (21) will be removed from this survey
(3) I determine whether my students like to work alone or in a group	No change
(4) I determine whether my students feel comfortable competing with other students	Removed
(5) I identify ways that the school culture (e.g., values, norms and practices) is different from my students' home culture	No change
(6) I implement strategies to minimize the effects of the mismatch between my students' home culture and the school culture	No change
(7) I assess student learning using various types of assessments	No change
(8) I obtain information about my students' home life	No change
(9) I build a sense of trust in my students	No change
(10) I establish positive home-school relations	No change
(11) I use a variety of teaching methods	(11) I use a variety of teaching methods *such as visual aids*

	I have added "such as visual aids" to clarify the item further
(12) I develop a community of learners when my class consists of students from diverse backgrounds	No change
(13) I use my students' cultural background to help make learning meaningful	No change
(14) I use my students' prior knowledge to help them make sense of new information	(14) I use my students' prior knowledge *of science* to help them make sense of new information
	I have added "of science" to make it more domain-specific.
(15) I identify ways how students communicate at home may differ from the school norms	No change
(16) I obtain information about my students' cultural background	(16) I obtain information about my students' cultural background such as their L1 or mother tongue
	I am adding 'such as their L1 or mother tongue'
(17) I teach students about their cultures' contributions to science	(17) I teach students about their cultures' contributions to science *if the content and context permit*
	I am adding 'if the content and context permit'
(18) I greet English Language Learners with a phrase in their native language	(18) I greet English Language Learners with a phrase in their native language *if I am able to*
	I have added "if I am able to" to contextualize this item.

(19) I design a classroom environment using displays that reflects a variety of cultures	No change
(20) I develop a personal relationship with my students	No change
(21) I obtain information about my students' academic weaknesses	Will be removed since combined with (2)
(22) I praise English Language Learners for their accomplishments using a phrase in their native language	Will be removed
(23) I identify ways that standardized tests may be biased towards linguistically diverse students	No change
(24) I communicate with parents regarding their child's educational progress	No change
(25) I structure parent-teacher conferences so that the meeting is not intimidating for parents	No change
(26) I help students to develop positive relationships with their classmates	No change
(27) I revise instructional material to include a better representation of cultural groups	No change
(28) I critically examine the curriculum to determine whether it reinforces negative cultural stereotypes	No change
(29) I design a lesson that shows how other cultural groups have made use of mathematics	Will be removed since same as item (17)
(30) I model classroom tasks to enhance English Language Learners' understanding	No change
(31) I communicate with the parents of English Language Learners regarding their child's achievement	No change
(32) I help students feel like important members of the classroom	No change
(33) I identify ways that standardized tests may be biased towards culturally diverse students	No change
(34) I use a learning preference inventory to	(34) I use a learning preference inventory to gather data about how my

gather data about how my students like to learn	students like to learn *(For instance, are they visual, linear, kinesthetic or auditory learners)* I am adding '(34) I use a learning preference inventory to gather data about how my students like to learn (For instance, are they visual, linear, kinesthetic or auditory learners)'
(35) I use examples that are familiar to students from diverse cultural backgrounds	No change
(36) I explain new concepts using examples that are taken from my students' everyday lives	Removed
(37) I obtain information regarding my students' academic interests	No change
(38) I use the interests of my students to make learning meaningful for them	No change
(39) I implement cooperative learning activities for those students who like to work in groups	No change
(40) I design instruction that matches my students' developmental needs	Removed
(a) I am mindful when using Canadian cultural metaphors as analogies to teach scientific concepts (For instance, using a potluck dinner analogy to teach digestion)	Added
(b) I understand that ELL's cultural beliefs regarding certain scientific concepts may differ from my own (For instance, the evolution-creation debate)	Added
(c) I give students the opportunity to improve their proficiency in English in my science class	Added
(d) I am mindful when using illustrations or metaphors from mainstream popular culture (including movies, television and music) as analogies to teach scientific concepts	Added

(e) I repeat content-specific terms and phrases multiple times so that ELLs can comprehend them better	Added
(f) I encourage ELLs to use their L1 to define and understand content-specific terms and phrases	Added

Appendix E Letter of Information

EXPLORING THE PRECEPTIONS OF SELF-EFFICACY OF ONTARIO'S SCIENCE TEACHERS TO TEACH IN DIVERSE CLASSROOMS

LETTER OF INFORMATION

My name is Mithila Vidwans and I am a PhD candidate at the Faculty of Education at Western University. I am currently conducting research into Science teachers' perceptions regarding teaching in a diverse classroom and would like to invite you to participate in this study.

The aims of this study are to understand Ontario's Science teachers' perceptions of preparedness to teach Science in diverse classrooms which include a substantial number of English Language Learners (ELLs). This study comprises of two parts: (1) A survey questionnaire and (2) An interview.

If you agree to participate in this study you will be asked to complete an online survey (approximately 20 minutes) which asks for your opinion about your perceived level of preparedness to teach Science in diverse classrooms. If you require paper copies of the survey, please contact me. You will be invited to participate in an interview which will last for 30 minutes which will be audio-recorded and later transcribed into written form. If you participate in the survey, you are not obligated to participate in the interview. The online survey can be accessed here: [redacted]

The information collected will be used for research purposes only, and neither your name nor information which could identify you will be used in any publication or presentation of the study results. All information collected for the study will be kept confidential and all the data will be stored in a password-protected computer which will only be accessed by me. You will not be identified by name in any reports of the research.

There are no known risks to participating in this study.

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your employment status.

If you have any questions about the conduct of this study or your rights as a research participant you may contact the Manager, Office of Research Ethics, Western University at [redacted] or [redacted]. If you have any questions about this study, please contact me; Mithila Vidwans at [redacted] or [redacted] or my thesis supervisor [redacted] at [redacted] ext [redacted] or [redacted]

This letter is yours to keep for future reference.

Thank you!

Mithila Vidwans

Appendix F UWO Ethics Approval

Western Research

Research Ethics

Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Dr. Farahnaz Faez
Department & Institution: Education/Faculty of Education,Western University

NMREB File Number: [redacted]
Study Title: Exploring the Perceptions of Self-Efficacy of Ontario's Science Teachers to Teach in Diverse Classrooms
Sponsor:

NMREB Initial Approval Date: June 03, 2014
NMREB Expiry Date: December 31, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Letter of Information & Consent	Please find attached: (1) Letter of Information inviting Science teachers to participate in the study. (2) Consent form for surveys which will be signed by Science teachers willing to participate in the survey (3) Consent form for interview which will be signed by Science teachers willing to participate in the interview	2014/04/16
Instruments	Survey instruments & Interview questionnaire	2014/05/05
Revised Western University Protocol	Please find attached the ethics protocol in PDF (Clean copy)(Sections 2.2 and 4.3 modified)	2014/06/02
Revised Letter of Information & Consent	Please find attached the Letter of Information in PDF (Clean copy)	2014/06/02

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB[redacted]

[redacted]

Ethics Officer to Contact for Further Information

[redacted]

This is an official document. Please retain the original in your files.

Appendix G UWO Ethics Approval Amendment

Western Research

Research Ethics

Western University Non-Medical Research Ethics Board
NMREB Amendment Approval Notice

Principal Investigator: Dr. Farahnaz Faez
Department & Institution: Education\Faculty of Education,Western University

NMREB File Number: [redacted]
Study Title: Exploring the Perceptions of Self-Efficacy of Ontario's Science Teachers to Teach in Diverse Classrooms
Sponsor:

NMREB Revision Approval Date: April 08, 2015
NMREB Expiry Date: June 03, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Instruments	Survey Questionnaire	2015/02/26
Revised Western University Protocol		2015/02/26

The Western University Non-Medical Science Research Ethics Board (NMREB) has reviewed and approved the amendment to the above named study, as of the NMREB Amendment Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB[redacted]

[redacted]

Ethics Officer to Contact for Further Information

[redacted]

This is an official document. Please retain the original in your files.

Western University, Research, Support Services Bldg., Rm. 5150
London, ON, Canada N6G 1G9 t. 519.661.3036 f. 519.850.2466 www.uwo.ca/research/ethics

Appendix H Board A Ethics Approval

[redacted]

Mithila Vidwans
1137 Western Road
London, Ontario
N6G 1G7

December 19th, 2014

Dear Ms. Vidwans;

RE: Exploring the Perceptions of Self-Efficacy of Ontario's Science Teachers to Teach in Diverse Classrooms
DECISION: Approved; further documents requested

The Research Advisory Committee (RAC) has reviewed your study and subsequently requested some additional documentation in conjunction with granting approval. *This study may proceed at this time; however the RAC requests additional items to be included in your application.*

- An interview protocol / script submitted in writing
- A brief paragraph to serve as the body of an email invitation out to potential participants, to be sent directly to secondary science teachers from a member of the Research Advisory Committee
- An information letter to participants to be submitted as a separate document so that it may be included as an attachment to an email invitation to potential participants

In addition, in keeping with the details of our telephone conversation on December 19th, 2014, we will be focusing our recruiting efforts on science teachers in secondary schools only. Given the upcoming school holiday, we will work to get the invitation out to secondary teachers in the first few weeks of the New Year.

On behalf of the Research Advisory Committee, thank you for submitting your research proposal. Once the clarifications outlined above have been addressed, please submit them directly to the Research Advisory Committee, care of [redacted] (email address listed below), where we will append them to your original application. If you have questions about the conditions of this approval, or require any further information, please do not hesitate to contact me directly. All the best as you move forward in your research.

Sincerely,

[redacted]

Appendix I Board B Ethics Approval

[redacted]

[redacted]

[redacted]

Mithila Vidwans
1137 Western Road
London, ON
N6G 1G7

March 24, 2015

Dear Ms. Vidwans

This letter is to confirm that research approval has been granted to your project entitled *"Exploring the Perceptions of Self-Efficacy of Ontario's Science Teachers to Teach in Diverse Classrooms."*

The Research Advisory Committee at the [redacted] reviewed the proposal and the survey instruments provided. Elements of your proposed research fit nicely with our [redacted] teachings and improvement of student achievement.

Your Letter of Information will be distributed to the potential participant pool via [redacted] Curriculum Consultant, Any changes to this letter should be sent to her immediately. Please connect with [redacted] if you have any questions about the distribution.

If there is any significant change in research activities, or timelines please notify [redacted] (Research Officer, Research and Development Services [redacted]

One copy of the final report and an executive summary of the research results should be sent to my office, when the study has been completed.

Please feel free to contact me, if I can be of any further assistance.

Sincerely,

[redacted]

[redacted]

[redacted]

[redacted]

CURRICULUM VITAE

MITHILA VIDWANS

EDUCATION

Degree	Discipline	University	Year
Doctor of Philosophy (PhD)	Curriculum Studies & Studies in Applied Linguistics	The University of Western Ontario	2016
Master of Education (MEd)	Curriculum Studies	The University of Western Ontario	2011
Bachelor of Arts (Hons).	English Literature & Sociocultural Anthropology	University of Toronto Mississauga	2009

SCHOLARSHIPS AND AWARDS

Year	Scholarship/Award	Amount
December 2015	Ontario Student Opportunity Grant (OSOG)	$7,770
June 2015	The British Association for Applied Linguistics (BAAL) Students/Early Career Researchers Scholarship	£1,000
June 2015	Faculty of Education Conference Travel Program	$722.91
May 2015	Society of Graduate Students (SOGS) Travel Award	$175
September 2014-April 2015	Graduate Student Teaching Assignment (GSTA)	$18,180
September 2014-April 2015	Western Graduate Research Scholarship (WGRS)	$13,650
August 2014	Ontario Student Opportunity Grant (OSOG)	$4,940
June 2014	Faculty of Education Conference Travel Program	$70.51
June 2014	Faculty of Education Conference Travel Program	$532
March 2014	Inclusive Education Research Award	$750
February 2014	Faculty of Education Conference Travel Program	$376.21

April 2013	Faculty of Education Conference Travel Program	$600
January 2013	Society of Graduate Students (SOGS) Travel Award	$245.48
September 2012-April 2013	Western Graduate Research Scholarship (WGRS)	$13,650
September 2012	Canadian Association of Applied Linguistics (CAAL/ACLA) Travel Grant	$196.02
September 2011-April 2012	Western Graduate Research Scholarship (WGRS)	$13,650
December 2011	Textbook & Technology Grant	$150
September 2011	Canadian Association of Applied Linguistics (CAAL/ACLA) Travel Grant	$400
September 2011	Society of Graduate Students (SOGS) Travel Award	$300
July 2011	Ontario Student Opportunity Grant (OSOG)	$5,300
August 2010	Ontario Student Opportunity Grant (OSOG)	$5,250
December 2006	Ontario Access Grant	$1,052

RESEARCH EXPERIENCE

Date	**Position**	**Institution**
September 2014-April 2015	Research Assistant PI: Dr. Farahnaz Faez Research Project: Subject-Specific Vocabulary and Expressions of Academic Subjects: A Corpus-Based Case Study of Mathematics	The University of Western Ontario
January 2014-April 2014	Research Assistant PI: Dr. Farahnaz Faez Research Project: Subject-Specific Vocabulary and Expressions of Academic Subjects: A Corpus-Based Case Study of Mathematics Research Project: Measuring Teacher Efficacy to	The University of Western Ontario

	Teach English Language Learners (ELLs) in Mainstream Classrooms	The University of Western Ontario
September 2013-December 2013	Research Assistant PI: Dr. George Gadanidis Research Project: science as Performance Art in K-8 Classrooms	
September 2012-April 2013	Research Assistant PI: Dr. Farahnaz Faez Research Project: Subject-Specific Vocabulary and Expressions of Academic Subjects: A Corpus-Based Case Study of Mathematics Research Project: Content and Language Integrated Instruction (CLIL) Research Project: Teaching Subject-Specific Language to English Language Learners (ELLs) Research Project: Globalization and English Dominance around the Globe Research Project: Teaching English as a Second Language (TESL) Professionals' Engagement with Research	The University of Western Ontario
September 2011-April 2012	Research Assistant PI: Dr. Farahnaz Faez Research Project: Teaching Subject-Specific Language to English Language Learners (ELLs)-Common European Framework of Reference (CEFR) and English Language Portfolio (ELP) Based Instruction Research Project: Globalization and English Dominance across the Globe Research Project: Novice Teaching English as a Second Language (TESL) Professionals	The University of Western Ontario
October 2010	Research Assistant PI: Dr. Karen Bird Research Project: Voter Turnout among Immigrants and Visible Minorities	McMaster University

UNIVERSITY TEACHING EXPERIENCE

Term	Position	Course	Department	Institution
Winter 2015	Instructor	ED5413S Introduction to Teaching English as a Second Language (ESL)	Teacher Education Program, Faculty of Education	The University of Western Ontario
Fall 2014	Instructor	ED5413Q Introduction to Teaching English as a Second Language (ESL)	Teacher Education Program, Faculty of Education	The University of Western Ontario

SELECTED CONFERENCE PRESENTATIONS (REFEREED)

Vidwans, M. (2016, April). *Investigating Canadian teachers' self-efficacy perceptions to teach science in diverse classrooms.* Paper presented at the American Association for Applied Linguistics (AAAL) Conference, Orlando, Florida, April 9-12.

Vidwans, M. (2015, November). *Investigating science teacher efficacy & preparedness in Ontario's diverse classroom contexts*. Paper presented at the18th Bilingual Workshop in Theoretical Linguistics (BWTL), the University of Western Ontario, London, Ontario, November 20-21.

Vidwans, M. (2015, September). *An exploration of Canadian teachers' self-efficacy perceptions to teach in diverse classrooms.* Paper presented at the British Association for Applied Linguistics' (BAAL) 48th Annual Meeting, Aston University, Birmingham, United Kingdom, September 3-5.

Vidwans, M. (2015, June). *Examining Ontario's science teachers' self-efficacy perceptions and preparedness to teach in diverse classrooms.* Paper presented at the Canadian Society for the Study of Education (CSSE) Annual Conference in conjunction with the Congress of the Humanities and Social sciences, University of Ottawa, Ottawa, Ontario, May 30-June 3.

Vidwans, M. & Faez, F. (2015, March). *Science teachers' self-efficacy perceptions to teach in diverse classrooms*. Paper presented at the joint American Association for Applied Linguistics (AAAL) and Canadian Association of Applied Linguistics (CAAL/ACLA) 2015 Conference, Toronto, Ontario, March 21-24.

Vidwans, M. (2014, May). *Exploring the self-efficacy perceptions of Ontario's science teachers to teach diverse classrooms.* Paper presented at the Annual Canadian Association of Applied Linguistics (CAAL/ACLA) Conference in conjunction

with the Congress of the Humanities and Social sciences, Brock University, St. Catherines, Ontario, May 26-28.

Faez, F. & **Vidwans, M.** (2014, May). *Teacher efficacy to teach English Language Learners (ELLs) in mainstream classrooms.* Roundtable presented at the Canadian Society for the Study of Education (CSSE) Annual Conference in conjunction with the Congress of the Humanities and Social sciences, Brock University, St. Catherines, Ontario, May 25-28.

Vidwans, M. & Faez, F. (2014, April). *Science Teachers' self-efficacy perceptions to teach in Ontario's diverse classrooms.* Poster presented at the Celebrating Linguistic Diversity Annual Conference, Ontario Institute for Studies in Education (OISE), Toronto, Ontario, April 30-May 2.