TEACHERS’ PERSPECTIVES ON CULTURALLY DIVERSE CLASSROOMS AND RESPONSIVE SCIENCE AND MATHEMATICS TEACHING

by

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Abstract

This study focused on investigating Kindergarten to Grade12 (K-12) teachers’ perspectives about the effects of students’ cultural diversity on their science and mathematics teaching and their perspectives and understandings of culturally responsive teaching. Largely informed by the principles of qualitative case study approach, this investigation employed phenomenographic methods including individual teacher interviews and informal observations of select science and mathematics classrooms for data collection and analysis. Participants included ten teachers from Vancouver, a major urban city in Western Canada.

A synthesized theoretical framework of (trans-multi)culturally responsive education comprising of critical and transformational multicultural education perspectives and complementing notions of culturally responsive teaching served as a guiding lens to analyze and interpret the data. Two research questions were addressed: 1) What are K-12 teachers’ perspectives about the effect of cultural diversity on their science and mathematics teaching? 2) What are the teachers’ understandings of and perspectives on culturally responsive teaching as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms? Key findings illustrate that: 1) teachers described students’ cultural diversity as a mosaic as well as a strength and a challenge; 2) teachers recognized the level of English language competency as one of the key systemic factors compounding the challenges associated with students’ cultural diversity; 3) lack of culturally relevant resources, support and training serve as an impediment to teachers’ successful integration of Indigenous knowledges in their science and mathematics classrooms; 4) teachers’ perspectives of science and mathematics, cultural diversity, and Canadian culture were full of contradictions; and 5) teachers’ understandings of culturally
responsive teaching and its manifestation in their classrooms were diverse and full of conundrums.

The findings have implications for future research on how teachers’ perspectives of students’ cultural diversity influence their expectations of culturally diverse students’ engagement and achievements, and their assessment practices in science and mathematics classrooms. The findings also demand further research focusing on whether teaching the content of science and mathematics limits teachers’ pedagogical responsiveness where they may merely “talk the walk” of multicultural education without realizing the actual potential of students’ and communal funds of knowledges in their diversity-rich classrooms.
Lay Summary

This study explored ten K-12 teachers’ perspectives on how their students’ cultural diversity influences science and mathematics teaching in Vancouver classrooms. The teachers were also asked if they utilize culturally responsive methods while teaching science and mathematics in their classrooms. The teachers were interviewed individually, and their science and mathematics classrooms were observed to help put their perspectives in context. The findings of the study indicate many complexities that teachers face while teaching science and mathematics to their culturally diverse students. The findings illustrate that teachers’ understandings of students’ cultural diversity and responsive teaching are contradictory.

The results raise questions of how initial teacher preparation/training and ongoing professional development on various dimensions of cultural diversity are designed and implemented. Further research is needed to explore how teachers’ perspectives on students’ diversity influence their assessment practices. Research is also needed to explore whether teachers merely “talk the walk” of multicultural education.
Preface

The research reported in this dissertation was designed, conducted, and analyzed by the author with guidance from the Supervisory Committee. A part of Chapter 4 has been accepted for publication in the Alberta Science Education Journal (Raisinghani, In press). A part of Chapters 1 and 2 has been published in peer reviewed journals (Raisinghani, 2016a; 2016b). The preliminary findings of the study were presented and received the Best Graduate Student Paper award by the Canadian Society for the Study of Education (Canadian Association for Curriculum Studies and Science Education Research Group) conference 2016 (Raisinghani, 2016c). This research study has been approved by the University of British Columbia Research Ethics Board (UBC Behavioural Ethics Board Number: H14-03230).


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List of Abbreviations

BC: British Columbia
BCTF: British Columbia Teachers’ Federation
CRT: Culturally responsive teaching
EAL: English as an Additional Language
ELL: English Language Learners
ESL: English as a Second Language
K-1: Combined Kindergarten and Grade 1 classroom
K-12: Kindergarten to Grade 12
NOS: Nature of Science
PTC: Parent Teacher Conferences
STEM: Science, Technology, Engineering and Mathematics
TEK: Traditional Ecological Knowledge
UBC BREB: University of British Columbia Behavioural Research Ethics Board
UBC: University of British Columbia, Vancouver, British Columbia, Canada
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Dedication

I dedicate this Dissertation to:

**My parents**

My late father (Professor) **Prem Mangharam Raisinghani**, who inculcated in me the belief that the greatest wealth in the world is education. Papaji used to say that “Education is the ‘Greatest wealth because it can never be stolen—once you earn it, no one can take it away from you and the more you share the more it grows”. Papaji encouraged me to become “selectively permeable” like a cell membrane which allows only “good things” to enter and gets rid of the “bad things”. I dedicate this dissertation to you papaji— you are and will always be alive in my heart, mind and in spirit.

My mother **Mrs. Mohini Prem Raisinghani**, who taught me how to stand up after each fall, and who cultivated in me, a curious mind. When I came back from school, rather than asking “What did you learn today”; I remember mummy you asked: “Did you ask any good questions today?” I dedicate this dissertation to you mummy, who let me be “me” and who has been always there in my moments of self-doubt and agony!

**And my students**

Whose questions served as a source of inspiration to begin (re)searching (trans-multi)culturally responsive education. I dedicate this dissertation to my all students whose lived experiences in multiple cultural contexts have played a central role in shaping me as a teacher-learner-researcher. You are my soul mates in this journey of teaching, learning and living education through life!
Chapter 1: Introduction

This study investigated the perspectives of ten teachers about the effect of cultural diversity on their science and mathematics teaching and on culturally responsive teaching (CRT). A primary purpose was to discern whether they perceive CRT as a viable strategy for teaching science and mathematics to diverse student populations in Vancouver, an urban city in Western Canada.

Perspectives are defined as “a co-ordinated set of ideas and actions a person uses in dealing with some problematic situation” (Becker, Geer, Hughes, & Strauss, 1961, p. 34). Hence, perspectives involve reflection and evaluation of phenomena, and are influenced through one’s belief system comprising of values, culture, and experiences of the world (Namazzi, 2015). Since, perspectives involve one’s thoughts and actions; I acknowledge that the participating teachers’ perspectives in this study are informed through their varied experiences of teaching science and mathematics to students of diverse cultural backgrounds.

1.1 Background and Rationale for the study

The presence of more than 200 ethnic groups with immigrants accounting for 20.6% of the total population makes cultural diversity an indispensable characteristic of life in Canada, and makes multicultural education an essential requirement in Canadian classrooms (Freiler et al., 2012, July; Statistics Canada, 2013, May 8). Indeed, student populations are increasingly becoming culturally diverse in urban centers across Canada, and many teachers have identified dealing with cultural diversity as a key challenge in their classrooms (McGahey, 2012, January 31).
According to Putnam (2007), ethno-cultural diversity reduces social solidarity as it produces fear and deters people from associating with others. Hence, it is not surprising that students’ diversity produces a significant concern among Canadian teachers, who find themselves in need of acquiring highly specific skills to address and manage diversity in their classrooms (Allan, 2012). Literature shows that often students coming from diverse cultural backgrounds encounter discrepancies between their lived home and school experiences (Allen & Boykin, 1992; Henry, 1994; 2010; 2017). Such discrepancies are more evident in science and mathematics because these subjects are often taught as unambiguous, repeatable facts that are devoid of any cultural connections (Barba, 1998; García, 2002; Gay, 2002b).

Given the fact that these cultural discrepancies may greatly impact students’ ability to learn and achieve (Nicol, Archibald, & Baker, 2010; Nieto, 2000a), teachers are always in search of ways that could help them in making learning of these subjects comprehensible and relevant (Gay, 2002b; Nashon, Anderson, & Nielsen, 2009). However, many of them have been largely unsuccessful in transforming the traditional curricular and pedagogical strategies of science and mathematics into inclusive practices that are culturally responsive (Barton, 1999; 2000; Egbo, 2009; Gay, 2010b).

Furthermore, the Canadian multicultural education policy officially framing Canadian national identity within the English-French bilingual language discourse along with the unique nature of Canadian multiculturalism across provinces makes it harder for teachers to adopt CRT (Gill & Chalmers, 2007; Henry, 2017). Complicating the notions of cultural diversity in Canada, the apolitical, liberal-humanist versions of multiculturalism has resulted in schools that have become sites of isolation and social injustices because they are poorly equipped to deal with existing student diversity (Ghosh & Abdi, 2013; Kirova, 2008; Moodley, 1995).
Acts of racism that are covertly and overtly embedded in schools (Ghosh, 2008), perpetuate notions of standardized Whiteness as the norm by subjugating other cultures and treating them as inferior or primitive (Giroux, 2001; 2005; hooks, 1994). This forces many students to ignore their own subjectivity by taking “a vow of silence” (Henry, 1994, p. 316). Existing discriminatory arrangements in contemporary school systems, which continue to disenfranchise many students, make responding to students’ diversity one of the biggest challenges for teachers (Ainscow, 2008; McGahey, 2012, January 31).

Addressing the issues of cultural diversity has been an exclusive goal of multicultural education in Canada since its inception (Joshee, Peck, Thompson, Chareka, & Sears, 2016). Considering the fact that teaching practices are influenced by teachers’ beliefs about students’ cultural diversity and about cultural integration in science and mathematics (Gay, 2010a; 2010b; 2013; 2015), further research that investigates teachers’ perspectives is necessary. Literature is replete with studies informing CRT in multiple cultural contexts (For example, Boyer, 2006; Chu & Garcia, 2014; Daniel, 2016; Graue, Delaney, & Whyte, 2014; Gunn, Brice, & Peterson, 2014; Gutstein, 2010; Harding-DeKam & Ben-Peretz, 2014; Lipka, Wildfeuer, Wahlberg, George, & Ezran, 2001; Lipka et al., 2005; Lipka, Sharp, Adams, & Sharp, 2007; Nelson-Barber & Trumbull, 1995; Owens, 2015; Yazzie-Mintz, 2007). Very few studies inform CRT in urban Canadian contexts (Henry, 2017). Hence, it is important to investigate teachers’ perspectives about the effects of students’ cultural diversity and the viability of CRT as a strategy for teaching science and mathematics in their diversity-rich classrooms.

1.2 Research Questions

To reiterate, this study investigated teachers’ perspectives on cultural diversity and CRT in science and mathematics classrooms. The study largely draws upon principles of qualitative
case study approach (Merriam, 1988; 1998; Stake, 1995; 2000; Yin, 2014), and utilizes phenomenographic methods (Marton, 1981; 1986; 2015) for data collection and analysis. A (trans-multi)culturally responsive education framework, which was informed by the critical and transformational multicultural education perspectives (Keating, 2007; Nieto, 2000a) and Gay’s (2010b) notion of culturally responsive teaching served as a guiding lens to analyze and interpret the data.

The research questions guiding the study were:

1) What are K-12 teachers’ perspectives about the effect of students’ cultural diversity on their science and mathematics teaching?

2) What are the teachers’ understandings of and perspectives on culturally responsive teaching as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms?

1.3 Significance

Despite research on preparing teachers for multicultural education, there has been little research published on multicultural Science teacher education (Seiler, 2013). Moreover, literature shows that most studies have investigated pre-service teachers’ perspectives regarding cultural diversity and CRT in different contexts (Atwater, Freeman, Butler, & Draper-Morris, 2010; Kahn, Lindstrom, & Murray, 2014; McGee, 2014; Nieto, 2003; 2005; Obidah & Teel, 2001; Sleeter, 2001; 2008; Sleeter & Cornbleth, 2011; Teel & Obidah, 2008). Not many have explored the perspectives of in-service teachers in urban Canadian contexts, and Canadian literature on the issue is scarce (Henry, 2017). This partially reflects an American influence on Canadian teacher education research and practice (Van Nuland, 2011).
Insights developed through this study are necessarily in dialogue with the understandings of teachers in wider Canadian and other international societal contexts that value multicultural, intercultural and cross-cultural educational perspectives.

1.4 Terminology

I briefly state below the key definitions that I hold as a researcher as these understandings have informed my thoughts and actions while interacting with the teachers, and while analyzing perspectives throughout the research process.

1. **Perspectives** are “a co-ordinated set of ideas and actions a person uses in dealing with some problematic situation” (Becker et al., 1961, p. 34). In this dissertation, I have used the term perspectives based on the classic definition of Becker, Greer, Hughes, and Strauss (1961), which indicates that perspectives “refer to a person’s ordinary way of thinking and feeling about and acting in such a situation” (p. 34).

2. **Culture** is a dynamic, complex process and an evolving product of human interaction within a particular time and space that is influenced and shaped by temporal politics and distributions of social power (Banks, 2010; Bhabha, 1994; Goodenough, 1976). In this study, I have exclusively used the term culture to denote a way of life which comprises of consciously and unconsciously learned patterns of behaviour, including non-verbal behaviour and language, values, modes of thinking and meaning making, rhetoric and perceptual norms, and socio-political elements of identity that continually evolve as one interacts with Others in processes of living life.

3. **Cultural Diversity** includes all cultural experiences that students bring into school. These may include beliefs, community background, family structure, home influences, language, learning styles, gender norms and norms of sexuality, socioeconomic status, values,
exceptionalities and associated “special needs” and dis/abilities (S. Lee, 2010). Thus, in this dissertation, I refer to cultural diversity as an encompassing aspect of one’s identity, which is influenced, but not limited, by “family, community, geographical location, designations of race and ethnicity, language, strong interest affiliations, religion, gender, and sexual orientation” (Horowitz et al., 2005, p. 114).

4. **Culturally Diverse Students** may be recognized differently in different socio-political cultural contexts and this may lead to contested and different understandings of culturally diverse students. However, as per the inclusive understandings of cultural diversity, culturally diverse students in this dissertation include all students who may be diverse based on their cultural backgrounds, ethnicity, class, gender, race, sex, religion, sexual orientations, dis/ability or other exceptionalities. Other than the instances when it is used by a participant, I have used the term “dis/ability” with a slash to highlight the fact that disabilities lie in the environment and not in the person. I believe that we all might find ourselves able or disabled under certain environments. Thus, in this dissertation, I have used cultural diversity in an inclusive manner where this term may refer to students of non-dominant groups who are often marginalized, the term logically includes every student.

5. **Students with “Special needs” or Exceptional Students**, both terms are used synonymously in the literature to denote students who have been identified as the students with Ministry designation. The Vancouver School Board has identified these students as Special Education Learners having “special needs” (Vancouver School Board, 2014a; 2014b). In the wider literature around inclusive education, students with “special needs” have been recognized as students with exceptionalities (Lupart & McKeough, 2009). Thus, in this dissertation, I have used both terms synonymously, but I acknowledge that the term “special
needs” does not fully reflect the inclusivity desired in contemporary classrooms. Therefore, wherever possible, I have used the terms “exceptional students” or “students with exceptionalities” to identify students with Ministry designation as these terms more closely resonate with culturally responsive education and reflect the inclusivity desired in a classroom that is responsive to the needs of its diverse students.

6. **Science**, guided by Dewey’s (1929) notion, refers to “systematic methods of inquiry” (p. 8). I acknowledge that Science is a socially and culturally constructed human activity, which can serve as a powerful tool for understanding the world around us, as well as in making it a better place to live and learn by identifying and dismantling social inequities (Bishop, Clarkson, & Presmeg, 2008; Esmonde, 2014; Hodson, 2010; 2011; Mukhopadhyay & Roth, 2013). **Mathematics** refers to a “tool of conceptual thought” for learning science (Nashon, 2006, p. 6). Hence, the capitalized term **Science** in this dissertation includes mathematics and specific science subjects such as Biology, Chemistry, Physics, and other General sciences that are usually taught as separate content entities in schools.

### 1.5 Researcher’s Background and Positionality

As a science teacher, teacher educator, and a member of the community of educational researchers, I strive to inspire “education for life” by finding ways that could help contextualize learning by integrating multiple ways of knowing and diverse lived experiences of students in teaching. Over the course of more than fourteen years of my teaching career in multiple cultural contexts, I have witnessed many culturally diverse students feeling alienated and longing for a sense of belonging in several classrooms. I found this sense of isolation and need for belonging more pervasive in science and mathematics classrooms, as these subjects are often taught as abstract, factual bodies of Eurocentric, Westernized, high-status knowledge. I have attempted to
capture the unspoken voice of many of these culturally diverse students in my following poem that was published as part of my paper in the *Journal of the Canadian Association of Curriculum Studies* (Raisinghani, 2016a, p. 185):

### 1.5.1 Longing for Belonging: Unspoken Voice of a Learner

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who am I? What do I know?</td>
<td>Unaccomplished…Lifeless…</td>
</tr>
<tr>
<td>Would you like to know?</td>
<td>Useless…Unwanted…</td>
</tr>
<tr>
<td>Would you like to care?</td>
<td>I feel like the Dust…that is</td>
</tr>
<tr>
<td>Mesmerized in y(our) (W)esternized World…</td>
<td>bound to be left (thrown)</td>
</tr>
<tr>
<td>Do you see my perplexity…?</td>
<td>My soul…my thoughts…my</td>
</tr>
<tr>
<td>Understand my fear…?</td>
<td>cultural ways of knowing …</td>
</tr>
<tr>
<td>Today’s schooling…</td>
<td>All these I have to wipe out…</td>
</tr>
<tr>
<td>technicalized teaching…</td>
<td>on the doormat…leave them</td>
</tr>
<tr>
<td>scored testing…</td>
<td>outside… at the door…</td>
</tr>
<tr>
<td>measured successes…</td>
<td>Cultureless!</td>
</tr>
<tr>
<td>Uniformity, excellence…</td>
<td>I have to become…</td>
</tr>
<tr>
<td>standardized achievements…</td>
<td>If I want to belong…in this</td>
</tr>
<tr>
<td>Strangers’ sciences…</td>
<td>acultural classroom?</td>
</tr>
<tr>
<td>mathematical abstractions…</td>
<td>I long for belonging…</td>
</tr>
<tr>
<td>How do I compete…</td>
<td>And grieve for my knowledge…</td>
</tr>
<tr>
<td>where do I stand?</td>
<td></td>
</tr>
<tr>
<td>Is that all…All that matters?</td>
<td>Is it learning…Learning for Life?</td>
</tr>
</tbody>
</table>

This PhD research is a continuation of my ongoing efforts through which I continue my quest of finding ways that could help in tempering this agony that many culturally diverse students endure in today’s contemporary modes of schooling. The “need to belong is fundamental and pervasive” (Baumeister & Leary, 1995; Manstead, 1997, p. 241). I believe that
creating a sense of belongingness is crucial for students’ learning because the students who do
not feel belonged and cared for in a classroom often find classroom activities meaningless,
distasteful and disengaging (Delpit, 2006; Pang, 2001). By engaging in this research with
elementary and secondary teachers in diversity-rich classrooms of Vancouver, Canada, I hope to
generate insights that could help broaden teachers’ understandings of cultural diversity,
multicultural education perspectives and CRT, and thereby, help in making the learning of
science and mathematics relevant and meaningful for many culturally diverse students in
Canadian and wider contexts.

I am aware of the complexities involved in my engagement with this research as I reflect
on my own positionality as an (in/out)sider in this research as well as the associated power
dynamics inherent in this engagement. As Merriam et al. (2001) notes: “The insider’s strengths
become the outsider’s weaknesses and vice-versa”— an insider is unusually considered to have
advantages of “easy access, the ability to ask more meaningful questions and read non-verbal
cues, and...to project a more truthful, authentic understanding of the culture [phenomena] under
study.” Unfamiliarity resulting in curiosity and privilege to ask, “taboo questions” and retain
remote confidentiality, gives an outsider a benefit of being considered less inherently culturally
biased (p. 411).

Being a science teacher and teacher educator with experiences of teaching at the middle
and secondary school levels as well as at the undergraduate college and university levels, I
consider myself as an insider. I am aware of the dynamics and every day challenges involved in
teaching various subjects to diverse students. My involvement as a parent in the schooling
processes of my two daughters who are studying in the participating elementary and secondary
schools as well as my engagement in school programmes as a volunteering parent, also allows me the privilege to be perceived as an insider.

My current involvement in this PhD programme as well as teaching at the University of British Columbia (UBC) and my prior teaching experience as an Associate Professor (Education and Science) in Micronesia may suggest that I am an insider. Yet my upbringing and prior education in India, being a female who has been raised in a patriarchal, male dominant culture, following a Hindu religion and a vegetarian diet (and thus unable to join teachers in their lunch when offered), and being perceived as a “visible minority”\(^1\), English Language Learner (ELL), and an international student in Canada\(^2\), make me an outsider in this research.

1.6 Dissertation Organization

This dissertation is organized into five chapters. In Chapter One, I presented a brief introduction to the study, the background and rationale, research questions, significance and my background and positionality. Chapter Two comprises a comprehensive literature review, which includes an overview of the history of multiculturalism in Canada and discusses the historical and contemporary notions of multiculturalism and multicultural education conceptualized in the Canadian context. By exploring the meaning of culture and cultural diversity that has guided this research, the need and implications of CRT are discussed. This is followed by a discussion of critical and transformational multicultural education perspectives and the notion of CRT, and

\(^1\) In Canada, a characterization recognizing non-European immigrants (Ghosh & Galczynski, 2014; Statistics Canada, 2013, May 8). Throughout this dissertation, to problematize the inherent discrimination in such characterization of people, I have used quotation marks around “visible minority” and around all other labeling terms.

\(^2\) While writing my dissertation, I have received a Permanent Resident status in Canada, and I am not sure if this makes me more of an insider now.
synthesized understandings of these perspectives in the form of a (trans-multi)culturally responsive education framework on which I grounded this research.

Chapter Three provides methodological specifics of this qualitative case study and presents the data collection and analysis methods in detail. This chapter also includes a discussion on reliability, validity, and generalizability as well as ethical considerations, significance and limitations of the study. In Chapter Four, key themes that emerged by synthesizing and triangulating the findings in relation to the study’s research questions are shared.

The final Chapter Five provides a discussion of the findings by grounding these in literature as well as by interpreting the meanings that are consistent with this study’s theoretical framework. It also includes the conclusions and implications for theory and practice in multicultural Science education and teacher education and provides recommendations for future research.
Chapter 2: Literature Review and Theoretical Framework

In this chapter, I begin with a brief overview of the history of multiculturalism in Canada and discuss the historical and contemporary notions of multiculturalism and multicultural education conceptualized in the Canadian context. Then, by reviewing the literature from a broader area of multicultural education, I present various manifestations that have evolved since its inception in North America. With an attempt to critically examine how educational exclusion and inclusion are conceptualized and constructed historically, politically, and ideologically, I then discuss the current dilemmas experienced by many students specifically in science and mathematics classrooms and share how incomplete understandings of culture and multiculturalism have limited the scope and dimensions of multicultural education in many classrooms. Considering the above discussion, I then explore the meaning of culture and share the understandings of culture and cultural diversity that have guided my research and argue for the need and implications of CRT.

The chapter concludes with a discussion of critical and transformational multicultural education perspectives as well as the notion of CRT, which have centrally informed my research as a theoretical lens. I then share my synthesized understandings of these perspectives in the form of a (trans-multi)culturally responsive education framework on which I grounded my work as a researcher while investigating and making sense of the participating teachers’ perspectives in this study.

2.1 Multiculturalism in Canada: Historical Developments - Present Situations

Recognized as one of the world’s major immigrant nations, Canada is an “ethnocultural mosaic” (Chui & Flanders, 2013; Ghosh & Galczynski, 2014). Nationally, ethnic and cultural
diversity is increasing rapidly with more than 200,000 newcomers arriving as landed immigrants each year in Canada (Beairsto & Carrigan, 2004). The make-up of the country’s multicultural society has changed over time with a shift in the source countries of immigrants from the United States of America (USA), and countries in Northern and Western Europe to countries in Asia, Latin America, and the Caribbean since the end of World War II (Joshee, 2004). The vast majority of this immigrant population is concentrated in the nation’s largest urban centers: Montréal, Toronto, and Vancouver (Chui & Flanders, 2013; Joshee et al., 2016). In 2011’s National Household Survey, nearly 20% of Canada’s population self-identified as a “visible minority” (Ghosh & Galczynski, 2014; Statistics Canada, 2013, May 8). It is estimated that by 2031, immigrants will represent between 24.5% and 30.0% of Canada’s population comprising of an increased 55.7% to 57.9% of immigrants from Asia, and a decreased percentage of European immigrants, which will range between 15.4% and 17.8% (Morency, Malenfant, & MacIsaac, 2017).

Acknowledging its immigrant and multicultural character as a nation, Canada is the first country that established a national multicultural policy in 1971 (Ghosh & Galczynski, 2014; Moodley, 1995). Formulated by the then federal Liberal government, the policy was primarily initiated in response to the report of the Royal Commission on Bilingualism and Biculturalism in 1963 and the Official Language Act of 1969, which conferred equal status to both French and English as the official languages of the Canadian Parliament and the Government of Canada (Moodley, 1995). As according to Ghosh and Galczynski (2014), the four main objectives of the policy were: (1) to support all cultural groups in developing their capacities to grow and
contribute in Canada; (2) to assist “minority” groups in overcoming cultural barriers to full participation in Canadian society; (3) to promote inter-group relations; and (4) to provide facilities to “minority” groups for language learning.

The Canadian Charter of Rights and Freedoms was established in 1982 (Ghosh & Abdi, 2013). Later in 1988, Parliament passed Bill C-93, the Canadian Multiculturalism Act, a federal law, which promoted the preservation and enhancement of multiculturalism in Canada. Emphasizing diversity as a key component of moral, social, and political order in Canada, this law included a provision for funding mainstream institutions such as police forces, hospitals, and schools to implement multicultural policies and programmes aimed at ensuring equal opportunity for all Canadians by reducing barriers to access (Hyman, Meinhard, & Shields, 2011).

The core of the Canadian multicultural policy stresses the value of Canada as a “family of the nation,” emphasizing the cultural maintenance of its “mosaic, social fabric” (Kirova, 2008, p. 119). Once recognized as the “world’s most successful pluralist society” (Fleras, 2009, p. 55), Canadian multiculturalism ostensibly believes in an inclusive and tolerant society that allows different cultural groups to maintain their unique cultural identities while participating and contributing equally in a unifying national Canadian identity (Fleras & Elliott, 2002). Recognizing and valuing the contributions of all cultural groups as crucial for the nation’s success, the Canadian multicultural policy celebrates this diversity through a positive acceptance of races, religions and cultures, and invites the integration of ethnic identities with the Canadian national identity (Kymlicka, 2010).

I acknowledge that the term “minority” is politically charged and incomplete. Following Ghosh & Galczynski (2014), in this dissertation, I have included it whenever it was used as such in the original sources to indicate people who have been historically and socio-culturally marginalized.
However, since its inception, the official multicultural policy has been greeted with mixed reactions, and realities differ from rhetoric. The meek plea to share ethnic cultures with the rest of Canadian society does not seem sufficient to sublimate the fear of undermining national unity by diverse cultural groups that are often involved in ethnocentric efforts to sustain their ethnic and cultural identities (Fleras, 2009; Moodley, 1995). The racism of the “cultural mosaic” is consistently identified by many activists and scholars. Research such as Maynard’s (2017) *Policing Black Lives* challenges prevailing rhetoric of Canadian multiculturalism by providing the realities of many African Canadians.

Aboriginal people, referring in this dissertation to all Indigenous peoples of Canada including Indians/First Nations, Inuit and Metis (Battiste, 2009), are concerned that the policy completely ignores Canada’s native population as it does not recognize their historical relationship with land and inherent treaty rights (Battiste, 2009; Ghosh & Galczynski, 2014; Kovach, 2009; L. T. Smith, 2012). The Province of Quebec, in spite of the recognition of French language as an official language, criticizes an “equalizing multiculturalism” for Francophones’ lost cultural equity (Fleras, 2009; Moodley, 1999, p. 140). Some European ethnics, especially Ukrainians, question the success of a policy promoting cultural preservation without linguistic preservation (Moodley, 1995). Continually increasing numbers of immigrants from “visible

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4 The constitutionally recognized groups of Aboriginal people in Canada only includes First Nations, Métis, and Inuit peoples, and exclude several other Indigenous groups deserving of inclusion (Y. P. Pratt & Danyluk, 2017).

5 The term Indigenous peoples in this dissertation refer to all native populations in wider international contexts and include Aboriginal people of Canada. Thus, the terms Indigenous and Aboriginal are not used as synonyms in this dissertation. Indigenous is a more inclusive term, however, the term Aboriginal is also used to respect the voices of participating teachers and the British Columbia Curricular initiatives which has identified Indigenous Knowledges of Aboriginal people of Canada as Aboriginal knowledges.
minorities” adds another dimension in Canadian multiculturalism and demands critical scrutiny in the present Canadian context (Fleras & Elliott, 2002; Fleras, 2009; Ghosh & Abdi, 2013).

Unlike the other immigrant receiving countries such as Australia, New Zealand, United Kingdom (UK), and USA, multiculturalism in Canada is quite complex. The specific demographics of the Canadian population, the breadth and diversity of the needs of culturally diverse people including the immigrants and Aboriginal people, and the constitutionalized accommodation and appropriation of diversity into Canadian national identity, make the discourse of Canadian multiculturalism, obscure (Ghosh & Galczynski, 2014; Kymlicka, 2010).

In contemporary Canadian society, which is “a kaleidoscope of overlapping and intersecting identities” (Fleras & Elliott, 2002, p. 17), where individuals’ cultural identities are fluid, hybrid patchworks of cultural differences and overlapping similarities, meanings of multiculturalism can be interpreted in multiple ways (Fleras, 2009; Ghosh, 2002; Ghosh & Abdi, 2013).

Following Conservatives’ interpretation of multiculturalism as multi-ethnic/multi-racial cultures, for many, the multicultural policy is a policy for only those who are not White. Hence, even almost half a century after the policy’s inception, the dominant groups (English and French), have remained outside of the framework of the official multicultural policy, which focused mainly on exposing mainstream Canadians to different cultural groups so that they could be accepted (Ghosh & Galczynski, 2014).

Characterizing multiculturalism as a “paradox: Not meaning what it says, [and] not saying what it means,” Fleras (2009, p. 4) has questioned, “which dimension of multiculturalism should prevail: the cultural (who decides what counts as difference, what differences count?), the social (ensuring equal treatment and treatment as equals), or the national (making society safe from difference, safe for difference)” (p. 2)? One recent example of such a quandary is Bill 60,
The Quebec Charter of Values, which was proposed to ban the wearing of religious symbols in the public sector and force private companies doing business with governments, schools, daycares, and hospitals to adhere to secular rules in Quebec (Global News Staff, 2013, November 7; Québec Official Publisher, 2013).

Extolling of cultural differences might lead to their conceptualization as a hindrance to equal access, and thereby, suggest their removal (Fleras, 2009). In fact, liberal-humanist versions of multiculturalism are “apolitical and reflect a popular yet fragmentary response to the demands of diverse groups” (Levine-Rasky, 2006, p. 88). By suppressing the “difference” to achieve “equality” and conceiving citizenship and “the common good” in a fundamental universalist manner (Blades & Richardson, 2006a, p. 1), the official doctrine of multiculturalism in Canada has failed to meet the challenges of “social cohesion and good citizenship” (Dei, 2011, p. 15). In such situations, how could we transcend an abstract multicultural discourse and recognize the vital role of schools in (re)imagining the possibilities of creating democratic global citizens (Blades & Richardson, 2006b)? How do we promote a multicultural discourse in schools that allows students to morally and ethically engage in provocative conversations to not only inquire “what does it mean to be a citizen” but more importantly to understand in what ways they could participate as agents of social change in “shared social symbolic, political and material worlds” (Blades & Richardson, 2006a, p. 5; den Heyer, 2006), while being cognizant of “what it means to be human” (D. G. Smith, 2006, p. 125) in a multicultural global society?

Revolving around the issues of immigrant integration, cultural identity, religious and linguistic diversity, and racism, multiculturalism in Canada is exclusively a concern with cultural diversity (Joshee et al., 2016). Considering that “cultural diversity is a fact of life in Canada” (Gill & Chalmers, 2007, p. 552), and the success of Canadian multiculturalism depends on
“improving our understandings of the challenges raised by this diversity” (Kymlicka, 2010, p. 24), how could we make multiculturalism a dynamic part of everyday life? Acknowledging that “education has always been seen as a key to ensuring that cultural diversity was managed properly” (Joshee et al., 2016, p. 35), what roles does multicultural education have to play in Canada’s success as a multicultural nation? I begin this query with revisiting the history of multicultural education in Canada.

2.2 Multicultural Education in Canada: Historical Underpinnings

Conceived as a response to cultural pluralism in society and informed by the federal multicultural policy, charter, and act (Ghosh & Abdi, 2013; Kirova, 2008), multicultural education in Canada has evolved through a range of interpretations of “what it is and what it should be” (Fleras, 2009; Moodley, 1995, p. 808). Significantly cross-fertilized by the prevailing practices of multicultural education and the critique of these practices in other immigrant-receiving countries such as the Australia, France, New Zealand, UK, and USA (Kymlicka, 2010; Lund, 2003), multicultural education in Canada is formally a provincial responsibility (Joshee, 2004; Joshee et al., 2016).

However, the federal programmes serve as the key directional sources to inform and shape multicultural curricular materials utilized in various provincial and territorial school systems country-wide (Joshee, 2004). Traditionally, all educational institutions in Canada are perceived to have an obligatory responsibility to promote ethno-cultural retention, appreciation of the cultural heritages of Others, and increased intergroup harmony by providing the continuity and content to the ongoing dialogue about the nature of multiculturalism and the management of diversity (Elliston, 1996; Fleras & Elliott, 2002; Fleras, 2009; Lund, 2003).
The implications of the Multiculturalism Act on education have led to two main perspectives: 1) the ethno-cultural support-service orientation, and 2) language-based view of multicultural education. This includes: Implementation of anti-racist programmes in schools; initiation of heritage language programmes; extension of Anglo-North-American traditions of English literature to a new range of voices and experiences; and the inclusion of non-European inventors, scientists and mathematicians in science and mathematics lessons (Kirova, 2008; Willinsky, 1999). The provincial autonomy in education on one hand has afforded flexibility to meet local needs but on the other hand, the differing politics across provinces has resulted in varying commitments to multicultural education both in terms of theory and practice (Ghosh, 2002; Ghosh & Abdi, 2013; Ghosh & Galczynski, 2014). In the following section, I review various understandings of multicultural education.

2.3 Multicultural Education: Multiple Perspectives

Conceptualized as “an idea or concept, an educational reform movement, and a process,” (Banks & Banks, 2010, p. 3), since its inception in the late 1960s and early 1970s, a central tenet of multicultural education is to foster greater cultural harmony and inter-cultural interactions both in schools and in wider society (May, 1999). Centralized around the ways that could provide the best educational means for addressing differential achievements of diverse students, multicultural education has evolved in multiple ways. The most cross-cutting themes of various conceptions of multicultural education could be based on typologies described by Gibson (1984), Magsino (1985) and Ouellet (1992) (as discussed by Moodley, 1995), Nieto (2000a) and (Ghosh & Galczynski, 2014) (Table 1).
Table 1 Typologies of Multicultural Education

<table>
<thead>
<tr>
<th>Multicultural Education Term</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education for an Emergent Society/Mono-cultural Option: Fusion</td>
<td>This conceptualization of multicultural education entails the reconstitution of cultural diversity into a new single national identity through fusion of all cultures, or by their assimilation into a dominant culture.</td>
</tr>
<tr>
<td>“melting pot”/Assimilation</td>
<td></td>
</tr>
<tr>
<td>Education for Cultural Pluralism</td>
<td>This liberal-humanistic, pluralistic view of multicultural education aims at cultivating acceptance, understanding and valuing of cultural differences with the goal of peaceful co-existence of various cultural groups.</td>
</tr>
<tr>
<td>Education of the Culturally Different or Benevolent Multiculturalism</td>
<td>To equalize educational opportunities, this approach of multicultural education focuses on reducing “the gap” between home and school culture by providing assistance to culturally different students to master <em>norms</em> and “official language.”</td>
</tr>
<tr>
<td>Education for Cultural Accommodation/Education about Cultural Differences or Cultural Understanding</td>
<td>To ensure equality of all groups and maintain diversity, this approach involves the inclusion of special ethnic-language instruction and cultural enrichment programmes which aim to boost self-esteem of ethno-culturally diverse groups.</td>
</tr>
<tr>
<td>Multicultural Education Term</td>
<td>Characteristics</td>
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<td>---------------------------------------------------</td>
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<tr>
<td>Education for Cultural Preservation</td>
<td>Aims at transmitting the cultures of groups whose identities are considered to be “at-risk.”</td>
</tr>
<tr>
<td>Intercultural Education</td>
<td>Emphasizes State’s role in enhancing relations between the various groups through increased opportunities for exchange and collaboration. The joint value is placed on cultural maintenance (the cultural diversity element) and equitable participation (the intercultural element).</td>
</tr>
<tr>
<td>Education for Multicultural Adaptation or Bi-cultural (Bi-lingual) Competency</td>
<td>Seeks to develop bicultural competencies among all students as a reciprocal process, encourages maintenance of “native” culture and language along with the acquisition of “mainstream” culture and language.</td>
</tr>
<tr>
<td>Antiracist or Antiracism/Anti-discriminatory Education</td>
<td>Inspired by Neo-Marxism, antiracist education emerged largely in opposition to “apolitical and folksy” orientation of multicultural education. It is a deliberate and political attempt to right wrongs through challenging individual and structural discrimination particularly based on racism and its intersection with class and gender, and through social reconstruction which seeks a society based on equity and social justice.</td>
</tr>
<tr>
<td>Multicultural Education Term</td>
<td>Characteristics</td>
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<tr>
<td>------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Critical Multicultural Education</td>
<td>Critical multicultural education aims to raise individual and group consciousness by questioning the significance or lack of significance attached to “difference” based on institutionalized unequal relations of power that are formed on the basis of gender, class, sexual orientation, race, culture, ethnicity, religion or any other markers used to discriminate people. It attempts to transform and restructure the socio-political relations of dominance and promote social justice by counteracting discrimination and ethnocentrism through challenging inequities. Critical multicultural education confronts issues of power and privilege inherent in society as well as in structures, policies and practices of schools. The ultimate goal is to empower students to bring social change that ensures equity for all.</td>
</tr>
<tr>
<td>Multicultural Education as a Normal Human Experience</td>
<td>To meet new challenges offered within the Global arena and by seeing education as a process of cultural transmission, this approach of multicultural education emphasizes acquiring multicultural competencies to function in multiple cultural contexts through transcending cultural/ethnic identities and recognizing Self and Others as multicultural human beings.</td>
</tr>
</tbody>
</table>
Despite their distinctiveness, most of the above mentioned multicultural education programmes overlap with their educational orientation located within the apolitical “consensus paradigm,” where multicultural education is often considered as “an end in itself or at best as a means to create a congenial environment” (Moodley, 1995, p. 808). Moreover, with the main focus remaining on equality for racially and ethnically diverse students, many of these programmes fail to adequately address the issues of social inequalities (Ghosh & Galczynski, 2014; Sleeter & Grant, 2003). Even the antiracist approach, with the reification of “race” — which is actually a “non-scientific, imagined construction,” — as a notion of identity, has resulted in “polarized color consciousness” and restricted fighting against injustices that are concerned with racism of Whites and Blacks (Ghosh & Abdi, 2013; Jolly, 1995; May & Sleeter, 2010; Moodley, 1995, p. 808).

However, critical multicultural education and the notion of multicultural education as a normal human experience seems to be inclusive of social justice and developing a society in which “difference is not a negative concept” (Banks & Banks, 2010; Ghosh & Abdi, 2013; Ghosh & Galczynski, 2014, p. XIII; Gibson, 1984; Grant & Sleeter, 2010). Critical multicultural education questions the cultural hegemony of “White supremacy” (Gillborn, 2005, pp. 490-492), which is perpetuated by conservative multiculturalism, and the essential emphasis on sameness based on benign pluralism. It critiques negligence of difference, a characteristic of liberal multiculturalism, which claims that we are all same because we are different, and the left-liberal treatment of multiculturalism which considers difference as an essence that exists independently of history, culture and power (Fleras, 2009; Moodley, 1995). Critical multicultural education stands against oppression that is inherent in dominant modes of schooling (McLaren, 1995; Nieto & Bode, 2010; Sleeter, 1996).
Considered as a “mirror image” of critical pedagogy (Gay, 1995; Nieto, 2000a, p. 317), critical multicultural education brings forth a new vision that recognizes “difference” as an enriching dimension rather than a disadvantage. Broadening the attention from diversity, this redefined vision of multiculturalism redefines the “norm” to include all students, i.e., students from diverse groups (identified on the basis of ethnicity, culture, race, class, gender, sexual identity, dis/ability, and exceptionalities) as well as from White dominant cultures (Ghosh & Galczynski, 2014). Disrupting the neoliberalist notion of schools as “factories” (Aoki, Pinar, & Irwin, 2005, p. 188) of “social and cultural reproduction” (Giroux, 2001, p. 235) that perpetuate systemic discrimination, critical multicultural education utilizes critical pedagogy as a “humanizing pedagogy” that attempts to raise human beings with “corpo consciente” — the “conscious being[s] of praxis” (Freire, 2000, pp. 75 & 125).

Emphasizing that education is never a neutral activity (Freire, 2000), critical pedagogy necessitates that teachers take an educational stance and recognize its ideological basis. Stressing the democratic ethos for the benefit of both the individual and the collective, critical pedagogy creates pedagogical spaces that enable the possibilities of dialogic interactions between teachers and students to acquire autonomy (Giroux, 2005). Originating from the Greek words auto (self) and nomy (rule), this autonomy establishes a reason for freedom that promotes self-discipline and self-realization of how to be in the world with “conscientization,” the critical consciousness, which emphasizes that one’s own autonomy can attain legitimacy only if one learns to respect the autonomy of others (Freire, 2004, p. 38).

Bringing forth the notion of pedagogy as an emancipatory practice, critical pedagogy demands that teachers recognize how the issues of knowledge, authority, and power embedded in relationships between teacher and students, classrooms and community, institutions, and society
influence the audience, voice, classroom instruction and assessment activities. It challenges teachers to understand the implications of their teaching on shaping their students’ lives within particular socio-political-cultural contexts (Nikolakaki, Giroux, & Freire, 2012; Pykett, 2009), and take courage to cultivate the conditions for a “just society” (Ghosh & Abdi, 2013, p. 107).

By acknowledging that all human beings are fundamentally multicultural (Egbo, 2009; Goodenough, 1976), the notion of “multicultural education as the normal human experience” (Gibson, 1984, p. 111) alleviates the tendencies to stereotypic identification based on ethnic culture and divisive binaries of native/mainstream culture. The hope is to bring social justice by opening up possibilities for fuller appreciation of cultural competencies among all students by welcoming them as “[trans-]multicultural” human beings who have varying degrees of “multicultural competence” in at least some cultures (Goodenough, 1976; Erickson, 2010, p. 37).

This broader humanistic and critical notion of multicultural education informed the theoretical framework for this research (Ghosh & Abdi, 2013; Ghosh & Galczynski, 2014; Nieto, 2000a). Targeted to reform educational environments for equity and equality for all students regardless of their gender, sexual orientation, socio-economic class, and ethnic, racial, or cultural characteristics (Banks, 1981; Gollnick & Chinn, 2013), critical multicultural education encompasses antiracist approaches and critical pedagogy as its main tenets. The goal is to empower teachers and students to challenge the “monolithic canon of traditional curriculum” through critique and transformation (Nieto, 2001, p. 48).

By broadening the attention from mere ethnocultural diversity, critical multicultural education attempts to “deal with cultural difference (which is created in relation to a cultural norm)” (Ghosh & Galczynski, 2014, p. XIII), and strives to create inclusive total school environments to ensure that all students (including the dominant, White, middle-class norm), feel
recognized and remain equally engaged in the process of knowledge creation (Banks, 1993; Banks & Banks, 2004; Ghosh, 2002; Ghosh & Abdi, 2013; Ghosh & Galczynski, 2014; Swartz, 1992). Conceptualizing education as a site of struggle (Giroux, 2001; 2005), a necessary vehicle for bringing social change though resistance and transformation, critical multicultural education is inherently political. It attempts to unveil the domination and underlying power struggles and demands for the right to be different with a recognition that everyone has a unique identity based on their class, culture, dis/ability, ethnicity, gender, religion, sexual identity, exceptionalities and other distinctive features (Ghosh & Galczynski, 2014).

Many educators have explored multicultural education as a field of inquiry to advance our understandings of how cultural diversity could be used as a powerful resource to enhance learning, participation, and collaboration in diversity-rich classrooms (Atwater et al., 2010; Atwater, Russell, & Butler, 2014; Banks & Banks, 2010; Beirsto & Carrigan, 2004; Ghosh & Abdi, 2004; 2013; Ghosh & Galczynski, 2014; Gibson, 1984; Giroux, 2001; Giroux, 2005; Gollnick & Chinn, 2013; Ladson-Billings, 2009; O. Lee & Luykx, 2006; Nieto, 1994; 2001; 2003; Sleeter, 1996; Sleeter & McLaren, 1995; Sleeter & Grant, 2003; Sleeter & Cornbleth, 2011). But, what understandings of multicultural education are conceptualized and manifested in today’s classrooms? In the next section, I describe present realities of multicultural education.

2.4 Multicultural Education: Current Dilemmas

The presence of more than 200 ethnic origins with immigrants accounting for 20.6% of the total Canadian population makes cultural diversity an indispensable characteristic and multicultural education, an essential requirement in the Canadian classrooms (Freiler et al., 2012, July; Statistics Canada, 2013, May 8). In the Surrey and Vancouver school districts of the lower mainland of British Columbia (BC), 50%-60% of the students are from first generation
immigrant families, wherein parents and their children speak a language other than English in their homes (Surrey School District, 2018; Vancouver School Board, 2018). However, even after more than four decades of establishing the nation’s multicultural policy, issues of educational equity and equality remain unresolved (Ghosh & Abdi, 2013; Ghosh & Galczynski, 2014). Despite the potential of multiculturalism to transform society, it has symbolically served as a “melting pot on a slow burner…to absorb, assimilate, and depoliticize minority students” (Moodley, 1995, p. 811).

There is a wide gap between intellectual conceptualization and subjective experiences of multicultural education practiced in diversity-rich classrooms (Banks, 1993; Gay, 2010b; Ladson-Billings, 2001; Nieto, 2000a; 2001). The liberal-humanistic model of multicultural education in Canada, celebrating multiculturalism premised upon equality and acceptance for “uniqueness of differences” envisions harmonizing the integration of diverse ethno-cultural groups as a “salad bowl” (Kirova, 2008, p. 107). However, such abstract imaginaries are “divorced from the policies and practices of schools and from society” (Nieto, 2000a, p. 9) within which they exist, and therefore, fail to dilute the tensions that arise in everyday social interactions (Berry, 2013; Levine-Rasky, 2006). Fractured from personal, social, historical, and political contexts that inform subjective experiences in schools, workplaces, and neighborhoods, multicultural education cannot be understood in a vacuum.

The inability of the Canadian federal government to influence multicultural education in a meaningful way has resulted in vague implications of multiculturalism in education, which is unable to negotiate the dynamics of power and politics of difference based on universal dignity and equality (Ghosh & Abdi, 2004; 2013; Ghosh & Galczynski, 2014; May & Sleeter, 2010). The apolitical view of multicultural education that neglects the multiplicity of identities and
presents culture as a static artifact actually emphasizes the difference, and results in mere attempts to integrate and accommodate ethnocultural differences within the dominant White, middle-class, Eurocentric culture through add on “piñata or the snowshoe curriculum” (Hoffman, 1996, p. 550, original emphasis) and “folklorization” (Kirova, 2008, 107). Rather than demanding critical examination of dominant discourses that deeply influence school and classroom culture, such “Fairyland” multicultural education is disconnected from the lives of students, teachers and community (Nieto, 2000a, p. 9). Emphasizing knowing Others only through “celebration[s]” in the form of “holidays and heroes” (Nieto, 1995, p. 196) and 4-Ds — “[dialect], dress, dance, and diet” (Levin, 2009, p. 124), such multicultural education, afflicted with denial and defensiveness, leads to “a hyphenated mode of being among the nation’s citizenry” (Kirova, 2008, p. 105).

In fact, most of the history of Canadian schools reflects discriminatory practices that systematically ignored, appropriated or even abolished the rights of Aboriginal people, immigrants, and linguistic minorities such as Francophones, as well as of exceptional students, and hence has contributed in eliminating diversity rather than supporting it (Levin, 2009). Being poorly equipped to cope with cultural diversity, the Canadian schools are unable to eliminate the unequal treatment of marginalized students, and are increasingly becoming locations that foster isolation and replicate racialized forms of injustice (Ghosh & Abdi, 2013; Kirova, 2008). Restricted belongingness enforcing dislocation and exclusion (Dei, 1996; Dei & James, 2002; G. Pratt, 2003), gendered Islamophobia, the politics of veiling women, and the negative stereotyping of Tamil youth with a gang label or Paki name-calling in the post-9/11 context, all exhibit the hidden violence and discrimination permeated in the Canadian schools and wider society (Dei, 2005; Zine, 2006).
Over representation of some racial groups in the criminal system (Chan & Chunn, 2014; Fleras & Elliott, 2002; Goraya, 2015), exceeding dropout rates of “visible minority” students, higher representation of racialized groups among the poor, hidden penalties for “visible minorities” in the labour market due to their non-White origins, and better integration and higher income level of White immigrants, further challenge and question the efficacy of present multicultural education in Canadian schools (Berry, 2013; Kirova, 2008). Despite the increase in the number of “visible minority” teachers over the years, inequitable schooling practices along with discriminatory licensing and hiring practices have resulted in a Canadian educator workforce that is considerably less diverse than the current Canadian population and student populations (J. Ryan, Pollock, & Antonelli, 2009). The teacher education programmes at UBC is an example of demographic inequities, wherein student enrolment includes about 35% racial minorities while faculty in key departments, such as the Department of Curriculum and Pedagogy (EDCP), includes just about 6% of racialized members. In EDCP, just five out of twenty-nine of its tenure track faculty are “visible minorities” (The University of British Columbia, 2018). Role models and empathetic allies who partially underwrite equity are extremely important for ensuring socially just responsive education.

Indeed, schools have become “sites of sociocultural reproduction,” where continued contestation and struggle about race, class, ethnicity or gender has resulted in better chances to learn for certain students who are considered privileged because of dominant ideologies and practices (Giroux, 2001, p. 115). The interlocking processes of meaning and power embedded within institutional structural relations sustain and enhance the distinctions of difference between dominant culture and other cultures (Giroux, 2005). By legitimizing the Eurocentric, Western middle-class systems of “meaning, linguistic and social competencies, and elements of style,
manner, taste and disposition,” schools serve as sites of reproduction of unequal distribution of “cultural capital” (p. 188). Institutional racism in the form of taken-for-granted practices such as standardized testing, streaming or tracking, heavy teaching loads and large classes discriminate against underserved students and serve to reproduce the status quo in American and Canadian schools (Mathison, 2003).

The deficit-based efforts to close achievement gaps, which are often measured on the basis of standardized test scores and graduation rates (J. Lee, 2002), actually widen the gap by dividing, categorizing, and creating boundaries of hegemonic hierarchy among students on the basis of race, gender, and socioeconomic status (Esmonde & Caswell, 2010; Gutiérrez, 2008). Current emphasis on high academic standards, along with the “standards craze” (O. Lee, 2003; Rodriguez, 2003, p. 21), emphasizes teaching only to instill the skills needed to pass tests. This test-based teaching to prepare students for entry into higher education institutes with science and mathematics as the “gatekeepers” (Noddings, 1994, p. 90), serves as an inherent discriminatory practice, which alienates and disenfranchises certain students (Egbo, 2009; Grant, 2008; Sleeter, 2008). National targets focused on assessing and enhancing science, mathematics, and reading achievements (O’Grady, Fung, Servage, & Khan, 2018), which demand to prepare and enable youth to compete in a knowledge-based economy, and highly skilled labour markets (Willms, 2009) further contribute in systematically perpetuating these social inequalities and prevent teachers from learning to teach for diversity.

The mainstream teaching practices based on Eurocentric Western norms, which nurture logic over feelings and often promote self-contained individualism are devoid of learning experiences that foster affection, harmonic interdependence, and communalism cherished in many cultures, and cause compartmentalization and separateness among culturally diverse
students (Allen & Boykin, 1992; Henry, 1994; 2010). In fact, such practices conform and normalize “White supremacy” (Gillborn, 2005, pp. 490-492) and contribute to a “Vertical Mosaic” of Canadian multiculturalism where White people of European and English origins are placed at the top, and Aboriginal people along with the “visible minority” immigrants are placed at the bottom of social hierarchy (Gundara, 2001/2, p. 55). Hence, implicated in the reproduction of Eurocentric knowledge and White middle-class culture, schools have become instruments of promoting individualism, capitalism and exploitation that are “designed to produce difference” (Roth, 2007, p. 68).

In such situations, how do we begin the process of “privileging equity over equality, education over schooling, and power/identity over mere access and achievement” (Gutiérrez, 2009, p. 15)? How can we challenge unjust, unequal relationships of power, and transform the material and historical reality of teaching currently being practiced in our schools? Increasing ethnic and cultural diversity among student populations in urban centers across Canada has intensified the demand for teachers to become “[trans-multi]culturally competent” (Meyer, Bevan-Brown, Park, & Savage, 2010, p. 353), “cross-cultural counselors” (Banks, 1981, p. 1), who are morally committed to bring social equity and empower their culturally diverse learners (Freiler et al., 2012, July; Ghosh & Abdi, 2013).

Traditionally, few teacher education programmes prepared teachers to teach effectively in diversity-rich classrooms (Cornbleth, 2008; Ladson-Billings, 2001; Obidah & Teel, 2001; Teel & Obidah, 2008). Tremendous ambiguity about multicultural education and how it should look in teacher education programmes resulted in theoretical, fragmented, and contested discourse of multicultural education, which addressed diversity in a “tokenistic” way (Gill & Chalmers, 2007, p. 552). Many of these programmes have historically been suffused in deficit-based theories,
which promote negative assumptions about diverse student populations by classifying students from non-dominant groups as genetically or culturally inferior in general (Bennett, 2012; Egbo, 2009; Nieto, 2000b), or specifically superior in science and mathematics.

The relativist model of multicultural education, which warrants equal respect and value for all cultures but supports the legitimacy of “living in meaningful cultural collectives outside the mainstream,” does not help in diluting inequalities (Moodley, 1995, p. 807). It rather perpetuates a stereotypical, socio-pathological perspective, which causes many well-meaning educators to suffer from a “deficit syndrome” (Gay, 2010b, p. 25), and see children coming from different cultures — other than the socially accepted norm, the White culture — as “abnormal” (Ladson-Billings, 2001, p. 3) or as “problems” (Moodley, 1995, p. 806) that need to be fixed, normalized, enculturated, or socialized.

A theoretical, fragmented, and contested discourse of multicultural education has been proven insufficient to prepare teachers to deal with the complexity of socio-political dynamics inherent in diversity-rich classrooms and efficiently teach culturally diverse students (Atwater et al., 2010; Gay, 2003; Grant & Gillette, 2006; Hernandez, Morales, & Shroyer, 2013; Ladson-Billings, 2001; Rodriguez, 2003). An unfortunate consequence of such teacher-training is reflected in teachers’ standardized norms of classroom participation and mainstream expectations, which are often incompatible with their students’ cultural understandings (Ghosh & Galczynski, 2014; O. Lee, 2001). In their attempt to “correct and compensate for… cultural deprivations” (Gay, 2010b, p. 49) of “Other People’s Children” (Delpit, 2006), often teachers are unable to recognize that cultural discrepancies between students’ life-worlds and school culture are hidden barriers that can have a huge impact on students’ ability to learn and achieve (Nicol et al., 2010). How the education system and schools respond to the diversity inherent in the
Canadian population has remained a critical issue in Canadian education history (Egbo, 2009; Levin, 2009). Therefore, it is not surprising that many Canadian teachers identified dealing with students’ cultural diversity as a key challenge in their classrooms (McGahey, 2012, January 31).

There has been a recent surge to have a greater focus on diversity and multicultural education in their course work for pre-service teachers in teacher education programmes in North America (Van Nuland, 2011). However, how effectively such understandings are implicated in these teachers’ teaching practices is yet to be explored fully (Kahn et al., 2014). A lot has changed in recent years but the core of teacher education programmes in Canada has remained unaltered (Howe, 2014). As Cornbleth (2008) has emphasized, only adding culturally responsive subject matter into traditional teacher education programmes is insufficient. Without creating opportunities for teachers to examine their own prejudiced actions, biased perceptions and expectations that they may have of their culturally diverse students, it is difficult to alter teachers’ beliefs and their pedagogical approaches.

One could argue that Canadian teachers have many opportunities for on-going professional development trainings but the increasing diversity among student population, along with shrinking budgets and specific curricular initiatives without appropriate teacher support, continually put teachers under increasing pressure to “make do with less while achieving more” (Howe, 2014, p. 597). This is evident in the concerns of many British Columbian teachers who feel overwhelmed and unprepared to integrate Aboriginal knowledges as per the redesigned British Columbia curriculum (Arnold, 2018; British Columbia Teachers’ Federation, 2017, December). Previous studies in other Canadian provinces such as Manitoba and Saskatchewan (Kanu, 2011) suggest that these situations are illustrative of quandaries faced by teachers in wider Canadian contexts.
Considering the long colonial histories and contemporary realities of injustices and negligence of Aboriginal knowledges in Canada, it is a social and ethical responsibility for educators to be prepared to teach and advance understandings of Aboriginal knowledges in schools as also demanded in the Calls to Action of the Truth and Reconciliation Commission of Canada (2015). The need to better prepare teachers to work with Aboriginal students and communities has also been recognized as one of the key issues in the Accord on Indigenous Education (ACDE Association of Canadian Deans of Education, 2010).

Despite the initiatives that have attempted to advance indigenization/decolonization of curriculum in various Canadian provinces (Aikenhead, 2006; Aikenhead & Elliott, 2010; Aikenhead & Michell, 2011; Kim, 2017; Nicol et al., 2010; 2013; Snively & Corsiglia, 2001; Snively & Williams, 2006), teachers have been largely unsuccessful in transforming the traditional curricular and pedagogical strategies of teaching science and mathematics into inclusive practices that are culturally responsive (Egbo, 2009; Ghosh & Galczynski, 2014; Kanu, 2011).

Consequently, students may not see any relevance in learning these subjects. Cultural conflicts between school science and mathematics, and students’ perceptions of these subjects may lead to their disengagement in learning, and even impact their attitudes about pursuing further education and future careers in these areas (Aikenhead & Jegede, 1999; Bishop, 1994; Blades, 1997; Ezeife, 2002; 2003; Snively & Williams, 2016). In British Columbia, the percentage of Aboriginal students who successfully graduate from high school with one of the three main science courses namely, Physics, Chemistry and Biology, which are considered crucial for entry into post-secondary institutions, is very low (Snively & Williams, 2006). The recent British Columbia Ministry of Education’s Aboriginal Report indicates that even though
the percentage of Aboriginal students graduating from high school has improved (climbed up from 57% in 2011-2012 to 64% in 2015-2016), these students’ successful transition into post-secondary institutions remains low because of their underrepresentation in university preparatory science and mathematics (British Columbia Ministry of Education, 2016, November).

Helping teachers in developing knowledge, skills, and attitudes that are necessary to teach effectively in diversity-rich classrooms remains a complex and difficult task (Cornbleth, 2008; Daniel, 2016). According to Lewis (2001), in their efforts to become fair, teachers often adopt a culturally “colorblind ideology” (p. 781), and perceive fairness as “see[ing] no color, hear[ing] no color, speak[ing] no color” (Paley, 1979, p. 7). Unfortunately, in such myopic efforts, teachers acquire “color muteness” (Pollock, 2008, p. 375) and discount the disparities that diverse students might encounter because of their different cultural, racial, and socioeconomic backgrounds (Ford, Moore, & Milner, 2005; Pollock, 2008).

According to Egbo (2009), in a racialized and multicultural society like Canada, it is not uncommon to see teachers claiming to be “colourblind” by proclaiming, “‘Black, White, blue or green, I love all my students’, ‘I do not see colour’, ‘I treat everyone equally’, or ‘As far as I am concerned everyone is the same’” (p. 11). How do we understand the actions of such teachers, who in their efforts to not to be labeled as blatant racists, become “cultural hegemonist[s]” and expect all students to behave according to the school’s cultural standard of normality (Gay, 2010b, p. 48)?

6 In this dissertation, I have borrowed the terms “colourblind” and “color muteness” to draw attention towards how the ignorance of difference could be embedded in one’s modes of thinking knowingly or unknowingly and could lead to systemic perpetuation of discriminatory practices. I have used these terms with caution and want to acknowledge that this terminology could be considered problematic as it is based on “ableist” notion, and thus in itself may serve as an exclusionary and discriminatory terminology.
These practices may account as hegemonic discourses that reproduce the dominance of privileged groups as commonsense thinking, and force invisibility and subsequent acceptance of power among marginalized and oppressed (Egbo, 2009). In fact, such “colourblind” actions actually perpetuate what King (1991) has called “dysconscious racism” (p. 133)—the uncritical habit of mind which fails to challenge the White norms and status quo and justifies existing discrimination by accepting the prevailing order of things as given (Ladson-Billings, 2009, p. 35). It breeds the false belief that cultural and racial identities do not influence interpersonal relations (Schofield, 2010), and fails to understand that non-discriminatory practices require one to become “colour-sensitive and aware of differences, rather than concealing them” (Bell, 2007; Ghosh & Abdi, 2013, p. 170).

Indeed, such actions of ignoring “difference,” are counter protective. John (Fire) Lame Deer has claimed: “I think White people are so afraid of the world they created that they don’t want to see, feel, smell, or hear it” (as cited in Brady, 2005, p. 998). I acknowledge that such perceptions of “White people” could have been shaped within contexts of marginalization and oppression that Indigenous peoples have faced historically.

However, looking through the lens of critical and transformational multicultural education (Keating, 2007; Nieto, 2000a), such a comment could qualify as a derogatory racial comment because it is perpetuating the notions of labeling and understanding people based only on skin colour. Such perception of people based only on skin colour disregards the ethnocultural differences within “visible minority” cultures by making them all non-White or People of Colour. Does not it also ignore the “invisible minorities”, and perpetuate the belief that White people all have the same culture or are cultureless? Classifying people as Black, non-White or People of Color, and White portrays a false assumption that all White people are racist.
Leonardo, 2002). The Whiteness considered as the globally privileged norm (Ladson-Billings, 2009) also tends to hide the ethnic backgrounds and cultural diversity of White people and leads many of them to see themselves as having “no culture” and Other people as “ethnic” (Nieto, 2000a, p. 26).

Moreover, such a manner of identifying and treating people based on colour exacerbates the very notions of discrimination that critical multicultural education aims to denounce (May & Sleeter, 2010; Nieto, 2000a). Polarizing colour consciousness tends to overlook racism based on other ethnic markers and fails to recognize the rich complexities of differences/unicness of various ethnic groups as well as address the “ethnochauvinism” embedded among and within various ethnocentric groups (Cuccioletta, 2001/2; Moodley, 1995, p. 813; 1999).

Similarly, language and representation play a crucial role in the construction of identity as “teaching above all… is a linguistic activity” (Smith, 1971 as cited in Gay, 2010b p. 78). The terms: “minority”, “disadvantaged”, “at-risk”, “disempowered”, or “dominated” are all politically charged and incomplete because they victimize students by emphasizing what they are missing rather than capitalizing on what they have (Gay, 2010b; McLaren, 1995; Nieto, 2000a). For example, the term privileged is a misnomer as according to Pinar (1993) it is not only the marginalized who suffer but also the so called “privileged” because they are unaware or ignorant of the fact that “their knowledge is racialized knowledge”. Even the very term “minority” used to identify and describe people of different cultures is hegemonic and problematic. How do we legitimize calling schools where African American students become a majority, a “majority minority” school (Nieto, 2000a, p. 28)?

Thus, while thinking about multiculturalism and multicultural education, it is essential to acknowledge that the issues of equality and fair treatment become very complex in pluralistic
societies like that of Canada, where the “difference is not [only] multifaceted, but is also considered a deviation from an arbitrary ‘norm’ represented by the dominant group” (Ghosh & Abdi, 2013, p. 3). Hence, there are “no more pressing sets of problems in educational theory today than those that fall under the broad issue of cultural difference” (Peters, 2000, p. 18 as cited in Carter, 2004, p. 821).

Considering the complexity inherent in cultural diversity and the abundance of issues that are identified as problematic within multicultural theory and practice, how do we create a “just society” (Ghosh & Abdi, 2013, p. 107) in Canadian contexts? Kymlicka (2010) recognizes the greater success of multiculturalism in Canada in contrast to multiculturalism in other Euro-Western countries and hopes that in spite of various challenges posed by diversity, multiculturalism in Canada will not lead to the promotion of ghettoization and balkanization. But how can this hope become a practical reality? Indeed, for Canadian multiculturalism to flourish, a critical examination of current multicultural education policy and practices is essential.

The success of multicultural education depends on how schools, as important centers of socialization, become “vehicles for achieving the democratic ideals of equality and justice in society” (Ghosh & Abdi, 2013, p. 2). McLeod and Krugly-Smolska (1997) envision multicultural citizenship as a commitment to cultural support, immigrant adjustment, and human rights by promoting intergroup ethnocultural relations, ethnic and racial tolerance, acceptance, anti-racism, and equity through fairness, respect, and trust among all people in all parts of Canada. By moving beyond the cultural mosaic where all cultures are together but as separate entities, Ladson-Billings (2004) has urged us to think about multiculturalism as “Jazz” where all cultures have their own rhythm, their own unique tone, but played together they all embrace each other in one voice, creating a harmony — “Jazz” (Ladson-Billings, 2004, pp. 50-51).
While such harmonized visualization of multiculturalism as *Jazz* is commendable, how could one help teachers in the task of interpreting, applying, and practicing these understandings as a multicultural educational reality in their cultural diversity-rich classrooms? The question becomes more crucial in science and mathematics classrooms — subjects that are typically perceived as abstract “detached, remote bod[ies] of knowledge” (Boaler, 1993, p. 13) that are “acultural” (Krugly-Smolska, 1996, p. 26), and divorced from the socio-cultural contexts from where they were conceived (Barba, 1998; Gay, 2010b).

Considering science and mathematics culturally neutral and value free subjects (Bishop, 1994; Ghosh & Galczynski, 2014; Hodson, 1999), teachers often find it difficult to see how knowledge can be socially constructed in these subjects (Banks & Banks, 2010; Bishop, 1991; Gay, 2002b; Mukhopadhyay, Powell, & Frankenstein, 2009). In fact, many teachers continually fail in integrating students’ cultural ways of knowing in their teaching of science and mathematics in a relevant and meaningful manner as their standardized norms for classroom participation and mainstream expectations are often incompatible with their students’ cultural understandings (Ghosh & Galczynski, 2014; O. Lee, 2001).

In the name of uniformity, accountability (Mathison, 2012), and standardized test-based teaching (Mathison, 2003; Pinar, 2005), today’s “gap gazing” schooling mindlessly aims only towards filling the “achievement gaps” (Gutiérrez, 2008; 2009). Considered as the “gatekeepers” (Noddings, 1994, p. 90) for higher education, a ticket for entry into high-status jobs, and a winning token for higher social status, science and mathematics have just become an “international currency for national and global technological development in today’s world” (Gutstein, 2007; Jegede, 1995, p. 122; Raisinghani, 2016a, p. 187; 2016b).
Science and mathematics have continued to develop and perpetuate “scientific racism” (Hodson, 1999, p. 230) by legitimizing discrimination and institutional injustices through stereotypical and prejudiced attitudes towards “minority” groups (Ghosh & Galczynski, 2014). Since the 17th century, Eurocentric or Western Modern Science (WMS) has a monopoly on what is legitimated as scientific knowledge and whose knowledge gets known (Aikenhead & Elliott, 2010; Ezeife, 2002).

Claiming to be a neutral or value-free “intellectual activity whose truth-finding goal is not, in principle, affected by national, class, racial, or other differences,” WMS continues to generate Western colonial perspectives, and thereby, devalue and disrespect many students’ cultural backgrounds (Ahlquist & Kailin, 2003; Snively & Corsiglia, 2001). Moreover, in many socio-cultural contexts, WMS is continually translated and taught as a gendered practice of “white male science,” thus further contributing to discriminatory injustices towards “minority” groups (Belczewski, 2009; Pomeroy, 1994; Snively & Corsiglia, 2001, p. 9).

Current Euro-Canadian practices of teaching scientific knowledge as “empirical, literal, and irrevocable truths” (Schwab, 1962, p. 24) based on dangerously “ahistoric [and] acultural” (Krugly-Smolska, 2004, p. 420) textbooks that endorse the superiority of WMS at the cost of Other cultural ways of knowing (Indigenous/non-Western/Eastern) mark an educational failure (Barton & Yang, 2000; Snively & Corsiglia, 2001; Zarry, 2002). With the exception of a few efforts to “equalize” the curricula by decolonizing, indigenizing, or multiculturalizing education (Aikenhead, 2006; Aikenhead & Elliott, 2010; Aikenhead & Michell, 2011; H. Lee, Yen,
Aikenhead, 2012), most actually subjugate, colonize, or discipline the Indigenous knowledges and ways of knowing by peripheral representation of these as “relics from the past” (Ninnes, 2003, p. 175). Hence, without recognizing the history, philosophy, and sociology of Science inherent in diverse cultures, many school curricula continue to promote deficient or distorted views as “exclusively European or North American white, ethnocentred” Science, which is devoid of humankinds’ cultural achievements (Hodson, 1999, p. 231).

Underlying cultural assumptions of teachers could add another dimension in this power dynamics (Atwater et al., 2010; Tillman, 2002). Teachers’ cultural beliefs deeply influence their instructional practices and teaching judgments (Gay, 2010a). The importance, inevitability and challenges of culture in education are well expressed by Erickson (2010):

In a sense, everything in education relates to culture—to its acquisition, its transmission, and its invention. Culture is in us and all around us, just as is the air we breathe. In its scope and distribution, it is personal, familial, communal, institutional, societal, and global. Yet culture as a notion is often difficult to grasp. As we learn and use culture in daily life, it becomes habitual. Our habits become for the most part transparent to us. Thus, culture shifts inside and outside our reflective awareness. We do not think much about the structure and characteristics of culture as we use it just as we do not think about any familiar tool in the midst of its use. (p. 35)

7 Indigenous knowledges in this dissertation denote to non-European traditional cultural knowledges of Indigenous peoples of the world and include Aboriginal knowledges of Aboriginal people of Canada.
This lack of reflective awareness about culture is evident in the actions of some educators who do not accept that their worldviews, values, and beliefs are filtered and shaped through their cultural lenses (Beairsto & Carrigan, 2004). As Gay (2002a) mentioned:

Culture simultaneously anchors and blinds us. It forms our center in the dynamics of living and interacting with others while leading us to assume that our own ways of being and behaving are the only right way. (p. 617)

Many teachers of mainstream culture are not receptive to the ethnic, racial, cultural, economic, and linguistic diversity that their students bring into their classrooms because they believe that they themselves have no culture and therefore, assume that their actions are not culturally determined (Gay, 2010a; Ladson-Billings, 2001; Sleeter, 2001). One example of such culture-blind attitude could be seen in practices of a math teacher in Schofield’s (2010) study who denied the necessity of integrating multicultural resources and justified using a book depicting only White individuals by saying “math is math” (p. 275). Similarly, many teachers perceive science teaching as a politically neutral and objective field of study and therefore, are unable to see any connections between science education and racism (Atwater, 2010).

This politically neutral teaching is dangerous as it leads to subtle forms of “racist half-truths” that are often invisible and harder to detect (Atwater, 2010, p. 105). Such neutrality plays a key role in an abusive economic and political system as it masks the real political and economic concerns of Science and society, propagates suppositions about nature and humans that support inequalities, hides its pilfering of non-Western scientific ways of knowing, and results in oppression, social inequities and alienating experiences for many students in diversity-rich classrooms (Aikenhead, 1997; Aikenhead & Ogawa, 2007; D’Ambrosio, 2008; Dei & James, 2002; Henry, 1994; 2017; McGee, 2014). The cognitive conflicts and cultural dissonance
between these students’ life-world cultures and culture of school science and mathematics make the learning of these subjects as a painful and unpleasant experience of dry, mechanical memorization and reproduction of facts and formulas (Ezeife, 2003).

Unfortunately, many proponents of “genetic inferiority perspective” contend that intelligence is a biologically determined and irreversible trait that is inherited and believe that some races are innately inferior to others. Therefore, they recommend that the logical steps for schools are to continue providing the best academic preparation for “the most able students, usually from the White race, and appropriate training for those who are less capable, the majority of whom are people of color” (Hollins, 2015, p. 119). Similarly, the proponents of “cultural deficit perspective” believe that the culturally diverse students encounter school failures because the values and practices that these children learn at home are culturally deficient (p. 119).

Such deficit-based perspectives lead many teachers (who are predominantly White) to have negative relationships with students who are often already marginalized on the basis of colour, race, culture, ethnicity, immigrant status and socio-economic class (Ford et al., 2005; Gay, 2015). Hence, it is crucial for teachers to become aware of their own cultural biases (Ferner, 2013; Gay, 2010b; S. Lee, 2010; Nieto, 2000a; Reygan & Francis, 2015). But, how can one help teachers to recognize and overcome their own cultural biases and teach in a manner that “respects and cares for the souls of [their] students” (Baker, J., Bell, C., & Yearwood, J., 2003, p. 37; hooks, 1994, p.13)?

Certainly, culturally neutral, deficit-based, reductionist approaches that may “distill a child’s educational experiences to a test score” need to be stopped (Volante, 2016, June, p. 43). The first step could be to (re)examine the notion of culture. In the next section, I explore the
meaning of culture and how it is manifested in contexts of multicultural education. I then share the understandings of culture and cultural diversity that have informed this investigation.

2.5 What is Culture?

It is hard to pinpoint culture as it is easily misused and misunderstood (Landman, 1996). Generally equated with ethnicity, culture is often seen as a fixed set of stable practices that an individual inherits through family (May & Sleeter, 2010). The situation becomes more complicated in the field of education where with 250 different uses of the term, the meaning of culture is continually argued (Banks & Banks, 2010).

The present depoliticized conceptualization of culture as an exotic, static artifact (Ghosh & Abdi, 2013; Kirova, 2008) in the field of education has stripped multicultural education from the dynamism and complex realities of socio-economic-political contexts that underlie the very foundation of education in a culturally diverse community. Despite the ideological emphasis on social justice, equity, and democratic citizenship, current discourses of multicultural education view culture as an organizing principle that creates borders around race, ethnicity, gender, and class, and often serves as a structural category to generate inequality and distance between marginalized, and those who are at the center of power in schools and in society (Ghosh & Abdi, 2013). Bhabha (1994) has urged us to rethink our perspectives on culture:

Cultures are never unitary in themselves, nor simply dualistic in the relation of Self to Other...because of the inscription and articulation of culture’s hybridity...the discursive conditions of enunciation...the meaning and symbols of culture have no primordial unity or fixity; that even the same signs can be appropriated, translated, rehistoricized and read anew. (pp. 35-39)
Indeed, culture is complex and includes knowledge, art, beliefs, morals, capabilities and habits acquired by one in a society (Taylor, 1970). Culture is not merely a sedimentation of historical experience, it is a dynamic process and evolving product of human interaction with(in) a particular time and space that is influenced and continually shaped by temporal politics and distribution of social power (Banks & Banks, 2010).

The important aspect of multicultural discourse in education is to understand how differential recognition and access to knowledge of the various micro-cultures within macro-cultural systems contribute to differential power relationships resulting in recognition and marginalization of certain cultures as dominant norm or Other(ed) (Sharma, 2010). And more importantly, how these hegemonic hierarchies of cultural representation in turn inform and shape individual identities (May & Sleeter, 2010). Figure 1 displays various factors that may influence an individual’s cultural identity.
Figure 1 An Individual’s Cultural Identity Profile

Adopted with permission from Egbo (2009, p. 4) 

Even though, it is important to acknowledge that “identity choices are inevitably constrained and shaped by one’s position[ing] in the wider society” (May & Sleeter, 2010, p. 6), the recognition of historical situatedness of culture and embedded power hierarchies within each

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of these factors should not limit our identities (Bhabha, 1994; Gilroy, 2000). The fact is that in
diverse societies like Canada, identities are merging continually as many individuals are
becoming transcultural by transcending the subordination and domination inherent in singular
historic identity (Cuccioletta, 2001/2).

In our everyday practices of *doing being human*, each one of us is continually evolving as
a “[trans-]multicultural” human being (Erickson, 2010, p. 37) with the recognition of Self in the
Others, giving life to a culture of métissage where each person is a cosmopolitan citizen
(Cuccioletta, 2001/2, p. 8). In fact, such development of more encompassing individual identities
is essential in diverse multicultural societies like that of Canada to ensure the creation of a new,
broader sense of “we” that could dampen the negative effects of diversity and lead to new forms
of social solidarity among people (Putnam, 2007). It is essential to acknowledge that
multiculturalism is a *normal* human experience, and is present in every human society (Banks &
Banks, 2010; Gibson, 1984; Goodenough, 1976).

Similarly, cultural diversity should not be merely seen as an ideological object of
knowledge that controls and represses cultural difference by appreciation of *Other(ed)* cultures
and superficial inclusion of cultural knowledges against an invisible Eurocentric frame of
reference (Sharma, 2010). While talking about cultural diversity, one needs to understand that
diversity does not simply mean differences based on race or ethnicity but includes all cultural
experiences that students bring into school. How could one incorporate and perpetuate such
comprehensive and fluid understandings of culture and cultural diversity in multicultural
education programmes, and help teachers to grow as professionals who are “[trans-
]multiculturally competent” (Stanciu, 2011, p.10)?
Essentially, teachers need to have deeper understandings of not only the existing cultural diversity of their students, but also of the processes of cultural difference that enunciate and underlie the dynamism of all cultures and valuate their different takes on ways of knowing and meanings of life (Bhabha, 1994; Gay, 2010b). Ghosh and Abdi (2013) have asked: “Are educators aware of the ethical responsibilities and political implications that education for a critical democracy implies” (p. 3)?

The answer for this and similar questions lies in addressing the need for teachers to not only have thorough content knowledge of the particular subjects but also a critical understanding of culture, cultural differences, and embedded structural inequalities within schools so that they can work towards creating or empowering educational experiences for all students by inviting them as knowledge co-constructors in diversity-rich classrooms (Ghosh & Galczynski, 2014; May & Sleeter, 2010; Nieto, 2001). Construction of knowledge that is “actively built from within” by a thinking person necessitates social interaction (Cakir, 2008, p. 196; Confrey, 1990). From a constructivist perspective —knowledge cannot be simply given to students, students as “active learners” must construct their own meanings (Pollard, 2001, p. 4). However, this does not imply that Science can be learned by an individual’s own sense making of the natural world.

As Driver, Asoko, Leach, Mortimer, and Scott (1994) emphasized, scientific knowledge is both symbolic in nature and socially negotiated. It is an accumulated body of symbolic constructs that have been approved, accepted, and internalized by a scientific community. Learning of Science involves being initiated into the scientific ways of knowing because learning Science is not an individualistic creation of meaning based on personal experiences but it is an initiation into the “ways of seeing” (Driver, 1989, p. 2) or “scientific ways of knowing”
(Driver et al., 1994, p. 6), which have been established and found to be fruitful by the scientific community.

Thinking along the limited notion of constructivism, a teacher’s role is merely constrained to facilitating students’ investigations and explorations and does not necessarily include the teacher proactively supporting students’ scientific and mathematical development (Cobb, 1994). However, if students are to be given access to the knowledge systems of Science, the process of knowledge construction must go beyond personal empirical inquiry and psychological or individualistic constructivism. Thus, rather than helping individuals in organizing their personal sense-making about the natural world, the role of teachers is to mediate students’ knowledge by making scientific concepts and practices meaningful at an individual level (Driver et al., 1994).

Hence, we must begin viewing the learning of science and mathematics as a process of enculturation into practices of intellectual communities (Aikenhead, 1996; Bishop, 1991; Cobb, 1994; Cobern & Aikenhead, 1998; Hodson & Hodson, 1998), and social co-construction of scientific concepts (Driver et al., 1994; Settlage & Southerland, 2012). During enculturation, the critical issue of supporting students’ learning does not remain at the superficial level of asking whether the students are constructing their own knowledge, but instead demands deeper inquiry about “the nature and quality of those socially and culturally situated constructions... by counteract[ing] the political correctness” that frequently surrounds constructivism in science and mathematics education (Cobb, 1994, p. 4).

To make genuine inquiry and co-construction of knowledge possible in cultural diversity-rich science and mathematics classrooms, it is essential that teachers are cognizant that the tasks, tools and materials, and representations that are chosen to provide activities and experiences to
diverse students profoundly influence their learning and engagement (Barton, 2000; Roth, 2007; Turner et al., 2012; Wilson, Mojica, & Confrey, 2013).

Indeed, to facilitate students’ investigation and understanding of the concepts and constructs of Science, one must allow them to utilize their prior experiences to seek out their problems and not impose one’s own view (Boaler, 1998; Cakir, 2008; Confrey, 1990). If individual students are given the opportunity to construct meaning from their experiences, then the learning becomes meaningful as it derives from an authentic context. Allowing students to pursue individual learning goals in a contextualized, culturally responsive manner empowers them by inviting them as co-constructers of knowledge in their diversity-rich science and mathematics classrooms (Berry Bertram, 2011; J. C. Brown & Crippen, 2017; Gutstein, 2010; Nashon, 2013; Nashon & Anderson, 2013; Stewart, 2010).

2.6 Dimensions of Multicultural Education

In this dissertation, I have utilized critical and transformational multicultural education perspectives (Keating, 2007; Nieto, 2000a) along with Gay’s (2010b) notion of CRT as a complementing theoretical framework to inform my understandings of overarching vital characteristics of culturally responsive education while collecting and analyzing the data. This section addresses key dimensions (Banks, 2010) and levels of multicultural education (Nieto, 2000a), fundamental premises of transformational multicultural education (Keating, 2007), and core elements of CRT (Gay, 2010b).

Banks (2010) proposed five dimensions of multicultural education namely, content integration, knowledge construction, prejudice reduction, equity pedagogy and empowering school culture that may serve as a guiding framework to inform teachers’ understandings towards creating and sustaining effective multicultural environments in schools. The first
dimension of “Content Integration” suggests that the infusion of cultural content should be logically utilized to illustrate key concepts and ideas of specific discipline and/or subject.

The second dimension of “The Knowledge Construction Process” refers to how teachers might help students in understanding the implicit cultural assumptions, frames of references and inherent biases within a discipline that influence the way knowledge is constructed and represented within a specific subject. For example, teachers could encourage students to analyze the processes of knowledge construction within science by drawing attention to how scientific racism is perpetuated through theories of intelligence, Darwinism and eugenics and their dangerous implications in socio-political contexts such as the one reflected in *The Bell Curve* by Herrnstein and Murray (1994), which legitimizes class and racial structure.

Considering that many students come to schools with prior misconceptions and negative attitudes about different racial and ethnic groups (Stephan & Stephan, 2001; Stephan & Vogt, 2004), “Prejudice Reduction” as the third dimension of multicultural education provides guidelines for developing positive attitudes among students. Four conditions could help in reducing prejudice and improving intergroup relations among diverse students: 1) the individuals experience equal status, 2) they share common goals, 3) rather than competition, intergroup cooperation exists, and 4) the contract is sanctioned by authorities such as parents, teachers, and administrators.

The fourth dimension of “Equity Pedagogy” inspires teachers to analyze their own teaching to determine the extent to which they have addressed multicultural issues and concerns by modifying their teaching in a way that supports the academic development of all students. Teachers are encouraged to include CRT styles that could help them in meeting the educational needs of diverse students and ensure personalized learning opportunities and academic
achievements among all. It also includes using cooperative learning techniques in science and mathematics instruction to promote engagement and academic achievements among culturally diverse students (Banks, 2009).

The fifth and final dimension of multicultural education “An Empowering School Culture and Social Structure,” discusses the school culture and institutional structures that promote gender, racial, cultural, and social class equity. It emphasizes examining and reforming power relations among teachers and students, as well as the hidden curriculum and its implicit norms and values that shape the institutional structures and social attitudes towards “minority” students. It stresses collaborative and critical examination of school practices by teachers and all members of school organization to ensure restructuring of these to address disproportionality in enrollment, participation and achievements, and thereby, create a school culture that empowers students of diverse cultural backgrounds. Figure 2 represents the key characteristics of these dimensions:
2.7 Levels of Multicultural Education

To facilitate teachers’ understandings of multicultural education and help them in developing a multicultural perspective, Nieto (2000a) proposed a model of multicultural education that has four levels: tolerance; acceptance; respect; and affirmation, solidarity, and critique. Proposing these levels as “dynamic and as having penetrable borders” (p. 339), Nieto

\[\text{Figure 2 Dimensions of Multicultural Education}\]

Republished with permission from Banks (2009, p. 15).\(^9\)

invites teachers to explore how multicultural education takes different forms in different settings by paying attention to various components of school environment.

The first level *tolerance* indicates enduring differences. This level of accepting the difference represents the lowest level of multicultural education in a school setting as what is currently tolerated can be rejected in future. Translated in the form of school policies and practices, *tolerance* identifies linguistic and cultural differences as inevitable burdens in a multicultural society and may limit multicultural education practices that do not build on but rather replace differences. Some examples of such practices are English as a Second Language (ESL) Programmes\(^\text{10}\) which continue to perpetuate the dominance of English. Superficially observing a Black History Month through a commemorating assembly and bulletin boards is another example.

The next level *acceptance* supports diversity by acknowledging differences. In schools, programmes such as transitional bilingual programmes that acknowledge students’ cultures and language by allowing them to use their primary language until they are “mainstreamed” for English-language environment demonstrate acceptance. It is also visible in the form of multicultural fairs and cookbooks as well as in including diverse languages in newsletters for communicating with parents.

The third level *respect* ensures respecting diversity by including diverse cultural perspectives and languages in education with admiration and high esteem. It might mean offering

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\(^{10}\) Some examples of these ESL programs are the ESL Science programs, which are still being continued to teach Science to many culturally diverse students (who are designated as ESL students) at the Secondary level in many British Columbia classrooms. Therefore, despite the political incorrectness of the term ESL, in this dissertation it has been included to maintain the originality of teachers’ voices and for the authentic representation of the contexts within which they teach. Wherever possible, I have used the terms EAL (English as an Additional Language) and ELL (English Language Learners), which inform the contextual reality of students who are learning English.
bilingual education programmes that use native languages throughout schooling and not only as a bridge to English. It also includes exposure of students to multiple ways of knowing by integrating diverse cultural perspectives and positive, frequent interactions with parents.

The fourth and final level *affirmation, solidarity, and critique* is based on the premise that multicultural education aims for equity and social justice for all students. Therefore, diverse languages and cultural ways of knowing should be embraced with legitimacy along with a recognition of difference as an evident part of learning. Such multicultural education programmes encourage students to contribute in knowledge co-construction with an acknowledgment of diversity and difference as valid vehicles for learning. This collaborative journey may include challenging diverse cultural perspectives, and at times students may struggle with one another. However, at this level of multicultural education, conflict is not avoided but utilized and accepted as an inevitable part of learning.

In schools, *affirmation, solidarity, and critique* may mean dismantling the established status quo that often places one group as superior to others. Students are encouraged to not only “celebrate” diversity but challenge it as well by reflecting on and transcending their own cultural assumptions and biases through *critique and affirmation*. Promoting understandings that view culture as not fixed and unchangeable, but as an entity that can be challenged and criticized, this level of multicultural education strives for inclusive multicultural educational settings in which culture and languages of all students are integrated in a comprehensive, critical, and consistent manner with *respect* and *solidarity*.

Evident in teachers’ attitudes that hold high expectations for all students and instructional strategies that include multicultural perspectives, as well as in parents’ and community involvement in designing, developing, and implementingmulticulturally sensitive and inclusive
curriculum, this fourth level of multicultural education exposes students’ and communities to a variety of cultural experiences and viewpoints, and thereby, creates opportunities for expanding their learning horizons by seeing beyond “ethnic enclaves” (Nieto, 2000a, p. 341).

2.8 Fundamental Premises of Transformational Multicultural Education

Keating’s (2007) connectionist approach of transformational multicultural education, which utilizes interconnectivity as a theoretical and pedagogical framework, builds on critical multicultural insights, and emphasizes the transformative aspect of multiculturalism by underscoring its potential to bring positive social change. By dismantling the “enforced separations” that compartmentalize and segregate humanity, transformational multicultural education calls for holistic, nonbinary epistemological and pedagogical methods which work towards bringing social justice (p. 1). Utilizing interconnectivity as a key, it invites us to redefine ourselves by acknowledging the relational nature of all cultural identities and reconfigure our relationships in nonbinary form by seeing sacred, deep-seated commonality among all human beings. Presenting this connectionist framework as an alternative to the generally employed politically charged oppositional pedagogies that are based on “binary (either/or) thinking and dualistic (“us” against “them”) models of identity,” which bring only partial relief (p. 1), Keating (2007) reasons that:

Connectionist thinking is visionary, relational and holistic. When we view ourselves and each other from a connectionist perspective, we look beneath surface judgments, right labels, and other divisive ways of thinking; we seek commonality and move toward collective healing. (p. 2)

Acknowledging that even though “sacred connections” and “healing” may sound strange in academic contexts, Keating (2007) claims that “holistic, spirit-inflected” connectionist
perspectives may “chip away at and in other ways transform social injustice” that are imbued in racism, sexism, classism and other forms of contemporary discriminating issues (p. 2). This connectionist approach of transformational multicultural education is based on following four premises:

2.8.1 Premise #1 Categories and labels, although sometimes necessary, can prevent us from recognizing our interconnectedness with others

This premise encourages educators to transcend the dualistic worldview, which imposes “narrow, binary-oppositional models of difference” to categorize and evaluate individuals in superficial categories of Us/Other as males/females; White/people of colour; straight, bisexual/trans or lesbian or queer and other discriminatory categories (p. 3). Not recommending espousing a “color-blind” or “gender-blind” perspective, this premise calls for educators to become self-reflective and mindful of how such inflexible categories of identity, prevent us from recognizing the interconnectedness among us as humans.

2.8.2 Premise #2 Out of all the categories we today employ, ‘race’ is perhaps the most destructive

Identifying race as one of the “most insidious and divisive tool,” that is normalized in every day modes of social life, this premise of transformational multicultural education draws attention towards how media and popular beliefs reinforce racialized hierarchy. It calls for educators to be aware of these false beliefs that privilege White supremacy by denying accountability for historical oppressions or at times deceitfully proclaiming a “(pseudo)-colorblind culture,” which subtly buttresses the economic, educational and other disparities by asserting that in contemporary multicultural societies, race does not matter (p. 5).
2.8.3 Premise #3 The oppositional politics so effective in the past are no longer as useful in the twenty-first century; we must develop relational, nonbinary forms of opposition, resistance, and transformation

Even though binary oppositional politics played a central role in offering teachers and students a new form of agency to examine and deconstruct oppressive discourses in the past through practices such as critical pedagogy, this premise argues that this restrictive binary logic keeps us locked within status quo as it shifts the focus from systemic injustices and stifles us to battle each other. It does so by: 1) promoting “monothinking” in our teaching and everyday lives, which leads us to develop inflexible, judgmental and dismissive attitudes towards Other(ed) ways of knowing by assuming that “there is only one right way to think, act, theorize, self-define, or mobilize for social change” (p. 7); 2) perpetuating poisonous “oppositionalilty” in our lives and ways of thinking, which fuels individualistic egos, and thereby, fragments us further by instigating “corrosive exchanges” whenever we encounter different cultural points of view (p. 7); 3) inhibiting our opportunities to envision alternative possibilities for individual and collective change as it keeps us locked into identity-based divisions and inequalities, the very movements it opposes, because the oppositional politics essentially rests on explicit/implicit oppositional distinctions among different cultural groups. Hence, this third premise of transformational multicultural education asserts that to bring radical social transformation, we must employ a nonbinary, relational oppositional stance.

2.8.4 Premise #4 Radical, liberatory change—on both individual and collective levels—is urgently needed and in fact possible, although not necessarily easy to achieve

Acknowledging classrooms as potential “places of change”, the fourth and final premise of connectionist transformational multicultural education advocates for deliberately employing context-specific, negotiable changes to enact transformation. It invites educators to self-
reflectively engage in “praxis” by developing and testing “multicultural feminist theories” in contexts of their specific teaching situations and modifying these on the basis of students’ needs, concerns and feedback. By emphasizing the mutual complicity, accountability, and interlocking power-inflecting identities in every-day classroom practices, transformational multicultural education calls for engaging in complicated, nuanced explorations of cultural diversity in the form of “transcultural dialogues,” which do not ignore differences but rather utilize these differences to generate complex commonalities (p. 16). Though, as a teacher, one must be cognizant that these transcultural dialogues could be painful as they challenge us to (re)examine and (re)configure our preconceived beliefs and worldviews, and require hard work, flexibility in goals, and continued belief that transformative positive change can happen (Anzaldúa & Keating, 2002).

Understandings of critical and transformational multicultural education perspectives could be implemented through pedagogical approaches that are culturally responsive. Gay’s (2010b) CRT is one such approach, the core elements of which are described in the following section.

2.9 Core Elements of Culturally Responsive Teaching

According to Gay (2010b), CRT is a “power pedagogy,” which recognizes cultural diversity as a strength, and emphasizes that culture plays an important role in how students receive and interpret knowledge —“Culture counts: Culture is at the heart of all we do in the name of education, whether that is curriculum, instruction, administration, or performance assessment” (p. 8). Hence, CRT encourages teachers to become “cross-cultural counselors” (Banks, 1981, p. 1) and “cultural broker[s]” (Stewart, 2010, p. 155) who can understand the
dynamics of culture and diversity, and operationalize these within the contexts of their classrooms and communities to promote equity and excellence for all students.

CRT requires building on what the students of diverse cultural groups have and engaging them in genuine “colortalk” that informs their “academic, civic, social, personal, political, moral, and transformative learning goals and behavioral dimensions,” (Gay, 2010b, p. 51). It facilitates “critical consciousness [by] engender[ing] respect for diversity and acknowledge[ing] the importance of relationships, while honouring, building on, and drawing from the culture, knowledge, and language of students, teachers and local community” (Nicol et al., 2010, p. 18).

Gay (2010b) defined CRT as “using the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them” (p. 31). The fundamental aim of CRT is to empower culturally diverse students. Gay (2013) stated:

The education of racially, ethnically, and culturally diverse students should connect in-school learning to out-of-school living; promote educational equity and excellence; create community among individuals from different cultural, social, and ethnic backgrounds; and develop students’ agency, efficacy, and empowerment. (p. 49)

Hence, making knowledge accessible and relevant by connecting it to students’ lives and experiences within and beyond the boundaries of classrooms are central in CRT, which strives for empowering and promoting personal efficacy, academic achievements and cultural efficacy among culturally diverse students. Gay (2010b) identified pedagogical potential of CRT as “Validating, Comprehensive, Multidimensional, Empowering, Transformative, and Emancipatory” (pp. 31-38).
By recognizing students’ cultural diversity as a strength and incorporating it into daily teaching, CRT validates cultural ways of knowing and makes learning relevant and meaningful. With its focus on the whole child, intellectually, emotionally, socially, and politically, CRT is a comprehensive and multidimensional pedagogy that emphasizes the importance of students’ cultural heritages and involves these in all aspects of teaching, i.e., curriculum, instruction, classroom environment, student-teacher and peer relationships, parental and community engagement, assessments, and other contextual factors that play a crucial role in creating an empowering educational experience for diverse students.

According to Gay (2010b), ensuring the development of academic knowledge and skills, inquiry, curiosity, and critical thinking skills that translate into students’ personal lives and motivate them to determine their role in bringing positive social change, CRT incorporates practices that are transformative and progressive. It broadens students’ minds towards multiple cultural perspectives and for acknowledging difference with respect and a critical understanding of socio-political, cultural contexts which may promote or hinder equitable educational opportunities for diverse students.

Aiming to simultaneously cultivate cultural integrity, individual abilities, and academic success of diverse students’ by “teaching through their own cultural filter” (Gay, 2013, p. 50), CRT is:

an equal educational opportunity initiative that accepts differences among ethnic groups, individuals, and cultures as normative to the human condition and valuable to societal and personal development. It foregrounds the positive learning possibilities of marginalized students and their heritage groups instead of belaboring their problems and pathologies. (pp. 50-51)
Recognizing that education is a socio-cultural, political process (Freire, 2000), and consciously or unconsciously, culture affects how we think, believe, act, teach and learn, Gay (2010b) proposed CRT to guide and enable teachers ensuring responsive teaching in their classrooms. Ladson-Billings (1995), identified culturally responsive pedagogy (her preferred term) as a “pedagogy of opposition,” which is committed to collective empowerment by promoting academic success, cultural competence, and critical consciousness to understand and change existing social order among culturally diverse students (p. 160).

CRT encourages teachers to acquire deep cultural knowledge of diverse students and critically examine their own cultural biases with continual engagement with the socio-political cultural codes and codes of power that influence pedagogical relationships in cultural diversity-rich classrooms (Delpit, 2006; Ladson-Billings, 2009; Young, 2010). It informs their understandings for developing a caring, cross-culturally competent, and culturally congruent curriculum and instruction. I have discussed the key characteristics of this CRT in form of five core elements, which I have described below.

2.9.1 Developing a cultural knowledge base

Gay’s (2010b) first core element of CRT posits that to meet the educational needs of culturally diverse students, it is essential for teachers to strengthen their own cultural knowledge base by recognizing students “funds of knowledge” (Nashon & Anderson, 2013, p. 403) and contributions of different ethnic groups. It demands teachers to broaden their understandings of cultural diversity beyond mere awareness of, respect for, and general recognition of the differences among cultural values and beliefs.

Strengthening a cultural knowledge base also requires teachers to develop their own and their students’ socio-cultural awareness by creating opportunities for — “understanding oneself,
knowing one’s roots, knowing the culture to which one belongs, as well as recognizing the fact there are ‘cultural differences in the world’… [and developing the ability] to perceive that there are positive and negative aspects of cultural differences” (Luka, 2012, p. 261). When teachers develop sociocultural consciousness, they understand that their worldviews are influenced by their life experiences, race, ethnicity, gender, socio-economic class, and many other cultural factors (Villegas & Lucas, 2002).

Socio-culturally conscious teachers have affirming attitudes towards their diverse students as they see cultural differences as potential resources for learning rather than as problems to be overcome (Daniel, 2016). They are familiar with the diverse “ethnic groups’ cultural values, traditions, communication, learning styles, contributions, and relational patterns” (Gay, 2002b, p. 107). These understandings help teachers in developing cultural sensitivity and sensibility (Kovach, 2013; Ladson-Billings, 2009) to see how their interactions with their students might be influenced by their own cultural beliefs and help them develop attitudes and expectations to how to integrate diverse cultural knowledges and experiences of their students into their teaching to ensure a responsive and inclusive classroom (Bransford, Darling-Hammond, & LePage, 2005).

The last pillar that could strengthen teachers’ cultural knowledge base is their on-going, reflective engagement with the scholarship of multicultural education along with continued efforts to learn about specific features and peculiarities of diverse cultural groups, and their contributions to a wide variety of disciplines.

2.9.2 Developing culturally relevant curricula

The second element of CRT encourages teachers to utilize their cultural knowledge base to make their curriculum and instruction culturally relevant. It invites teachers to integrate
diverse linguistic and cultural resources to approach academic problems and incorporate students’ cultural experiences into classroom learning experiences. However, many teachers are preoccupied with the universality of symbol and number systems of science and mathematics, and see these subjects as “free of culture” (Blades et al., June, 2001, p. 31), and thus, incompatible for integrating diverse cultural aspects (Gay, 2002b).

Such teachers often struggle to utilize students’ cultural experiences as starting points of instruction (J. C. Brown & Crippen, 2017). Their efforts to make the learning of these subjects relevant and meaningful for culturally diverse students are mostly limited to superficial content integration (Banks, 2010; Kirova, 2008). Gay (2013) reasons that while integrating cultural content, it is crucial for teachers to include accurate information about ethnic and cultural diversity and include both contemporary cultural content as well as historical foundational experiences “to counteract the negative discriminations and distortions perpetuated in conventional conceptions of knowledge and truth, in schooling generally, and in society at large” (p. 49).

According to Gay (2002b), to build culturally responsive curricula, teachers need to develop capabilities of analyzing and evaluating formal school curricula to determine the multicultural strengths and weaknesses of standard curriculum designs and instructional materials and make the changes necessary to improve the overall quality of their teaching. It requires teachers to reverse the trends of apolitical teaching that avoids controversial issues of racism, historical atrocities, powerlessness, and hegemony. It encourages teachers to deal directly with controversy by including diverse cultural knowledge and multiple perspectives and contextualizing these within race, ethnicity, gender, socio-economic class, and other socio-
cultural variables to do instructional justice to the complexity, vitality, and potentiality of cultural diversity.

Developing culturally relevant curricula also requires teachers to develop critical consciousness about the power of the “symbolic curriculum,” which is reflected through the display of pictures, symbols, icons, various artifacts, mottoes, as well as by the celebrations, statements of social etiquette, rules and regulations on their classroom and school’s bulletin boards (Gay, 2002b, p. 108). It is crucial that teachers utilize these displays as an instrument of teaching to share information, values, and actions of diverse cultures to enhance students’ knowledge, skills, and understandings of cultural diversity.

In addition to the formal and symbolic curricula, culturally responsive teachers are aware of the negative influences of “societal curriculum—the [misleading and distorted] knowledge, ideas, and impressions about ethnic groups that are portrayed in the mass media” (Gay, 2002b, p. 109). To create culturally relevant curricula, it is essential that teachers create opportunities for thorough and critical analysis of information presented through mass media and popular culture to help their students become judicious consumers of information disseminated through the societal curriculum.

2.9.3 Cultural caring and building a learning community

Motivating teachers to go beyond “aesthetic caring” of personal humaneness and instructional judiciousness, and embrace “authentic caring”, the third element of CRT demands fairness, rightness, equality, and morality with a responsiveness of understanding people in context (Gay, 2010b, p. 49). Emphasizing the establishment of welcoming, safe and inclusive classroom environments that are conducive to learning of all students, cultural caring requires teachers to utilize “cultural scaffolding” by guiding diverse students in the learning process to
utilize their own cultural understandings and experiences to expand their intellectual horizons and achieve academic success.

Recognizing that caring is a multidimensional “powerful ideological and praxis pillar of culturally responsive pedagogy” (p. 75), this element of CRT invites teachers to become “warm demanders” as caregivers, authority figures, and pedagogues who hold high expectations for academic success of all students (Bondy, Ross, Hambacher, & Acosta, 2013, p. 422; Ware, 2006). With unconditional positive regard, these warm demanding teachers embrace and embody genuine caring in spite of what that student might do or say (Bondy & Ross, 2008). They are committed to act competently with respect, honour, integrity, and a deep belief in the possibility of transcendence of culturally diverse students with a sociopolitical consciousness that strives to ensure equity and excellence for all, especially for students who have been historically marginalized including Indigenous students (Hambacher, Acosta, Bondy, & Ross, 2016).

In addition to caring, building a learning community among diverse students is another essential element of CRT. It requires teachers to understand the cultural preferences and learning styles of their diverse students to design non-conflicting communal learning environments, which do not hinder academic efforts and outcomes of diverse students. Such understandings will enable the teachers and students to see and understand the differences in one’s own and other people’s cultures and accept, acknowledge and engage in cross-cultural communication with respect, relevance and relationality (Archibald, 2008; Keating, 2007; Kovach, 2013).

The use and promotion of heritage languages is critical and integral to CRT to ensure culturally diverse students’ success, and for building caring and personally fulfilling learning communities (Averill et al., 2009). Heritage or native language use may help students in learning Science and facilitate conceptual development by allowing them to simultaneously interrogate
the structures, traditions, value systems and stereotypes embedded in their own socio-cultural contexts and learning environments (Delpit, 1988; 2006; Krugly-Smolska, 2013; Ladson-Billings, 1995).

2.9.4 Cross-cultural communications

The fourth pivotal element of CRT requires teachers to understand that culture and communication are mutually interdependent, and their interplay plays a key role in improving cross-cultural communications (Gay, 2010b). Acknowledging the connections between culture and communication as having profound implications for teaching and learning, this element guides teachers to decipher the “culturally encoded” intellectual thought and actions of their culturally diverse students (Gay, 2002b, p. 110). It encourages them to acquire knowledge about “the linguistic structures of various ethnic communication styles as well as contextual factors, cultural nuances, discourse features, logic and rhythm, delivery, vocabulary usage, role relationships of speakers and listeners, intonation, gestures, and body movements,” and utilize these understandings to modify classroom interactions to accommodate these diverse communication styles to support students’ learning and academic achievements (p. 111).

Thus, this element of cross-cultural communications encourages teachers to acquire “multicultural communication competency” to deal with the issues of cultural diversity and difference (Gay, 2002b, p. 112). Such competency enables teachers in developing instructional communications that do not violate the cultural values of diverse students, allows them to better decipher the intellectual abilities, needs, and competencies of their diverse students, and teach their students “code-shifting skills” so that the students can learn to communicate differently in different contexts for different purposes (p. 112). As Delpit (2006) mentions, there is a “culture
of power” that is enacted in every classroom and it reflects the culture of people who are already in power (p. 24). Therefore, it is important that teachers are aware of such power dynamics and teach “codes of power” to all students to ensure equitable cross-cultural communication in their classrooms (p. 24).

### 2.9.5 Cultural congruity in classroom instruction

Acknowledging the centrality of culture in all educational processes, this fifth and final element of CRT stresses that teaching to culturally diverse students should be “multiculturalized” (Gay, 2002b, p. 112). This element guides teachers in bridging the cultural gaps in classroom instruction by including diverse cultural frameworks in whole educational processes and matching instructional techniques to the learning styles of diverse students. To dilute the tensions among different cultural intersections and incompatibilities that might occur between the cultures of schools and values of different cultural groups, this core element requires teachers to gain knowledge of diverse cultural characteristics and confront their own misconceptions regarding diverse learning styles.

Considering that the learning styles are complex, multidimensional, and dynamic, to respond most effectively to diverse learning styles of their students, this element of CRT requires teachers to know how learning styles are configured for different cultural groups as well as the existing patterns of variance within these configurations. In addition, to ensure cultural congruity in their teaching, teachers need to develop rich repertoires of multicultural instructional examples and integrate these into high-status instructional processes and high-stakes school subjects such as science, mathematics, reading, and writing on a habitual basis. Integration of these examples serves as “pedagogical bridges” which help connect abstract and new concepts with the prior knowledge and lived realities of culturally diverse students (Gay, 2002b, p. 113).
Hence, to recapitulate, CRT acknowledges the deep embeddedness of culture within all educational processes, and integrates multiple ways of knowing, diverse cultural understandings and values in teaching and learning processes. Building on the above mentioned five core elements, CRT ensures the recognition of individual self-worth and the development of academic abilities and achievements along with cultural affirmation, social consciousness and critique, community building and personal connections and an ethic of caring in diversity-rich classrooms. By cultivating cooperation, collaboration, reciprocity, and critical social consciousness and critique, it invites knowledge co-construction as a mutual responsibility for learning among students, and between students and teachers, and develops students who can both understand and critique the existing social order (Ellerbrock, Cruz, Vásquez, & Howes, 2016; Gay, 2010b).

2.10 (Trans-multi)culturally responsive education

I have synthesized the above discussed theoretical perspectives in the form of a (trans-multi)culturally responsive education framework on which I have grounded my work as a teacher, teacher educator and researcher. The prefix “trans” in this framework emphasizes the transformative nature and connectionist potential of multicultural education as also reinforced in Keating’s (2007) transformational multicultural education and Ladson-Billings’ (2004) harmonious conceptualization of multiculturalism as a “Jazz”.

The “trans” also reflects the necessary transcendence of our individualized identities that are often fractured and fragmented on the basis of culture, ethnicity, class, gender, race, sex, sexual orientations and dis/ability or other discriminatory, divisive boundaries to facilitate conceptualization and enactment of “(trans-multi)culturally responsive curricular discourse” in contemporary cultural-diversity-rich classrooms (Raisinghani, 2016a, p. 189). It also suggests a
“trans/national” conceptualization of Science (Krugly-Smolska, 2004, p. 421, original emphasis), which would allow us to see the cultural aspects of all Indigenous Sciences including Western, and recognize the contributions of all cultures and countries without negating the historical and material effects of different socio-cultural-political contexts on Science.

The “trans-multi” connections symbolize the relational connectedness embodied in the moments of teaching and learning, which could allow educators to teach their students (w)holistically by educating the “heart, mind, body and spirit” (Archibald, 2008). It also signifies our interconnectedness as relational (trans-multi)cultural human beings who are able to connect with each other as one “human kin” (Grimmett, 2013, December), who are willing to inquire into our own intentions about (trans-multi)culturally responsive education with full consciousness. A critical (trans-multi)culturally responsive approach emphasizes that “scientific knowledge is both personally and socio-culturally constructed” (Bishop, 1994; Driver et al., 1994; Kuhn, 1970; Raisinghani, 2016a, 188). It acknowledges that different views of science and mathematics are firmly rooted in certain cultures, which influence how these systems of knowledge are formulated and utilized in diverse cultural contexts (Aikenhead & Ogawa, 2007; D’Ambrosio, 2008; Selin & D’Ambrosio, 2001; Stanley & Brickhouse, 2001).

Given the contested nature of the official multicultural policy and various interpretations of multiculturalism in Canadian educational contexts (Fleras, 2009; Ghosh & Abdi, 2013), responding to needs of diverse students has been a constant challenge for Canadian teachers as evident in literature and also reflected in the findings of this study. I hope that this (trans-multi)culturally responsive education framework will provide a “common ground” for educators to invite a (trans-multi)culturally responsive education for their culturally diverse students, which include students with all cultural (including Indigenous) backgrounds, ethnicity, gender, race,
sex, sexual orientations, dis/ability or other exceptionalities. Figure 3 visualizes this (trans-multi)culturally responsive education framework.

Figure 3 (Trans-multi)culturally Responsive Education Framework

Acknowledging that teaching is a “contextual, situational and personal process… a complex, never-ending journey” (Gay, 2010b, p. 22), embracing the above five core elements of CRT is a beginning step towards becoming a (trans-multi)culturally responsive teacher. One
must be cognizant that only awareness about these core elements with mere appreciation of cultural diversity, and “goodwill,” will not change the educational enterprise (p. 14). To truly bring education that is (trans-multi)culturally responsive—education that challenges the status quo and allows individual and collective empowerment of all students; along with acquiring critical pedagogical knowledge and skills to teach culturally diverse students, each individual teacher would need to have “courage to dismantle the status quo” (p. 14).

To do so, teachers would need to become critically aware about the intellectual processes that schools emphasize and neglect, and also of the hidden or “null curriculum — what schools do not teach” (Eisner, 1979/1994, original emphasis, p. 97; Null, 2011, p. 93). While integrating cultural aspects in science and mathematics, it is important to teach students not only about the controversy over what is (to be) included in the “official” (Hodson, 2010, p. 201) curricula prescribed in the “educational menu”(Eisner, 1979/1994, p. 88), but also how issues of power and knowledge intersect in deciding “what knowledge is most worth” (Pinar, 2011, p. 7), and/or “what knowledge counts” (Dei, 2011, p. 18) in particular socio-political cultural contexts. The teachers need to be aware of the cultural content and knowledges that are missing and deliberately invite their students to fill-in the “empty shelves” (Henry, 1994, p. 302-304) with the culturally congruent curriculum and instruction (Gay, 2010b). To bring such a change, each teacher would need to acquire courage to transform their own teaching practices through much deeper action that requires asking themselves: What does it mean to become a (trans-multi)culturally responsive educator (Nieto, 2000a)?

The journey for teachers to become (trans-multi)culturally responsive educators requires first becoming a (trans-multi)cultural person by transcending one’s culture-bound identity and
culture-based beliefs to confront one’s own racism and biases and thereby, learning to see reality from multiple perspectives (Gay, 2003; Nieto, 2000a).

Indeed, becoming a (trans-multi)culturally competent teacher is a “metamorphosis” that involves a deep “personal awakening and call to action” (Nieto, 1999, p. xviii). It is an ethical commitment that one must make with one’s own spiritual self without which “any attempts at developing a multicultural perspective [for teaching and learning] will be shallow and superficial” (Nieto, 2000a, p. 338). It is a “crystallizing process,” where similar to the 4C’s of diamonds: i.e., “clarity, carat weight, cut and color,” synergistic processes of growth, understanding, endurance, and change in personal, professional and academic multicultural knowledge, ideologies, and practices will crystallize in a “good [trans]multicultural educator” who continues to critically research, examine and incorporate multicultural perspectives into understanding, teaching, and learning (Jackson, 2003, pp. 42-43).

Thus, perspectives of critical and transformative multicultural education and CRT invite teachers to become “[trans]multicultural human beings” (Erickson, 2010, p. 37). Teachers who are willing and committed to examine and transcend the “deformed, fragmented, and incomplete” (Pinar, 1993, p. 61) story of formulized official curriculum, which is based on a colonial version of one national history (Raisinghani, 2016a)—who by being “critical to Othering” (Tupper & Cappello, 2008, p. 570), are committed to bring education that is not only multiculturally responsive but is (trans-multi)culturally responsive.

2.11 Summary

The comprehensive review and synthesis of literature reveals that even though multiculturalism and multicultural education policy are being implemented in Canada, the provincial autonomy of education along with multiple interpretations of multiculturalism has
resulted in an obscured discourse of multicultural education in the country. Efforts to prepare teachers to teach for diversity are still trivial in most teacher education programmes. Cultural diversity continues to be the greatest challenge for teachers especially in diversity-rich science and mathematics classrooms where these subjects are often taught as objective, neutral, acultural bodies of factual knowledge.

Critical and transformative multicultural education and CRT strive to ensure empowering and equitable education for culturally diverse students by placing culture, diversity and difference in the center of teaching processes. By questioning and dismantling the structural and institutional forces of discrimination and inequity, they call for restructuring total school environments, reshaping teacher attitudes and beliefs about cultural, ethnic, and racial diversity, overcoming resistance to teaching for cultural diversity in teacher education programmes and K-12 instruction, including multiple cultural perspectives in curricula, and for promoting CRT to establish pedagogical connections between specific subjects and skills routinely taught in schools and lived experiences of culturally diverse students. The amalgamated insights of critical and transformational multicultural education complemented with the notion of CRT in form of a (trans-multi)culturally responsive education framework have guided me in this study. This framework has provided me a (trans-multi)culturally responsive lens to critically understand and interpret the participating teachers’ perspectives as juxtaposed with the socio-cultural contexts of the diversity-rich classrooms within which they teach science and mathematics to their culturally diverse students. In the next chapter, I provide the methodological underpinnings of this study.
Chapter 3: Methodology

The goal of this research is to investigate teachers’ perspectives about the effect of students’ cultural diversity on their science and mathematics teaching, and their understanding of and perspectives on CRT as a viable strategy for teaching in diversity-rich classrooms. Since the choice of a methodological approach depends on the nature of the research problem and the social phenomena to be explored (Noor, 2008), to investigate the research questions, I drew upon the principles of a qualitative case study approach (Merriam, 1988; 1998; Stake, 1995; 2000; Yin, 2014), and utilized phenomenographic methods (Marton, 1981; 1986; 2015) for data collection and analysis.

Conducted during the 2014-2015 school year, this study is guided by the following two overarching research questions: 1) What are K-12 teachers’ perspectives about the effect of students’ cultural diversity on their science and mathematics teaching? 2) What are the teachers’ understandings of and perspectives on culturally responsive teaching as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms?

Four sub questions follow: 1) What perspectives of science and mathematics do K-12 teachers hold? 2) What perspectives of cultural diversity and culturally diverse students in their science and mathematics classrooms do K-12 teachers hold? 3) What are the relationships, if any, among K-12 teachers’ perspectives of science, mathematics, students’ cultural diversity, and their teaching of science and mathematics? 4) What are these teachers’ understandings of and perspectives on CRT i.e., do they see it as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms or not?
A (trans-multi)culturally responsive education framework that emerged by synthesizing the key features of complementary perspectives of critical and transformative multicultural education (Keating, 2007; Nieto, 2000a) and the notion of CRT (Gay, 2010b) helped me in making sense of the data. Thus, in this chapter, I first present the study’s research design. I then share a description of the research participants and context of the study, which is followed by the details of data collection and analysis processes. Finally, I discuss the credibility and trustworthiness of the study and conclude the chapter with ethical considerations and limitations of the study.

3.1 Research Design

Qualitative research is based on a distinct methodological tradition of inquiry that explores a social or human issue to advance in-depth understandings (Creswell, 2012; 2014). Characteristics of qualitative research include an emergent research design that ensures reflexivity while gathering holistic accounts of participant’s meanings in their real-life natural settings (Denzin & Lincoln, 2000b; 2008). Through multiple data sources and inductive data analysis, it involves the researcher as a central instrument of interpreting and communicating the research (Marshall & Rossman, 2011; Schostak, 2002). Research designs include a clear articulation of the data collection and analysis processes, and strategically lay out the details regarding what methods will be used, which data will be gathered, and from where, how, and whom (Adeyinka-Ojo, Nair, & Khoo-Lattimore, 2014).

The purpose of the study and research questions play a central role in shaping the research design. Qualitative research designs aim to study people, events, programmes, problems, and the like in their natural settings (Lassonde & Israel, 2008; Yin, 2014). This study is largely informed by the principles of a qualitative case study approach (Merriam, 1988; 1998;
Stake, 1995; 2000; Yin, 2014), and utilized phenomenographic methods (Marton, 1981; 1986; 2015) to investigate teachers’ perspectives within the contexts of their science and mathematics classrooms.

According to Stake (1995; 2000), a case study is an empirical inquiry which investigates a contemporary phenomenon in depth within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident. In fact, the case study design is the most appropriate design in researching the complex and dynamic situations in which the boundaries between a phenomenon and its context are inextricably linked (Tetnowski, 2015), and it is impossible to separate the phenomenon being studied from the context (Adeyinka-Ojo et al., 2014). In a case study, the context is explained in a logical manner so that it connects empirical data to the initial stage of research up to the conclusion stage.

The intent of a case study is to represent the case, the phenomena of the study, by looking for the emergent patterns and themes (Merriam, 1988; 1998; Stake, 1995; 2000; Yin, 2014). Hence, considering that there can be multiple issues influencing the phenomena under the inquiry, the case study research utilizes multiple sources of data to enable the researcher to cover a broader range of issues, and develop converging lines of inquiry by triangulating the data collected from these multiple sources (P. A. Brown, 2008; Yin, 2014).

Case study research is well suited to investigate complex contemporary phenomena which require one to pose the questions: “How” or “why” is a phenomenon experienced (Merriam, 1998; Tetnowski, 2015)? Considering the complexities involved in understanding culture and cultural diversity, and how these may influence an individual’s thoughts and actions within dynamic yet constrained educational settings, utilizing the principles of a qualitative case study approach as a methodological framework to investigate teachers’ perspectives regarding a
contemporary phenomenon of cultural diversity within the real-life contexts of their cultural diversity-rich science and mathematics classrooms, is appropriate. To capture a holistic view of the complex, dynamic, and contemporary phenomena of cultural diversity in real-life settings (Merriam, 1988; 1998), this study sheds light on the interplay between cultural diversity, science and mathematics teaching, and the viability of CRT in diversity-rich classrooms by utilizing multiple sources of data to investigate the participating teachers’ perspectives. Considering the interpretive nature of case study research (Stake, 1995; 2000), these multiple sources of data for the study were collected through phenomenographic methods (Marton, 1981; 1986; 2015), primarily semi-structured interviews with the participating teachers and the field notes taken during informal observations of their select science and mathematics classrooms.

To preserve the “‘multiple realities [comprising of] different and even contradictory views of what is happening” (Stake, 1995, p. 12), the in-depth focus of this study is on cultural diversity within diversity-rich science and mathematics classrooms as expressed through teachers’ perspectives within a bounded system that has its specific parameters in relation to time, activity, and space (P. A. Brown, 2008). The case under study in this research has definite boundaries as the participating teachers had similar educational qualifications and professional credentials. For example, they all at least held a bachelor’s degree in education and a certification to teach in British Columbia and were involved in teaching science and mathematics within elementary and secondary schools of Vancouver during school year 2014-2015. They all shared their perspectives in real-life contexts, i.e., in their diversity-rich elementary and secondary classrooms of Vancouver schools (Yin, 2014).

However as Yin (2012) notes, the distinction between “the case and its contextual conditions—in both spatial and temporal dimensions—may be blurred” (p. 145). To
contextualize the meanings inherent in teachers’ perspectives shared during their individual interviews, I informally visited their classrooms while they were teaching science or mathematics to their culturally diverse students. These informal observations of teachers’ classrooms helped me get a feel of the life in these classrooms and examine relevant contextual conditions, (Merriam, 1998; Yin, 2012) as well as allowed me the opportunities to place the teachers’ perspectives into context “by circumscribing what is inside and outside of the case” (VanWynsberghe & Khan, 2007, p. 4).

Emphasizing the variation in concern and methodological orientation to the case, Stake (1995; 2000) identified three types of case studies, namely, intrinsic, instrumental, and collective. In an intrinsic case study, a case itself is of primary interest and is undertaken for the study because of its particularity and not because it represents other cases or illustrates a particular problem or an issue. A case study is considered an instrumental case study when the choice of a case is made because studying it helps advance gaining insights into an issue or in redrawing generalizations that inform the issue of interest. Hence, in an instrumental case study, the case plays a supportive role and facilitates understanding of the issue or phenomena of interest. An instrumental study which is extended to include many cases forms a collective case study in which a number of cases are jointly studied to investigate and understand the phenomena or issue of interest.

Based on Stake’s (1995; 2000) above characterization of case study types, the present research aligns well with the principles of an instrumental case study as the focus of this research is not on investigating individual teacher’s teaching practices or studying each teacher as a case. Rather it aims on gaining insights about the phenomenon of cultural diversity within the real-life contexts of participating teachers’ science and mathematics classrooms by seeking their
perspectives regarding the effect of cultural diversity on their science and mathematics teaching, and about the viability of CRT in their diversity-rich classrooms. In the next section, I discuss the recruitment process of these teachers and their brief profiles.

3.2 Participants of the Study

Participating teachers in this study were recruited from various elementary and secondary schools of Vancouver, which is one of the most culturally diverse school districts in Canada, with sixty percent of its student population speaking a language other than English at home (Vancouver School Board, 2018). After getting ethics approval for the study from the University of British Columbia Behavioural Research Ethics Board (UBC BREB) and Vancouver School Board, I took written permission from the principals of select elementary and secondary schools\textsuperscript{11} to allow me to contact teachers from their schools. These principals helped me in contacting the teachers by sharing my invitational email which contained a brief introduction of the study along with the inclusion criteria for the probable participants and contact address of the researcher(s).

To recruit a select group of teachers (n=10), I utilized a purposeful sampling snow ball chain (Merriam, 1998), where I requested initial volunteering teachers (some of whom I knew as teachers of my daughters) to help me in contacting other probable participants. Even though balance and variety are important while recruiting the participants for a qualitative research study and there could be multiple variations among teachers based on their age, gender, educational and teaching experiences, cultural and socioeconomic backgrounds, the school and the grade

\textsuperscript{11} Although the schools were selected based on the statistics around ethnic and linguistic diversity, as evident in the study's research questions and theoretical framework, this research addresses broader notions of cultural diversity.
level at which they teach etc., the main criteria for teachers’ inclusion in this study was their current involvement in teaching science or mathematics to culturally diverse students of Grade K-12 within the elementary and secondary schools which fall under the Vancouver School District 39’s jurisdiction and their self-identified interest in the study. The willing volunteering teachers (n=10) were individually asked to sign a consent letter that was prepared as per the UBC BREB guidelines. This letter also contained information about researcher(s), and the conditions regarding participants’ partaking and withdrawal from the study (Please see Appendix A for a complete Informed Consent Form used to get consent from the participating teachers in this study).

I understand that the small sample of teachers participating in this study (n=10) is not representative of the totality of teachers in wider Canadian context. However, as Stake (1995; 2000) emphasizes, a good case study does not depend on defending the typicality of the case; the focus of this study is on generating rich, thick descriptions (Merriam, 1988; 1998) of the select Vancouver teachers’ perspectives to gain insights about the effect of students’ cultural diversity on their science and mathematics, and their understandings of and perspectives regarding viability of CRT in their science and mathematics teaching. Stake (2000) mentions, “a case study is both a process of inquiry about the case and a product of that inquiry,” where the focus is on what specifically can be learned from the case (p. 436). The insights gained from this study might inform teachers’ understandings at a national Canadian and international levels especially in countries that value addressing the issues of cultural diversity within their cultural diversity-rich educational settings.

All participating teachers had at least completed Bachelors’ degree in teacher education for teaching at the specific grade levels and were certified to teach in British Columbia schools.
The teaching experiences of these teachers ranged between 8-30 years and their self-identified age was between 25-65 years. No specific data regarding these teachers’ socio-economic status, ethnic or cultural backgrounds or gender or sexual orientation was explicitly collected during the study. However, seven of the participating teachers self-identified as females: four teaching at the elementary level and three at the secondary level. The remaining three participants self-identified as males; two of these taught at the elementary level, and one taught at the secondary level. Racially, eight out of ten teachers self-acknowledged their White, Canadian identity. One of the remaining two teachers self-identified as an Indo-Canadian who was born in Canada, while the other teacher self-identified as a Chinese-Canadian who immigrated to Canada in the early 2000s. Brief profiles of these participating teachers are presented in the following Table 2.
<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Age/Age Range</th>
<th>Teaching Experience (in years)</th>
<th>Educational Background</th>
<th>Courses and Grade Level taught</th>
<th>Grade Level and Courses (taught during 2014-2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashley</td>
<td>Female</td>
<td>36-45</td>
<td>14</td>
<td>Bachelor of Science (Marine Biology); Bachelor of Education, Diploma in Outdoor education. Attended two professional development workshops which focused on education systems in other countries: how they run, what is expected of students etc.</td>
<td>Biology 11, 12; Chemistry 11; Math 8, 9; ESL Science; Science 8, 9 and 10.</td>
<td>Biology 12; Chemistry 11; Science 9 and 10.</td>
</tr>
<tr>
<td>Callum</td>
<td>Male</td>
<td>63</td>
<td>10</td>
<td>Bachelor of Arts (Major in English, Minor in Psychology), Bachelor of Education.</td>
<td>Grades 3-7: All subjects.</td>
<td>Grade 3-4: All subjects.</td>
</tr>
<tr>
<td>Claire</td>
<td>Female</td>
<td>45</td>
<td>21</td>
<td>Bachelor of Arts, Bachelor of Education, Master of Education-Special Education (Learning Disabilities).</td>
<td>Kindergarten and Grade 1 (K-1): All subjects.</td>
<td>Combined K-1 Grade: All subjects.</td>
</tr>
</tbody>
</table>

12 Names of all participating teachers are pseudonyms.
<table>
<thead>
<tr>
<th>Name</th>
<th>Gender (Self-identified)</th>
<th>Age/Age Range</th>
<th>Teaching Experience (in years)</th>
<th>Educational Background</th>
<th>Courses and Grade Level taught</th>
<th>Grade Level and Courses (taught during 2014-2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>James</td>
<td>Male</td>
<td>37</td>
<td>8</td>
<td>Bachelor of Arts (Major in Geography, Minor in Philosophy), Bachelor of Education, Diploma in Education.</td>
<td>Grades 4-8: All subjects.</td>
<td>Grade 4: All subjects.</td>
</tr>
<tr>
<td>Jessica</td>
<td>Female</td>
<td>46-55</td>
<td>30</td>
<td>Bachelor of Arts, Bachelor of Education, Diploma in Education, Master of Education.</td>
<td>Grade 3: All subjects.</td>
<td>Grade 3: All subjects.</td>
</tr>
<tr>
<td>John</td>
<td>Male</td>
<td>36-45</td>
<td>17</td>
<td>Master of Engineering (Materials Engineering), Bachelor of Education.</td>
<td>AP Physics 11,12; ESL Science; Math 8, 9,11; Physics 11, 12; Science 8, 9, 10.</td>
<td>AP Physics 11, 12; Physics 11,12.</td>
</tr>
<tr>
<td>Louise</td>
<td>Female</td>
<td>47</td>
<td>11</td>
<td>Bachelor of Arts (Geography), Bachelor of Education, Diploma in Early Years Education.</td>
<td>K-1: All subjects.</td>
<td>Combined K-1 Grade: All subjects.</td>
</tr>
<tr>
<td>Milica</td>
<td>Female</td>
<td>36-45</td>
<td>16</td>
<td>Bachelor of Arts (Major in Psychology, Minor in History), Bachelor of Education. Attended various math and literacy workshops that apply to the diversity of students’ learning needs in the classroom.</td>
<td>Grade 2, 3: All subjects.</td>
<td>Grade 2: All subjects.</td>
</tr>
<tr>
<td>Name</td>
<td>Gender (Self-identified)</td>
<td>Age/Age Range</td>
<td>Teaching Experience (in years)</td>
<td>Educational Background</td>
<td>Courses and Grade Level taught</td>
<td>Grade Level and Courses (taught during 2014-2015)</td>
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<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Meera</td>
<td>Female</td>
<td>25-35</td>
<td>10</td>
<td>Bachelor of Science (Animal Biology), Bachelor of Education (Mathematics and Aboriginal Education), Master of Education (Distance Education) in Adult Learning &amp; Global Change. Attended two professional development workshops on students with “special needs” and ELL students.</td>
<td>Academic Mathematics 10; Biology 11; ELL Science; Science 9, 10; Mathematics 8, 9, 10,11; Physics 11. Prior to full time teaching served as a First Nations Resource Personnel.</td>
<td>Biology 11; Science 9, 10.</td>
</tr>
<tr>
<td>Polina</td>
<td>Female</td>
<td>25-35</td>
<td>8</td>
<td>Bachelor of Science (Biology), Bachelor of Education (Indigenous Module).</td>
<td>ELL Science; Mathematics 8, 9; Science 8, 9.</td>
<td>ELL Science; Mathematics 8, 9; Science 8, 9.</td>
</tr>
</tbody>
</table>
3.3 Context of the Study

Participating teachers in this research were involved in teaching science and mathematics in two schools: Mountain Elementary School and Mountain Secondary School during the school year 2014-2015. Both of these schools are located near a large research university and fall under the jurisdiction of Vancouver School District 39, which is one of the most culturally diverse school districts in Canada with sixty percent of its student population speaking a language other than English at home (Vancouver School Board, 2018).

Mountain Elementary School transitioned from a Kindergarten to Grade 7 School into a Kindergarten to Grade 5 School in the 2014-2015 school year. The school had 340 students from all over the world with a 56% population comprised of English Language Learners (ELL) belonging to 32 different language groups. Nearly 4% of the student population had Aboriginal roots and almost 5% had Ministry designation as Special Education Learners (Vancouver School Board, 2014a).

Mountain Secondary School had a culturally diverse student population of approximately 850 total students enrolled in the school year 2014-2015, 80% of which did not speak English at home. The students enrolled included 45 students designated as Special Education Learners, 200 ELL, 125 international students and 8 Aboriginal students (Vancouver School Board, 2014b). While both of these schools strived to provide highest quality learning experiences for their diverse students in a safe, inclusive environment, they recognized that the highly transient multicultural nature of their student populations serves as a continued challenge in tracking the

13 The names of both participating schools are pseudonyms.
progress of all students over time in a generalizable manner (Vancouver School Board, 2014a; 2014b). The average number of students in the elementary classrooms ranged between 24-30 students, whereas all secondary classrooms had 28-30 students. In all these classrooms, more than half of the students spoke English as an Additional Language (EAL) and some of the elementary classrooms had 3-4 students who were designated as having “special needs”.

It is important to note that “class size” and “composition” were extremely hot topics for the participants and their colleagues in the British Columbia Teachers’ Federation (BCTF) for at least a decade prior to and throughout the duration of this study. This concern about increasing class size as adding to the challenges of students’ cultural diversity is an ongoing issue, raised by the BCTF and by the teachers in other provinces. (British Columbia Teachers’ Federation, 2018; Canadian Teachers’ Federation, 2011; Thomas, September 13, 2011).

Research suggests that the increased class size resulting in a lower teacher-student ratio negatively affects students’ achievements and contributes to further marginalizing culturally diverse students (Froese-Germain, Riel, & McGahey, February 8, 2012; Schanzenbach, 2014). In BC prior to 2012, there were 3,300 classes with over 30 students. Following the introduction of Bill 22 in 2012, which provided a provision for additional compensation to the teachers with class-size exceeding 30 students in Grades 4-12, the number of classes having over 30 students was reduced (British Columbia Public School Employers’ Association, n.d.). However, still there were 1,385 classes with more than 30 students in 2016–17 (BC Confederation of Parent Advisory Councils, 2012; British Columbia Teachers’ Federation, 2017, October).

It is also important to note that soon after collecting the data for this study, following a decision by the Supreme Court of Canada in November of 2016, the BC government was required to reinstate the class size limits, class composition provisions, and staffing ratios.
Beginning in the 2017-18 school year, the class-size limits for primary classes are 20 students for Kindergarten and 22 students for Grades 1 to 3, and the class-size limits for the middle and secondary classrooms vary according to the district’s local collective agreement (British Columbia Teachers’ Federation, 2018).

However, there has been no agreement or regulation made regarding class composition. In the past ten years, the number of classes with four or more students with “special needs” in BC public schools increased by 81%. In 2016–17, one in every four BC classrooms had four or more children with “special needs” (British Columbia Teachers’ Federation, 2017, October). In addition to this, the teachers may have many undesignated exceptional students in their classrooms because of parental reluctance to get their child tested for exceptionalities, as evident in the findings of this study.

3.4 Data Collection

Phenomenological methods, primarily interviews complemented with informal classroom observations, were principle in collecting data and in uncovering meanings inherent in data gathered for this study, which largely draws upon the principles of a qualitative case study approach (Merriam, 1988; 1998; Stake, 1995; 2000; Yin, 2014). Phenomenography aims to find and systematize the various forms of qualitative thought in which people interpret significant aspects of reality and make sense of the world around them by describing, analyzing, and understanding their experiences (Marton, 1981). These interpretations can be categorized because while “investigating people’s understanding of various phenomena, concepts, and principles in a… ‘phenomenographic enterprise’… each phenomenon, concept, or principle can be understood in a limited number of qualitatively different ways” (Marton, 1986, pp. 30-31).
Hence, phenomenographic inquiry is guided by an underlying epistemological credence emphasizing that different individuals experience the world differently. Everyone’s experience of any phenomenon is partial—it is just one part of the larger whole, the collective sum of ways in which that particular phenomenon could be experienced. Accordingly, at any point of time in a specific context, there could be certain limited different ways of experiencing a particular phenomenon, and these different ways are structurally related (Åkerlind, 2008; 2012). Therefore, the outcomes of a phenomenographic research are presented as “categories of description,” which represent empirical interpretations of different ways of experiencing one phenomenon, and an elucidation of logical or otherwise meaningful relationships among these categories in form of an “outcome space—a diagram or similar representation of those relationships” (Forster, 2013, p. 31).

Additionally, it is a fundamental belief in phenomenography that presenting a careful account of the different ways people think about a particular phenomenon, and elucidating the relationships between these different ways of experiencing the phenomenon, may help uncover conditions that may facilitate enhanced understanding of the phenomenon, and transform one’s thinking to a “qualitatively ‘better’ way of thinking” (Marton, 1986, p. 46). Phenomenography embraces a non-dualistic ontology:

There is not a real world ‘out there’ and a subjective world ‘in here’. The world [as experienced] is not constructed by the learner, nor is it imposed upon her [sic]; it is constituted as an internal relation between them. (Marton & Booth, 1997, p. 13)

In the same vein, the aim of this research is in describing, analyzing and understanding teachers’ varied experiences of students ‘cultural diversity and CRT within the contexts of their science and mathematics classrooms, as evident in their perspectives. Elucidation of teachers’
perspectives regarding the phenomena of cultural diversity and CRT, and analysis of relationships among these varied perspectives will promote “better” understandings of these phenomena in contemporary classrooms that are increasingly becoming more and more culturally diverse.

Phenomenography acknowledges that there can be limited, yet a variety of ways in which any phenomenon is experienced and people might make sense of same phenomenon in distinctly different ways (Marton, 1981; 1986; 2015). Utilizing a phenomenographic approach has allowed me to get unique perspectives of participating teachers who might have experienced the phenomena of cultural diversity and CRT in the specific contexts of their diversity-rich science and mathematics classrooms differently.

Interviewing has been identified as a main data collection method used by phenomenographers (Marton, 1986; Richardson, 1999). Therefore, based on a comprehensive theoretical framework of (trans-multi)culturally responsive education which is informed by the complementary perspectives of critical and transformative multicultural education (Keating, 2007; Nieto, 2000a), and notions of CRT (Gay, 2010b), I largely used semi-structured “open-ended interviews” (Yin, 2014, pp. 110-111) for data collection.

Each teacher was interviewed twice. To facilitate the contextualization of what is being shared through teachers’ interviews and to get a feel of the contexts within which these perspectives might have been formed, the individual teacher interviews were complemented with four informal observations in each teacher’s science or mathematics classroom(s) during Spring and Summer 2015. The entire data collection process involved three phases: the first and third phases comprised of individual interviews with each participating teacher, taken prior to and
after the informal observations to their classrooms, and the intermediate second phase involved four observations to each teacher’s science or mathematics classroom(s).

Going beyond the spontaneous exchange of views in an everyday conversation, qualitative research interviews have a definite structure and function. The process of these interviews is not a conversation where both partners are equal. In qualitative research interviews, researchers define and control the direction of the conversation with a careful questioning and listening approach aiming to seek knowledge and gain in-depth understanding of phenomena under the study (Kvale & Brinkmann, 2009). The strength of these qualitative research interviews lies in capturing the multitude of participants’ views around a central theme and picturing a manifold and controversial human world (Kvale, 1996).

In defending the interview as a preferred method for phenomenographic data collection, Marton (1986) stresses the open-endedness of interview questions and the researcher’s ability to ask subsequent questions that arise from a participant’s subjective experiences of experiencing the phenomenon as shared during the interview:

We used questions that are as open-ended as possible in order to let the subjects choose the dimensions of the question they want to answer. The dimensions they choose are an important source of data because they reveal an aspect of the individual’s relevance structure. Furthermore, though we have a set of questions at the start of the interview, different interviews may follow somewhat different courses. (p. 42)

Hence, phenomenographic interviews focus on establishing the phenomenon as experienced and to explore its different aspects conjointly and as fully as possible (Ashworth & Lucas, 1998). Through individual teachers’ interviews in this study, I have attempted to listen and interpret their perspectives regarding the effects of students’ cultural diversity on their
science and mathematics teaching, and how they understand and consider CRT as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms. The semi-structured, open-ended nature of these interviews allowed me the flexibility to respond to different teacher’s responses differently, while still being guided by the research questions that were central to this case study (Noor, 2008). However, while developing and designing, and posing the questions for the interviews, I was careful not to influence teachers’ responses by being a relational and respectful listener who probed their responses only for the purposes of clarity or elaborating the meaning(s) of perspectives that they shared (Yin, 2012; 2014).

The overall focus of the initial individual interviews was to investigate teachers’ perspectives regarding students’ cultural diversity and how they might see its effect on their science and mathematics teaching. First, I invited teachers to share their educational background, and then asked them to share their perspectives regarding their school and classroom contexts, and how do they view students’ cultural diversity and its effect on their teaching of science and mathematics. The interview questions included: Could you please describe your school and classroom? What is it like teaching this (culturally diverse) class? Has there been a time when you felt least prepared to teach such a class? Have there been joyous moments teaching such a class? In what ways do you think the science or mathematics that you teach is relevant for your (culturally diverse) students? What advice would you give to a novice teacher in such a classroom? Would you see yourself as having transformed through the experience of teaching such a class? In cases where teachers’ responses to the specific question(s) required more clarification or to confirm the meaning of what was being said, I asked probing questions such as: Could you please explain this further? Can you tell me more? What could be an example of this? I have included a complete Protocol for Interview Session 1 in Appendix B.
During the second phase of the study, I informally visited the science or mathematics classrooms of the participating teachers to have a feel for their classrooms. Merriam (1998) discussed five stances that an observer might take: complete participant, participant as observer, observer as participant, and complete observer and collaborative partner, where the researcher and participant are complete partners in the research process. My role during informal classroom observations of this study ranged from of an “observer as participant” to a “complete observer” depending upon the comfort level of the teachers and their students.

My goal during these informal classroom observations was to gain and appreciate the contextual realities of the classroom(s) (Noor, 2008; Yin, 2014), which in turn helped me in understanding teachers’ perspectives elicited in interviews given prior to and after these informal observations. In addition to noticing the physical set-up of the classroom and getting a general feel of the classroom atmosphere which might be dictated by and simultaneously perpetuate the hidden curriculum (Eisner, 1979/1994; Null, 2011), these informal observations helped me in gaining insights about how the teaching of specific science and mathematics content is being operationalized within these cultural diversity-rich classrooms.

As an observing participant in these classrooms, I specifically tried to take field notes regarding if there were any cultural connections made explicitly/inexplicitly by looking at the verbal and non-verbal cues, and specific resources and activities utilized for teaching science or mathematics, and by noticing the questioning style and strategies for making student groups. As Wolcott (2005) mentioned, the critical art in all observation is achieved through recognizing when something of significance has happened, my focus was also on taking account of any specific events that might have happened during these visit(s). A complete Classroom Observation Protocol that guided my observations during this study is included as Appendix C.
During the second individual semi-structured interviews in the third phase of study, I invited teachers to share their perspectives on their understandings of CRT, and their perspectives on its viability as a strategy for teaching science and mathematics in their diversity-rich classrooms by reflecting on and relating to the specific activities or event(s) that occurred during my informal classroom observations to each teacher’s classroom(s). The questions I asked involved: I wonder what comes to your mind when you hear of CRT. Of course, different people might understand it differently, but I am curious to know your own interpretation of CRT and if it has any relevance to your classroom? How do you see the school policies, curriculum, and textbooks affecting your teaching of science or mathematics (for diversity)? What strategies and resources do you utilize to make science or mathematics relevant for your students? I am curious to know more about that particular activity or event that happened that day etc. A complete Protocol for Interview Session 2 is included as Appendix D. Having these interviews after the informal classroom observations created an opportunity for me to appreciate different constructions and meanings that participating teachers placed upon their experiences by juxtaposing the teachers’ responses with my interpretations of what I experienced in their classrooms (Noor, 2008).

To keep record of the data during all interviews and informal classroom observations, I took field notes (Merriam, 1998). However, as everything cannot be written down, in accordance with Yin’s (2014) first principle of data collection, I also audio recorded all interview sessions, which allowed me the opportunity to refer to accurate accounts of conversations to review while analyzing the collected data (Noor, 2008). To increase the reliability of this study, I followed the second principle of Yin (2014) and maintained a formal database that included systematically
recorded field notes of individual interviews and informal classroom observations, as well as an annotated bibliography of relevant documents utilized and collected during the study.

I was able to conclude the data collection process with a follow-up email or brief informal meeting with certain teachers, which provided room for clarifying questions that arose during re-reviewing the data collected through individual interviews as well as the field notes taken during the informal classroom observations. Table 3 represents the stages of data collection and overall time-line of the entire data collection process:

Table 3 Data Collection Schedule (April-July 2015)

<table>
<thead>
<tr>
<th>Stages of Data Collection</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Collection Methods</td>
<td>Individual Interviews Session 1</td>
<td>Informal Classroom Observations</td>
<td>Individual Interviews Session 2</td>
</tr>
<tr>
<td>Follow-Up Emails/Debriefing Meeting</td>
<td>June-July, 2015</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.5 Data Analysis

Phenomenography argues that different individuals conceptualize and experience any specific phenomena in qualitatively different ways at any one point in time and context (Marton, 1986). Although varied, these individual experiences are structurally related with each other “in a part-whole relationship” because of peoples shared discernments regarding some of the same aspects of the specific phenomenon that they experienced (Åkerlind, 2008, p. 635).
Thus, during phenomenographic data analysis, first the verbatim transcripts of collected data are reviewed on the basis of “criteria of relevance” to select the quotes that are relevant to the research questions being investigated (Marton, 1986, p. 43). Even though each quote contains meaning in itself, interpreting each quote in relation to the contexts in which it was made is essential. Next, the boundaries separating the quotes on the basis of individual interviews are abandoned and selected quotes are brought together to make up the data pool, which is then analyzed to discover the “pool of meanings” (p. 43).

Hence, each quote is interpreted in relation to two contexts: the interview from which it was taken and the “pool of meanings” to which it belongs. This is followed by an iterative and interactive process of categorizing and re-categorizing the quotes on the basis of similarities and differences to discover emergent themes, which are identified as fundamental “categories of description” (p. 43). These themes are then defined and redefined, adjusted and readjusted by testing these against the data until a whole system of meaning is stabilized.

Thus, phenomenographic data analysis is a dialectic process of meaning making in which the different ways of experiencing the same phenomena that emerge are not established independently or taken for granted, but are problematized in relation to each other as potentially varying ways of discerning the same phenomenon within a specific context and point in time (Åkerlind, 2008). During the entire emergent process of phenomenographic inquiry, researchers are encouraged to focus on the experiences of participants by transcending their preconceived notions and biases and validating their interpretations through seeking counter examples and peer-debriefing (Richardson, 1999).

Hence, following phenomenographic methods, the data collected in this study were analyzed by transcribing audio-taped interviews while referencing to the field notes taken during
the interviews as well as during the informal classroom observations to generate contextualized “thick descriptions” (Stake, 1995, p. 102). Audio taping teachers’ individual interviews allowed me the opportunity to develop accurate and complete transcriptions by listening to the conversation again as needed.

Stake (1995) emphasized the greater need of categorical data while utilizing a case study approach, therefore, to understand teachers’ perspectives in this study, I organized the data by “putting information into different arrays, making a matrix of categories and placing the evidence within such categories and creating data displays” (p. 135). I primarily used tables and flowcharts to keep the data organized, and to keep a record of emergent patterns and themes while examining and analyzing the data (Yin, 2014).

Guided by the study’s research questions, to understand the unique perspectives and actions of teachers with regard to the effects of students’ cultural diversity on their science and mathematics teaching, and their perspectives on CRT as a viable strategy for teaching in their diversity-rich classrooms, transcribed data were sifted, compared, and contrasted (Huberman & Miles, 1994; Miles & Huberman, 1994). Reading and re-reading these transcripts for “meaning units” (Collier-Reed & Ingerman, 2014, p. 252), and examining similarities and differences among teachers’ perspectives helped me in identifying emergent themes (Marton, 1986; Miles & Huberman, 1994).

3.6 Reliability, Validity and Generalization

Reliability refers to the consistency and replicability of research and reflects the extent to which a measurement procedure can reproduce same results “however and whenever it is carried out” (Wolcott, 2005, p. 159). Thus, the rigor of reliability in findings requires the researcher to
establish consistency in procedures. However, non-manipulative contextualized conditions that are central to qualitative research render reliability as an “artifact” in a qualitative study (p. 159). Hence, Wolcott (2005) recommends that rather than apologizing for not addressing the issue of reliability adequately or attempting to defend reliability through thoroughly documenting procedural details, a qualitative researcher should emphasize contextualized circumstances. Miles and Huberman (1994) following Guba (1981), use dependability and auditability as parallels of reliability for qualitative research.

In its technical sense, validity refers to the degree of accuracy of a measurement — it asks whether a researcher has accurately reflected or assessed the specific phenomenon that the study originally intended to explore (Wolcott, 2005). Rather than limited to measurement, in a wider sense, validity refers to the “truth value—the correspondence between research and the real world”. Thus, validity can never be demonstrated, it can only be made “more likely” (p. 161). Therefore, to strive for validity in a qualitative research, rather than differentiating between what is valid and what is not, the researchers need to illustrate what they do to make the truth value of their accounts more likely or more credible. For Miles and Huberman (1994), the parallel concepts are credibility and authenticity.

Generalization, an alternative term for external validity or “transferability” or “applicability” (Guba, 1981), raises a fundamental epistemological question about qualitative research: “How can one determine the degree to which the findings of a particular inquiry may have applicability in other contexts or with other subjects” (pp. 79-80)? To answer this question, a researcher could candidly reply “whatever can be learned from a well contextualized study” (p. 164). Rather than making context-free generalizations, a qualitative case study approach follows a naturalistic paradigm which emphasizes ontological beliefs of multiple realities,
epistemological understandings that acknowledge relational, interrelated engagement of inquirer and respondents in the research processes, and aims towards developing “idiographic knowledge” by focusing on differences as frequently and with as much interest as on similarities (Guba, 1981, p. 77).

Hence, generalization in a qualitative case study approach requires the researcher to share the interpretivist meanings of the contextual realities of phenomena as they are played out during the course of individual cases and lives. To generalize the implications of the study, the researcher as an interpreter makes an essential choice between cherishing the uniqueness of the case and emphasizing how this single case can generally inform others (Stake, 1995; 2000). According to Wolcott (2005), the essence of generalizing qualitative research studies lies in making a few generalizations, implicating a few more, and inviting readers to take up the challenge of making further connections depending on their own concerns and prior experiences. Miles and Huberman (1994) refer to transferability as a concept parallel to generalizability.

Thus, there are ways through which dependability, credibility, and transferability of qualitative research can be achieved and justified. However, qualitative research is generally viewed from a positivistic paradigm and the rigor with which dependability, credibility, and transferability of such research studies can be addressed, is often questioned (Adeyinka-Ojo et al., 2014). Viewed from a positivist paradigm, qualitative research is usually characterized as “soft” (Anfara, Brown, & Mangione, 2002, p. 28) or even disregarded completely as “fiction not science,” with an argument claiming that “there is no way [for qualitative researchers] to verify their truth statements” (Denzin & Lincoln, 2000a, p. 8).

To respond to these concerns adequately, one could refer to Lincoln and Guba’s (1985) criteria of “trustworthiness” (alternative criteria corresponding to positivist’s criteria of rigor) for
evaluating qualitative research. Their framework builds on Guba’s (1981) paper, which presented a comparative table to represent scientific (quantitative) and naturalistic (qualitative) terms for four aspects that are usually utilized to evaluate the rigor or trustworthiness of research studies. I have presented the complementary understandings of Guba (1981) and Lincoln and Guba’s (1985) framework as Table 4.

**Table 4 Quantitative and Qualitative terms and corresponding Qualitative Strategies**

(Adapted from Guba, 1981, p. 80)\(^\text{14}\)

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Quantitative term</th>
<th>Qualitative term</th>
<th>Qualitative Strategies(^\text{15})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truth Value</td>
<td>Internal Validity</td>
<td>Credibility</td>
<td>Prolonged engagement; Member checks; Triangulation; Peer debriefing; Time series analysis</td>
</tr>
<tr>
<td>Applicability</td>
<td>External Validity or Generalizability</td>
<td>Transferability</td>
<td>Purposive sampling; Thick descriptions</td>
</tr>
<tr>
<td>Consistency</td>
<td>Reliability</td>
<td>Dependability</td>
<td>Audit trail; Code-recode strategy; Triangulation; Peer examination</td>
</tr>
<tr>
<td>Neutrality</td>
<td>Objectivity</td>
<td>Confirmability</td>
<td>Triangulation; Researcher’s reflexivity</td>
</tr>
</tbody>
</table>

Hence, rather than justifying a qualitative research study’s rigor through positivistic measures of reliability, validity and generalization, the trustworthiness of a qualitative research

\(^{15}\) Please see Lincoln and Guba (1985) for detailed description of these strategies.
can be achieved by ensuring credibility, transferability, dependability, and confirmability of the study (Guba, 1981; Lincoln & Guba, 1985). Credibility, an alternative term for internal validity establishes the “truth value” of the study by acknowledging that multiple realities exist in the minds of people and hence, diverse multiple perspectives, which can be similar, different or even contradictory, are plausible regarding the same phenomenon. Time-series analysis, which involves asking ‘how and why’ questions about the relationship of phenomena over time, along with prolonged engagement in the research process, helps in ensuring credibility (Adeyinka-Ojo et al., 2014; Anfara et al., 2002). Credibility can also be attained by “member checks” (Guba, 1981, p. 80), which ensure that a study is approved by the participants or people who provided the information.

Transferability, as also mentioned previously, refers to the generalization or applicability of a study’s findings to other contexts. Embracing the stability and trackability, elements considered essential to achieve rationalistic reliability, dependability refers to the consistency of the study’s processes over time. Dependability of a qualitative study can be achieved by sharing “trackable variance—variance that can be ascribed to sources: so much for error, so much for reality shifts, so much for increased instrumental proficiency (better insights), and so on” (Guba, 1981, p. 81). Confirmability is a measure of the transparency of the research processes of the study: What was done/how the research was conducted/and how the researcher arrived at the conclusions (Denzin & Lincoln, 2000b; 2008)? Hence, rather than “certifying” the investigator or the methods used as “free of biases” or “neutral,” confirmability stresses the evidence of transparency of data produced (Guba, 1981, pp. 81-82).

Considering that in social science inquiries all validity is interpretive as the language is not transparent (Lincoln & Guba, 2000), and the interpretations one makes are dependent on
context (Angrosino & de Perez, K. A. M., 2000), and also on one’s paradigm (i.e., the understandings that one brings to the observation) (Kuhn, 1970), to ensure the “truth value” of this research, I have attempted to portray the case comprehensively by using “non-technical description and narrative” (Stake, 1995, p. 134).

One way to ensure the credibility of a qualitative study is to provide access to the decisions that are made in the process of conducting the research (Anfara et al., 2002; Guba, 1981). Therefore, to make this study transparent and believable for the readers, I have shared detailed records of data collection, coding, and analysis procedures and have provided “thick descriptions” (Stake, 2000, p. 439) of data generated and context of the study. These holistic descriptions have also helped me in ensuring transferability of this research as they will maximize readers’ encounters with the complexities of the case. Including in-depth information will facilitate “naturalistic generalizations” (Stake, 1995, p. 126), and create opportunities for readers to decide how and in what ways my study’s findings are relevant in their contexts.

Reviewing the data transcripts carefully to code and recode emergent themes and requesting a colleague who is not involved in the study to review the “chain of evidence” (Yin, 2003, p. 105) of the data, and also to independently code some of the data has helped me in affirming the dependability of this research study.

To assure methodological rigor of this research that largely draws upon principles of qualitative case study approach (Merriam, 1988; 1998; Stake, 1995; 2000; Yin, 2014), I have utilized phenomenographic methods (Marton, 1981; 1986; 2015), which allowed me the variability and openness to include numerous data sources such as individual interviews and field notes taken during interviews and informal classroom observations. Reflexive reviewing of data generated during multiple stages of transcription and analysis, and member checking during this
whole research process helped me in triangulating the data and thereby, in ensuring confirmability and credibility of this research (Merriam, 1998).

Triangulation is generally a process of using multiple perceptions and types of data to clarify meaning, verifying the repeatability of an observation or interpretation in qualitative research (Creswell, 2014; Denzin & Lincoln, 2008). Since, no observation or interpretations are perfectly repeatable, triangulation serves to clarify meanings by identifying different ways a particular phenomenon is seen (Stake, 2000). However, as triangulation may produce data that are consistent, inconsistent, or contradictory (Mathison, 1988), as a researcher of this study, I have utilized triangulation not merely as a “technological solution for ensuring validity” but have tried to value the evidence created through triangulation to develop a “holistic understanding” of the phenomena being studied (p. 17).

Member checking allowed me to receive any additional or alternative interpretations offered by the participating teachers and thus, helped in checking the validity of my interpretations and also in preserving multiple realities by including even contradictory perspectives of what was happening (Stake, 1995). Coordinating the data sources and corroboration of these multiple qualitative techniques helped me in enhancing the credibility and dependability of findings of this study, which largely draws upon principles of qualitative case study approach (Noor, 2008; Yin, 2014).

3.7 Ethical Considerations

In qualitative research, the researcher’s personal reflections and views about the meaning of the data are included in the research study (Creswell, 2012). Hence, the ethos of an interpretive qualitative case study approach lies in “seeking out emic meanings held by people within the case” (Stake, 2000, p. 441). Equating the role of a case study researcher to that of an
interpreter, Stake (2000) emphasized that the goal of a case study researcher is to decide the criteria of representation of the case. While being respectful and empathic to each participant’s realities, it is the researcher as an interpreter who determines and tells “what the case’s own story is”, and thereby, assists readers in making their own connections and meanings of the case (p. 441).

I recognize that “during fieldwork the researcher’s power is negotiated, not given” (Merriam et al., 2001, p. 409), and therefore, while engaging in this entire research process, I have attempted to be consciously aware of my perceived positionality as an (in/out)sider as well as of my own cultural biases. Guided by the complementary theoretical framework of critical and transformational multicultural education perspectives (Keating, 2007; Nieto, 2000a) and the notion of CRT (Gay, 2010b), I am cognizant of the intersecting nature of culture, race, gender, socio-economic status and other distinguishing criteria that serve as underlying basis for knowledge.

Bourdieu (1992), points out that a social science researcher may attempt to impose the concepts or categories that are products of their own socio-cultural worlds. To avoid such biases, Richardson (1999) has proposed to utilize a reflexive approach that takes into account the social relationship between researcher and participants and the constructed nature of the research processes. Guided by the work of Freire (2000), who insisted that education is never a neutral process, I believe that this research has potential to contribute towards “people’s wellbeing— the well-being of students, teachers, communities, and others” (Hostetler, 2005, p. 17).

Thus, to honour the multiplicity of differences and uncertain complexities inherent in such ethical engagements, the “truth value” of this research is reflected in the views of all participants involved. Considering the dynamism involved in contemporary modes of schooling
and multiple interpretations of culture and cultural diversity, while sharing the “story” of this study, I have attempted to capture and reflect the correspondence between research and the real world by “paint[ing] a picture of the case as a whole” (Avery & Meyer, 2008, p. 76). While offering my interpretations of participating teachers’ perspectives regarding the phenomena under study, I have also tried to create opportunities for the readers to engage with the contextual realities of the case and make their own interpretations and connections with the case (Stake, 1995; 2000).

As a novice researcher who is still learning to navigate the world of educational research, I acknowledge that conducting research in human endeavors like education is complex. During the entire research process, I have followed ethical considerations for qualitative research that include obtaining informed consent, ensuring no harm and risk to the participants, establishing honesty and trust among researcher and participants, and guaranteeing privacy, confidentiality, and anonymity (Miles & Huberman, 1994).

My study was approved as a minimal risk study by the institutional ethics board UBC BREB and received an approval from Vancouver School Board. As per the UBC BREB guidelines, all participating teachers of this research received and signed an Informed Consent Form which included information regarding the principal investigator(s), the research purpose and processes, and the conditions for their partaking and withdrawal from the study. Specific attention was given to respect and acknowledge individual teacher’s perspectives during all stages of engagement in the research process and especially, while asking and responding to questions during the interview sessions. No direct communication with any of the students was made during informal classroom observations and any indirect information collected about the
specific student or group of students was appropriately anonymized while transcribing and reporting the findings of this research study.

To maintain confidentiality and anonymity, I have used pseudonyms for all the participating schools and teachers. All data are secured in password protected files and will be kept secured for five years after the completion of this study.

3.8 Limitations

The findings of this study are limited to the select sample of teachers and the specific contexts of their science and mathematics classrooms in a large urban city in Western Canada, which might not be entirely representative of the wider Canadian contexts in their totality. Moreover, considering the qualitative nature of this research, I acknowledge that the overlapping interplay of contextual realities and individual socio-cultural and educational backgrounds as well as epistemological and ontological views of participating teachers, and my own beliefs and experiences might have contributed in making this study a “highly personal research” (Stake, 1995, p. 135).

Even though during the entire research process, I was mindful of my own personal biases, I acknowledge that since I made overall decisions regarding this study’s research design and theoretical lens utilized, the findings of this research study are informed by my own understandings and interpretations of teachers’ perspectives. However, since the utility of a qualitative case study approach is not based on its reproducibility but on the value of meanings generated (Stake, 2000), I am hopeful that the insights gained from this study will inform teachers’ understandings in wider Canadian and other international contexts that value multicultural, intercultural, and transcultural understandings.
Given that only ten participants were included in this study, I was necessarily cautious in transferability. Participant recruitment did not include students and I realize that this is a limitation. Certainly, teachers’ perspectives often differ considerably from students’ perspectives.

3.9 Summary

This chapter presented the study’s research design, described participants and context of the study, and outlined details of data collection and analysis. This was followed by a discussion of the credibility and trustworthiness of the study. The chapter concluded with ethical considerations and limitations. The next chapter includes results of this study.
Chapter 4: Results

In this chapter, I present the findings of this study. First, I restate the guiding research questions along with an overview of data collection processes. I share the overarching themes that emerged from the qualitative phenomenographic analysis of the data collected from teachers’ individual interviews complemented with informal observations of their classrooms to depict their perspectives regarding phenomena of cultural diversity and CRT within the contexts of their science or mathematics classrooms. I conclude the chapter with a summary of the emerged key themes.

The two principal research questions of this study are: 1) What are K-12 teachers’ perspectives about the effect of students’ cultural diversity on their science and mathematics teaching? 2) What are the teachers’ understandings of and perspectives on culturally responsive teaching as a viable strategy for teaching science and mathematics in their diversity-rich classrooms?

As mentioned in the methodology chapter, the data for this study were elicited through phenomenographic methods, primarily individual teacher interviews which were complemented with informal classroom observations. The first interview was aimed at investigating teachers’ perspectives of students’ cultural diversity, their educational preparedness and experiences of teaching culturally diverse students, and how do they go about teaching of science and mathematics in their specific school and classroom contexts. The second interview session was focused on investigating teachers’ understandings and perspectives of CRT and its viability as a responsive teaching strategy to teach science and mathematics in their cultural diversity-rich classrooms.
During this second interview session, I also invited teachers to reflect on their specific teaching moments and specific classroom events or activities that I witnessed during the informal observations of their classrooms. I also posed questions that could help clarify specific actions and strategies used in those lessons. These interview sessions and experiences of classroom observations ensured the triangulation of data collected and helped me in gaining an in-depth understanding of teachers’ perspectives of cultural diversity and CRT.

During my analysis and interpretation of these ten teachers’ individual interviews, I reflected on the contextual realities of their science or mathematics classroom(s) as I experienced during informal observations. While analyzing the data, I was also aware that the select teachers’ participation was completely voluntary, and thus, indicates their presumed interest and greater awareness about the phenomena of cultural diversity and CRT. Hence, the transferability of the findings is based on and limited by the perspectives shared by these ten teachers. In the next section, I share the overarching key themes that emerged from the analysis, along with the corresponding quotes of the teachers for each theme to reflect the multiplicity of voices and responsiveness towards acknowledging multiple ways of knowing, as guided by the theoretical framework of the study.

4.1 Emergent Key Themes

4.1.1 Theme 1 Cultural diversity as a mosaic

While reflecting on the demographic of the student population of their schools and classrooms, all the participating teachers acknowledged the rich diversity of the cultural backgrounds that their students bring into their science or mathematics classrooms. Describing the increasingly multicultural nature of their schools and classrooms, the teachers indicated that the dominance of one particular national, ethnic, or cultural group makes their school “uniquely
multicultural” like a “chocolate chip cookie” in which the dough represents one dominant culture and chocolate chips represent the presence of other diverse cultures as evident in the quote of following teacher:

[The school has] a wide range of students from different countries (including, but not limited to: China, Korea, India, Pakistan, Iran, Saudi Arabia, Philippines, Vietnam, Singapore, Russia, Japan, Czechoslovakia) [which] are represented but in no way equally. I have been teaching senior sciences. And its Physics [Grade] 11 and 12. When I came over here [to the school] in 1997, I noticed that in last fifteen years or, so the demographic of this school has been changed a lot. When I first entered the school, it was I would say at least half of the students were Caucasians from Canadian background and a smaller group of them were then of Asian from Hong Kong...and other nationalities...now in fifteen years there seem to be a shift. Majority of them [students] are from China and then there is some Korean and the rest is just a sprinkle of different nationalities...Indian background, Caucasians, Persian... I would say that the cultural diversity in my classroom...It’s like a chocolate chip cookie... where most of the cookie would be of Asian origin [the dominant Chinese culture] and the chips inside are of minority groups from diverse places. There is sprinkle of other minority nationalities which makes the cookie tasty... (John, Interview Session 1).

4.1.1.1 Level of cultural diversity is dependent on the schools’ location and transient nature of surrounding communities

Further exploration of these teachers’ perspectives regarding the uniqueness of their schools revealed that many of these teachers considered their schools as “unique” and different from other schools in the region. While the main reason for characterizing their school(s) as “unique” was because of their schools’ multicultural nature as evident in the cultural diversity of students’ populations, deeper analysis revealed that the teachers emphasized the “different” and “unique” ways of their schools being “multicultural” because of the richness of cultural,
linguistic, and socio-economic diversity that they experienced. The following quotes are representative of these teachers’ voices:

*Then I moved here about five years ago to this side of the world. And I [was] thinking ...sort of what were the cultural dynamics of the groups on the East side, as opposed to here? Because a lot of teachers find these to be completely different worlds, right! And so...I found when I went onto the Eastside of Vancouver, it was very shocking for me to not have one fair-haired child in the class. Like I look out and it’s all dark haired and definitely some Caucasian children obviously but definitely more Asian, Indo-Canadian children that seemed to be in pocket that I was in... that seemed to be a cultural group. Whereas up here in [name of the local university], even though we are on the West side of the [university] campus still it’s a very different pocket here that would be just off campus at [name of another school] or something. I think our group here obviously is much more culturally diverse here than it would be just off [university] campus. So yeah, coming here...is so diverse...like it is not only Indo-Canadian, not only Chinese, but it’s a little bit of everything. Which is nice! (Claire, Interview Session 1).*

*This school is very multicultural but in a different way. [The school has] a wide range of students from different countries ... A large portion of the students have English as a second language and a large number of them[students] have a moderate to low level of English speaking and comprehension ability. The general trend is students of higher socio-economic background. But we also have students whose parents are also students and have only scholarship or sometimes only part-time jobs to support their family. (Ashley, Interview Session 1).*

Pointing towards the wide variety of cultural backgrounds that students bring into their classrooms, the teachers shared that since most of the students in their schools are children of university students who come from various international contexts, the cultural diversity of their schools’ student population is richer and varied as compared to other schools in the city. These teachers saw their “west-side” school very different from “east-side” schools and took pride in its
uniqueness in terms of the diversity of student populations, student achievement, higher socioeconomic status, and “privileged” geographic location of school.

These teachers’ perspectives indicate their heightened awareness regarding the diversity of their students’ cultural, linguistic, and socio-economic backgrounds. They expressed that the transience of their student population is high because many of their students remain in the school only for the duration of their parents’ study. Teachers shared that this feature of being children of parents who are themselves students also affects the emphasis these children give to receiving education.

Well...you know school a little bit [acknowledged researcher’s involvement in the school as a parent and as a parent volunteer] but yeah as I was saying earlier we are on the west side of Vancouver, but definitely different from the schools not far from us. I think being on the university campus obviously makes the students that we are having here very different...you know it’s so diverse out here...just in different socio-economic ...we have parents that bring their children who live in very big homes near us but then we have children who come from family housing, children who just come here for just one year while their parents are doing post docs or whatever so definitely a range of socio-economic as well as culture... (Claire, Interview Session 1).

Having parents who might be studying also affects the range of socio-economic status of the students’ population as some of these students come from highly influential families who have immigrated to get “better” education based on their financial resources while there are others whose parents are solely relying on scholarship or part-time student jobs to meet the needs of their families. As per the teachers, these parents value education because they believe that education is the only path that could help them and their children in getting higher paid jobs, and thereby, in improving the quality of their life. The diversity and transient nature of students’
population and acknowledgment of high academic profile of their schools and greater emphasis on academics is evident in following teachers’ quotes:

[Mountain Secondary School] has a reputation of being a high-quality school. In the high school rankings that are published every year, [this school] ranks very highly, often as the best public school. This ranking is based on grades and test scores... (Ashley, Interview Session 1).

I think it’s to say that that this school [Mountain Secondary School] is within a neighbourhood, which is next to a university, and the background of the students is diverse culturally. They [the students] are very academic. Most of them. And those who are not, I guess [they] are driven by the drive to follow suit otherwise they wouldn’t know how to navigate and survive it [the world of high school]. Very academic just means that we have lot of students who are geared to enter into university after the high schools that is the focus they have. And I specially see that. Even in starting grade eight, I see that a lot of students are already very focused on what they are doing. Many of them take tuitions and study in after-school programmes and by grade eleven-twelve you could see that a lot of them have moved up to the higher level... (John, Interview Session 1).

The teachers also expressed their concern that due to the transient nature of their schools, it is more common to have students who join in the middle of the school year from diverse countries especially, from non-English speaking countries. The teachers shared that this transient nature of the student population makes it difficult for them to ensure students’ learning as well as affects their own emotional involvement with the culturally diverse students and their families as expressed in the following excerpt:

It’s also that school tends to be very transient, the children... you know in my previous school, the child I taught in grade one would still be there in grade seven and I get to see them graduate and move. But the thing for me, the sad thing in this school is by the time they get to the last grade here, there may be three or four kids left that I taught. So, I find
that very sad actually that you don’t …you know, I like making the connections with the families as well and seeing them all through the way, but people tend to come and go a lot during the [school] year as well. That can make it very hard in a class for us. You’re always having to adjust for a new child that has just arrived from [takes the name of non-English speaking country] and has no English or has never ever been in Canada before and that [s/he] has just appeared and that’s something we would see more [here] than other schools… (Claire, Interview Session 1).

Thus, the teachers’ perspectives revealed their acknowledgement and appreciation of students’ rich cultural diversity as well as their recognition of transient nature of students’ population. The following theme reflects the associated benefits and challenges of this rich cultural diversity.

4.1.2 Theme 2 Cultural diversity as a strength as well as a challenge

During their interviews, the participating teachers identified students’ cultural diversity as a strength and as a challenge. Valuing the diversity of cultural backgrounds that students bring into their science or mathematics classrooms, the teachers acknowledged that this cultural diversity helps them in promoting students’ learning as well as in broadening their own cultural understandings.

4.1.2.1 Cultural diversity enabling collaborative student learning and reflective teaching

The teachers shared that they utilize students’ diverse cultural backgrounds to invite multiple ways of knowing and as a criterion while making student groups. They stated taking account of students’ cultural diversity for enabling collaborative peer learning in their science and mathematics classroom(s). Many of them recognized this diversity as a “gift” as exhibited in John’s statement:
Having the diverse [student] population, I feel, can make the classroom a lot more exciting, the conversations...sometimes the conversations we have is not all Physics. I guess sometimes we diverge a little bit... and I do have people sharing their own experiences of culture...I guess that’s part of teaching in a classroom to realize that you are not just teaching a subject, you are teaching a group of students who have a lots of experiences to share...of learning in a different culture...Cultural diversity is a “gift” and sometimes you can find the correlations and links between their [students’] cultural experiences and what you are teaching... (John, Interview Session1).

Similarly, Ashley shared how different learning experiences of students from diverse cultural backgrounds help promote collaborative learning in her Chemistry 11 classroom:

Because you know all these different countries that the kids are coming from... their schooling is very different...as far as what they are learning at different grade levels so often in a class you’d get kids who may be...for example we get kids who...really excel in math so then when you are in Chemistry and you are doing sort of like the math focused part of Chemistry that’s where those kids can now become helpers to other kids in class who haven’t done that kind of math yet...so that’s where the kids can start helping each other because they had experiences of learning things at a different time... (Ashley, Interview Session 2).

Acknowledging students’ cultural diversity as a positive thing, participating teachers admitted that having culturally diverse students in their science and mathematics classrooms helps them in broadening their cultural understandings and creates opportunities for critically reflecting on their own teaching practices and biases. Callum’s following quote expresses how having culturally diverse students in his classrooms, has helped him in not making stereotypical or generalized assumptions about other cultures:

In general, I see cultural diversity is a positive thing because... it helps you to question things or challenge things or it’s just easy to make assumptions about things when
everybody thinks the same way...when you see the kids in Asia all learning times table in Grade 2, it makes you understand that it’s not a hardship and it’s very helpful. There is good and bad in almost every culture and it helps you. If you only grew up in one culture, then you don’t [value multiple perspectives]. It’s very easy to just make assumptions and not understand that [cultural ways of knowing] ...assumptions like that’s how it’s done or that’s the only right way or that’s the best way of doing it... (Callum, Interview Session 2).

In contrast to the above perspectives where teachers shared that they consider cultural diversity as a strength, the teachers also shared instances where they found themselves challenged and their teaching practices questioned because of the diverse cultural backgrounds of their students.

4.1.2.2 Experiences of confronting gendered cultural practices

Perspectives shared by participating teachers indicated how they had to deal with the gendered practices that were brought into their science or mathematics classrooms by culturally diverse students. One example of such an experience was shared by Louise who taught a combined K-1 classroom:

*I am sensitive to gender as well. You know I am not using phrases like “boys and girls” and you know making those differences. So, there is this student and his sister in my class...I have seen parents; they treat him like a “prince” [made a hand gesture to quote the word prince]. When they come to pick their children after school, I have seen always letting him take the front seat and the sister never gets a chance. I had to correct and tell this student, I am your teacher here [in the classroom] and I am telling you that you are going to finish clean-up your desk, you used colors to draw animals [as part of a science lesson], you have to do your part, not your sister...* (Louise, Interview Session 1).
As per Louise, this male student expected his sister to clean-up after him because may be that is what was encouraged in his home environment. The teacher felt that this male student disregarded her instructions and she needed to reinforce her position as a teacher, solely because she was a female. The situation encountered by Callum, who was involved in teaching a combined Grade 3-4 class was much more complex. This teacher shared his everyday dilemma of being in a difficult situation where he had to teach a female student whose parents did not want her to be in a male teacher’s classroom:

I have one girl in my classroom and her parents they never told me that it’s culture...that they didn’t want to have a male teacher and they are very conservative parents and they were upset that she [their daughter] had a man teacher and it’s even worse if I touch. Right? I like to do this... You know when they [the students] solve a [math] problem; you just give a pat on their [the students’] shoulder. And it’s a way of having a positive contact with the kids and it’s to make them understand that. It’s Ok for them [the students] to say no [to touch] and they have right to their body but it’s also okay for me to put my hand on their shoulder like this [pats on his own shoulder] and show them that they were right. But this girl had a taboo. She was always quiet, so I went near her desk and put my hand on her shoulder like this [displayed how he put his hand] and asked if she needs my help. And I touch kids some time in this way, right? I wish they [the parents] had told me at the beginning of the year, so I would have known. The dad told me a couple of months earlier. He told me that they never wanted their daughter to be placed in a male teacher’s classroom...I guess, they want me to let her [the student] work alone. If the father does not want...I let her work alone. (Callum, Interview Session 1).

Similarly, Meera also shared encountering gendered cultural interactions when one of the students brought up the issue of feeling neglected and rejected in the home because of traditional cultural preferences of desiring children of particular gender, in this case preferring boys instead
of girls to be born in the family. The following excerpt from Meera’s interview shares what happened in her Grade 9 science classroom:

We are learning about human embryology, artificial reproductive technologies and genetics. Talked about genetics quite a bit…and they[students] are very interested and they want to know about all the different types of prenatal testing and…you know what if people are choosing not to have girls and prefer boys? One student in my class told me [that] her grandparents don’t like her because she was a girl and her parents don’t have any other kids and they [the grandparents] are always complaining about her being a girl and not being [a boy], not keeping their family name. And they don’t like her and that was may be her dad’s parents whereas her mom’s parents are very close to her. So that was something interesting that she told me... (Meera, Interview Session 2).

4.1.2.3 Experiencing religious and cultural resistance

During their interviews, many of the participating teachers shared their experiences of facing religious and cultural resistance while teaching science and mathematics to their culturally diverse students. The teachers recounted that while teaching certain topics in their science and mathematics classrooms, they encountered situations where students of certain cultural backgrounds or their parents objected to the teaching of specific topics as well as questioned the appropriateness of the content taught at the specific grade level. As per the teachers, at times it was the students who expressed their objections verbally in the classrooms during teaching, while at times it was the parents who raised the concern during the Parent Teacher Conferences (PTC) or in writing. Meera’s following excerpt shares one such religious resistance that she experienced in her Grade10 science classroom:

Evolution for example, which is a common one [topic where students may have conflicting religious beliefs]. I have a student who told me her father believes in microevolution but not macroevolution, so she was saying that basically they don’t
believe that [evolution]. So, they believe that God created life and God created humans but there is evolution within sort of small amounts of evolution in the groups, but they don’t believe that we have all evolved from bacteria for example or related to them. So that’s just interesting for me. Well, we are studying science which is one way of looking at things and in that way of looking at things the evidence really suggests we are related to [bacteria] so it’s not really an argument you can have because you are not really talking about same things. So, if you are...if you think can learn about the world and you can do the experiment and learn something, and you believe in cause and effect then the science...the conclusion is that we... the evolution is very likely. If you don’t...if there is nothing that can change your mind, then you are not really learning science. You are talking about something else which is faith or religion in which you believe in something that doesn’t have any evidence. So that’s really interesting for me that how you could believe...This one individual doesn’t believe that life can evolve from non-life. And my opinion again is that you are talking about two different things we are not using the same logic system. Sometimes I worry about it, but the thing is that most people agree with the evidence of science... (Meera, Interview Session 2).

Thus, this teacher is worried that this specific student does not believe in evolution but then tries to comfort herself by saying that most of her students do believe in the evidence of science. The same teacher reported encountering situations where students of particular cultural backgrounds expressed their “surprise” and objected to learning certain topics such as reproduction and sexually transmitted diseases in a mixed gender classroom:

_I know sometimes people [the students] are surprised that we talk about certain topics in science, but I like to remind them that its science and in science there isn’t anything that is off topic really. We are learning about people, about cells or embryonic development and then we can talk about like moral ethical questions. And then they [the students] sometimes will have discussions about that. But it’s not really part of the curriculum so I will not really tell them [the students], which is the right decision. But I will give them information about what people think about. For example, about stem cell research or_
artificial reproductive technology. We are not talking about anything controversial. We are talking about science behind say reproduction or sexually transmitted diseases. In their countries [students’ home countries] they might separate boys and girls for discussing such topics, but I don’t. I mean, maybe I should [laughs] but it’s not my priority usually. Like especially here most students will participate and...and again in my opinion we are not really talking about anything controversial, we are just talking about science behind...and if they ask me whatever question they want, I will answer. I mean sometimes they ask me some funny questions, or you know whatever [laughs] but that’s fine in my opinion... (Meera, Interview Session 1).

Thus, the teacher in this case did not consider it essential to entertain the requests of some of her culturally diverse students who did not find it appropriate to discuss certain sexual education related topics in a mixed gender science classroom. The teacher maintained her decision to discuss these topics in a whole class setting by emphasizing, “We are not talking about anything controversial, we are talking about science”. Upon further inquiring about her decision, the teacher shared that she might create special groups of students if there was a request made in advance.

In some instances, it was the parents who sent a written complaint expressing their concerns regarding the teaching of specific topics. In this case, the parents demanded the school and the teacher to avoid using breathing exercises as a meditation practice and not teach about dinosaurs in a Grade two classroom because they found the teaching of these as promoting certain cultural and religious beliefs. An excerpt from Milica’s first interview session illustrates how she was called at the principal’s office because of one parent’s concern. This teacher shared that she found herself feeling pressured to change her teaching strategies and either remove the
entire science unit or change her lesson plan or make alternative teaching arrangements for specific students when these topics are being taught in her classroom:

*Sometimes it’s hard you might get a letter [from the parents through school] but in the end it’s our professional autonomy. I don’t want anyone to hear, sorry [points to the students and suggests that we step outside of the classroom. The following conversation happened outside of the classroom]. So, the parents were upset about the breathing [the teacher uses it as a meditation exercise to help students relax and stay focused at certain periods of time during the school day] because they felt that that was connecting spiritually to Buddha and that teacher should be also exposing kids to the Biblical stories, and that I should refrain talking about dinosaurs... because they [the dinosaurs] really [laughs] they didn’t exist. God just created in seven days the world. I just put the letter in my filing cabinet. It’s just their [specific parents’] philosophy of what education should be. Well, I will do a mystery unit instead [laughs] something like what happened to the dinosaurs [laughs]? But you know everyone is entitled to have their certain opinion and I can’t take it in too much because you are not going to try to be pleasing them [the parents] in any way. It’s just their opinion but I am the one that needs to be at the helm of the wheel all the time [laughs]. I know at first you read it [the parent’s concern], it’s upsetting but the comments that you receive as a teacher, you have to decide how deeper you are going to let it sink in. To combat that I just make sure that I am enjoying myself in my relationship with the students... (Milica, Interview Session 2).*

Teachers also shared that in some other cases, especially for mathematics, parents of certain cultural backgrounds expressed their dissatisfaction about the content taught in their classrooms, and also regarding the amount of homework assigned at specific grade levels. Teachers shared that parents of these cultures often complained that the content being taught in their mathematics classrooms is not age appropriate (i.e., it is of a lower level) and expressed that the amount of work done in the classroom as well as the assigned homework is insufficient. In such situations, the teachers considered parental expectations as “stereotypical” and emphasized
that it is the parents who need to understand their “Canadian style” of teaching. According to these teachers, such parental expectations contradicted the expectations of Canadian curriculum, in which they believed that the focus is more on the “process” and “understanding” of mathematics rather than rote memorization or calculation. The following excerpt of Claire better represents teachers’ voices:

Well, I think ...you know, the way some... it can be very stereotypic in some cultures and how do some cultures approach education in math. Like some cultures would very much wanting their kids to go to Kumon and really know all the computation so that’s sort of a big focus for them. And you can be stereotypical and say yeah. It [the focus on computation] mostly tends to be [in] a lot of Asian families and that’s really important to them. So, having that child do Kumon means that they are not necessarily going to be connecting with what I am teaching [in the math classroom]. Because they may already know some of it [the math]. But again, parents of those other cultures don’t always realize that my curriculum isn’t just that one part of math and they really feel that math for them is just adding, subtracting and computation so in a way that’s just me having to teach...I understand where they [the parents] are coming from and that’s important to them and but then I need to share with them that here in Canada, we have other parts of the curriculum and those are important too. So, I think sometimes the cultural diversity is an understanding of more just parents and I connecting about the expectations of the curriculum more so than having to bring their culture into what I am teaching. I think a lot of it is... I am having to also explain what is our culture here and how does it fit now that your child is here in Canada, right? So, it’s a tricky bit into respect their culture and also a realization that that’s may be not how we do it here in Canada and kind of hard to teach that [to parents] ... (Claire, Interview Session 2).
4.1.2.4 Challenges in creating diverse learning environments for culturally diverse students due to differing parental expectations

The differing parental expectations regarding the education of their children put these teachers in situations where they found it difficult to ensure safe and comfortable learning environments in their diversity-rich classrooms. Concerns for students’ safety within and beyond their classrooms seemed to be a constant challenge for these teachers. The participating teachers were faced with situations where culturally diverse students did not consider them as an authority figure or were intimidated by their presence as an adult because as per the teachers, these students associated physical punishment as the only way of being disciplined at home, and in their previous schooling experiences. This association of teacher’s authority with the physical punishment affected these diverse students’ participation and engagement in these teachers’ science and mathematics classrooms and posed a challenged for them to support these students’ learning in a safe and comforting way. The following excerpt from Louise’s interview echoes one such concern:

*I do take into consideration other children’s backgrounds when I am teaching them because obviously I have children that either don’t speak English or children who were taught in different manners and methods, and that’s also important. I also…at Kindergarten, I think the most important thing to know about children’s culture and background is taking into consideration where they are coming from, when they are coming here. Because there is, I need to be blunt. There is[are] cultures that [consider that] hitting a child is totally acceptable. So, when I have a child here, I have to think about that. Okay, it’s quite possible that this child comes from a family where they hit their children at home because it’s acceptable to hit their children in their culture. It doesn’t mean that I am going to judge that what that family is doing. What it means is, I have to consider that when I am dealing with this child. And my example would be: Sometimes I have children that are quite difficult to handle, and the cultural worker has*
explained to us well, that when the child comes here, in the beginning they [the student] might be thinking “this teacher is going to hit me and then they think that oh, this teacher is not going to hit me. I [the student] can act crazy because I am not going to get in trouble”. Like they [the culturally diverse student] can’t understand how I am...they [the students] are thinking I am going to be like where they came from, so I have to understand they are looking at me with their cultural eyes. I am looking at them with my cultural eyes and I have to try and think about how they see me and where they are coming from so I can better understand how I can work with them, understand them, help them, teach them etcetera etcetera. I know I am stereotyping to some degree but I know in certain cultures it’s acceptable to hit a child and it happens all the time here, it happens constantly and we have to have that conversation with parents: In Canada, you are not allowed to hit your children so you have to... and you work with them and we have the counselor, we have the cultural worker who get involved. In general, it’s a different parenting... (Louise, Interview Session 1).

Thus, the matter of such “different parenting” posed a continued challenge for the teachers. The participating teachers shared that the parental pressure that their culturally diverse students may undergo appalls them, and makes them concerned about how their teaching, especially, the grades that they assign for science and mathematics, might influence their students’ wellbeing. The teachers shared that the parental compulsion to achieve higher grades can be dangerous and it has even pushed their culturally diverse students towards attempting suicide in the past years as indicated in the following teacher’s excerpt:

I also had to be very aware about being [teaching] in a school like this [culturally diverse] ... especially teaching Grade 7 where I have had a situation with girls being suicidal because it’s...the kids are under so much pressure. They get 95% [in science]
and they are stressed about not getting 100%. There is CART\textsuperscript{16} ... you know CART? When they get involved it is because a child has attempted to commit suicide. So, when the CART got involved then I came to know about it. So, I know that I had two students in Grade 7 who were suicidal. It was partly cultural. I think that they [parents] were [states a particular nationality] but I think that North American people have the same [expectations of their children] ... that kind of pressure to achieve higher in science and mathematics comes from everywhere but especially from the parents who push too much. And I think partly it may come from other [societal messages]. What happens is that the parents have that fear that their kids, you know, they [parents] are so afraid that their kids ... you know in [states the name of a country] they start streamlining kids in Grade 4 or 5. So, parents are like panicking that my kids are not going to go to the university and with the kids [they are stricter in terms of academic achievements]. It’s needed to talk about the balance. You know people are too much mark driven. So, having kids like when they say I have got 95% and how did I lose my marks ... like having to deal with the kids that are concerned about getting a mark like ... like getting 95% as being a problem ... that’s really, really difficult, right? (Callum, Interview Session 1).

In addition to the parental pressure about getting higher marks, the exceptionalities of their students coupled with the specific family situations also made the teachers concerned about their students’ wellbeing as expressed in the following excerpt of Callum:

\textit{Well, one challenging time that I had was ... I had a student who is autistic and the mom was I think ... too involved and the dad ... mom and dad hated each other, they were separated and they hated each other ... the dad was from [states the name of a country] and the mom was from [states the name of another country] and I told this student to pick}

a country [for a science project on biodiversity]. So, the student couldn’t decide which country [to pick for the science project]. Well, that time... at the beginning of the new[school] year, I didn’t know the background and he [the student] couldn’t make up his mind and then after I found out what the problem was and... it was just really painful for this kid because he was afraid to insult his mom or his dad. Well, that was one of my very difficult years because the mom wanted to be involved and I tried to not involve her because I thought she would panic, right? So basically, I did manage to keep her involved but that was really challenging. She got really angry and yelled at me sometimes... so it was really difficult... (Callum, Interview Session 1).

The teachers’ reported that the parental reluctance to acknowledge and appreciate dis/abilities of their children makes it much harder for them to ensure safe learning environments for their diverse students. During my informal observations of the participating teachers’ classrooms, I could sense the challenges that these teachers were concerned about. While visiting one of the participating teacher’s Grade four classrooms, I witnessed a student throwing a pair of scissors across the classroom, which almost hit the teacher who had to duck to one side to protect himself.

This incident happened when this teacher was explaining the procedure for a science experiment and one student was continually interrupting the teacher by asking if he could pair-up with one of his classmates to do the experiment. At first, the teacher reminded the student to wait until he finishes explaining the procedure. However, upon hearing repeated requests, the teacher asked this student to take a walk outside the classroom. The student left the classroom and came back after a few minutes and started playing with the pair of scissors that were kept inside his desk drawer. The teacher was now giving instructions to the whole class about getting the supplies for the experiment and this student again started asking about pairing-up with one
specific classmate. At this point, the teacher refused this student’s request and that’s when the student threw the pair of scissors across the classroom. The teacher had to interrupt his science lesson and rescue all other students from the back door of the classroom while at the same time remain vigilant about this student’s actions who was now standing near his desk, agitated and angry. Reflecting on this incident after one day, here is what the teacher said:

*It’s becoming like a nightmare...at times I cannot fall asleep in the night because I am dreading what may happen in the classroom tomorrow because of [states the name of the particular student] presence in the classroom. You know, I feel constantly under pressure, but no one wanted him [the particular student] in their classrooms. He [the student] was sent out of the other school because of his this behaviour. He told me the parents punish him at home like not letting him watch the TV show or do what he likes to do. I don’t want to punish him, so I send him out to take a walk outside my classroom, but he is not doing most of the work. The parents know there is a condition [exceptionality] but they don’t want their child to be designated...* (James, as shared after school on May 6, 2015 during follow-up of my classroom visit on May 5, 2015).

Thus, as per the teacher, the school board and the previous teachers of this student had recommended that the student needs to be tested for the special education services, but the parents did not comply with the request because they did not want their child to be labeled. And because of parents’ reluctance, this teacher had to face an everyday challenge of keeping this student calm and motivated to participate in learning without receiving any additional support that this student needed. Even after trying his best, this teacher often has to assign many of the classroom tasks as homework to this student, as expressed in the following quote:

*I frequently just have to...I right out tell him [referring to the particular student] why I have to do these kinds of things. You know, I tell him... and he is just like “I don’t want to do this. This is ...I don’t want to be here. I don’t want to be here ...I don’t want to learn it.*
I don’t like this or why can’t we do this instead?” And I tell him that I am a teacher, I have to teach some of these concepts, so you like it or hate it, I have no choice in the matter. I might not even like to teach it, but I still have to teach you. If I don’t teach you then I lose my job, you understand? And then he gives up or he gets angry. He curses education...when this is going on, I just put myself back at his age and I understand what’s their [students’] frustration. And [paused because of the announcement from the office] you know a big part of my strategy for my day is to avoid situations like that. I pick my battles with him very close...very carefully. Do I have to pick a battle with him? Am I going to win this battle? Can I avoid it altogether? You know, what do I want to win with him? I am constantly asking those questions with him. You know, he has affected me way to too much like how and where I position in the classroom in any given moment, he’s always... sort of in the back of my mind. How much time I am giving to him? One thing that we do with him though is we [the teacher and the parents] ... if he doesn’t get [work] done in class, he takes all the work home to get it done with his mom and that helps a lot, so he does try to do it here. You know I just have given up on the idea of quick fixing him by the end of this year...he has got his issues and I am going to have to live with that… (James, Interview Session 2).

These are just some examples of the continuous quandaries that teachers face to find ways to create diverse learning environments for their students. The increasing class size further affects teachers’ effectiveness to teach for diversity. The participating teachers reported the increasing number of children in their classrooms as one of the main factors which influences their effectiveness to reach and meet the needs of their diverse students. As per these teachers, the school boards are allowing having 24-30 children in each classroom and they feel much pressured and overwhelmed with the number of children that they have in their diversity-rich classrooms. Teachers’ concern about increasing class-size resulting in reduced teacher: students’ ratio along with increased diversity of students is best represented in Milica’s following excerpt:
Since I began teaching, the amount of children in the classroom has changed a lot. When I first started teaching there were 16-18 children in the classroom and if you had a special needs child, the child with a designation, that child counted as two students and it wasn’t likely that you had a special needs child in your class. But now, I have 24 children and you can have two or three designated children and five children that aren’t designated [but may have special needs]. So, they may have ADD\(^1\) or ADHD\(^2\) or the common phrase that they are on the spectrum. And so, you don’t have the support for that which limits sometimes what you can teach in the classrooms in terms of hands-on activities. If the children still aren’t behaving appropriately or are talking with another language through your lessons because the amount of children that do not speak English is quite high as well. You want to make things simpler so that the kids are focused for shorter amounts of time. So that has changed a lot [the teaching strategies] for sure. They [students] want your attention. No matter what just [the] amount of children in the classroom could be a challenge... (Milica, Interview Session 1).

As per the teachers, while considering the allocation of students in each classroom, the school board recommends counting each student with exceptionality as equivalent to two regular students who have not been given any designation. Therefore, with the increasing presence of students with exceptionalities and almost half of the students who have come from 8-10 different cultural backgrounds and nationalities and speak 10-12 different languages in a classroom of 24 students, the teachers feel overwhelmed with the diversity of student population that they have in their classrooms.

In addition to the above factors, in teachers’ individual interviews as well as during my informal observations to their science and mathematics classrooms, the level of English language

\(^1\) ADD: Attention deficit disorder
\(^2\) ADHD: Attention deficit hyperactivity disorder
competency stood out as one of the key factors which greatly influences the involvement of culturally diverse students in these elementary and secondary Canadian classrooms. Due to the vastness of the issues of diversity that intervened with this English language competency, I have discussed this challenge as a separate theme in the following section.

4.1.3 Theme 3: Level of English language competency as an influence on level of students’ learning and engagement, and teachers’ teaching practices

Pointing to the transient nature of student population, the participating teachers admitted that the frequent arrival of new students from various countries throughout the school year makes it difficult for them to support the learning of their diverse students. As per the teachers, these newly arrived students not only experience a cultural conflict because of being in Canada for the first time, but also are often finding themselves engulfed in linguistic forfeiture due to English being used as the primary and mostly the only language of instruction in schools.

As per the participating teachers, for many of these new students English is totally a “foreign” language and most of their diverse students have low competency in comprehending and communicating in English. This creates a huge social and cultural barrier, as this low English competency not only affects diverse students’ academic performances but also influences students’ socialization processes in their science and mathematics classrooms. The teachers also shared how students’ level of English language competency influences their choice of resources and textbooks to teach science and mathematics in their diversity-rich classrooms as well as how these students’ placements in ESL programmes as ELL impact these students’ enrolment and engagement with specific courses and their graduation at the high school level.
4.1.3.1 Impact of English competency on students’ socialization, engagement and achievement

Raising the issue of low level of English competency among diverse students especially among those who have recently arrived from non-English speaking countries, the participating teachers indicated that the number of students designated as ELL is increasing exponentially in their classrooms. The teachers admitted that they find it difficult to promote cross-cultural communication and support the learning of science and mathematics in their diversity-rich classrooms where many of their culturally diverse students barely know any English. The teachers shared that often the diverse students form segregated “cohesive cultural bubbles” and use their native language to communicate with each other even in the classrooms. As per the teachers, not having the necessity to use English to communicate, impedes these students process of learning this new language and thereby, their full participation and engagement in their science and mathematics classrooms where English is the primary mode of instruction. The following excerpt of Callum echoes this concern:

_In the beginning of the year, I was very, very, very unhappy with my class because I have…this year I have got 10 kids with only perception they have is in [states the name of a non-English speaking country’s language]. Almost half of my class didn’t speak English at the beginning of the year and majority of them are [particular country’s language] speakers and I have always…in the past if I had one kid learning English…they learned it fairly quickly because they had to talk [in English to communicate with their peers]. But this year, what I have found I have several kids being ELL. They have been here now almost a year and they still don’t know how to speak in English! They just talk to each other in native language all day so it’s hard for them to communicate and express themselves [in English] and it is difficult for me to teach them. I have three students who have not learned a thing…I mean they are at the bottom in math and science._ (Callum, Interview Session 1).
To support the learning of science and mathematics and encourage cross-cultural communication among students coming from diverse backgrounds the teachers felt as if they had to act like “language police” for ensuring that all students are using English to communicate in their classrooms. However, the teachers found it difficult to break the “cultural bubbles” and avoid cultural segregation among their students because they noticed that often many culturally diverse students are not interested in learning English. Moreover, as per the participating teachers, the increasing numbers of these “cultural bubbles” is not only hindering participation and achievement of students who speak EAL, but the predominant use of native languages in schools is also forcing many English-speaking Canadian students to feel like an “outsider”. Many of who may eventually choose to transfer to other schools because of cultural isolation they experience. The following excerpt voices teachers’ concerns very well:

There is such a high population in our school of [states the name of a non-English speaking country] kids who don’t speak English. Certainly, there are these other kids who find that they don’t have a good social circle here. There have been many incidences where students have come in and they are talking about transferring to another school and I have said: How come? And they just say: “You know because I hate it here”. I guess they think... they kind of feel like a person would feel if like say that person moved to another country where nobody spoke English and went into class. Right, and they kind of feel like that, here. I guess maybe they... feel like well, this is sort of my school why I should have to feel like the outsider? The challenges [of students’ cultural diversity] are the fact that you do get students feeling left out. And this is where you know as I was saying, acting like the language police is the only thing that I can do in this [Chemistry 11] class. [It] is to say that you know that English is our common language and that’s the language like us all to speak while we are in here and when we are doing work together. And it’s difficult because we try to encourage the kids to also speak English outside of the [class]room so that socially there is something in common as well. But you can’t. You know, you can’t go down to them [the students] in the lunch in the cafeteria and say
“speak English” right? And there is a lot of students I think who are just here [for a short time]. They are not going to stay here, you know. They are going to be here may be for the high school and then they will go back to their country for university or they are going to do university here and then they are going to go back to their country for a job. So, learning English isn’t as important to them. And also, when they get here everywhere they see someone who speaks the language that they speak so really the impetus to speak English is very low. It [level of English competency] does make it very difficult you know. I do get students who I can see by their writing that have the right idea but they just don’t have the words to express it and the higher up you in get in school like the senior grades you really do have to be able to express your ideas in a way that are understandable, so it becomes more difficult as they [students] get older, to do well in a course if they don’t have a good grasp of the [English] language… (Ashley, Interview Session 2).

The teachers’ shared that because of the low level of English competency among their culturally diverse students, the number of behavioral and disciplinary issues that they encounter in their classrooms is also rising. Since many of their culturally diverse students are not able to adequately comprehend instructions given in English, these teachers shared that they feel continually challenged to think of ways that could help them in communicating their expectations clearly and establishing a team spirit and a collaborative, safe learning environment in their diversity-rich classrooms. The following excerpt from Milica’s interview shares what this teacher encountered at the beginning of the school year in her second-grade classroom:

In the beginning in my class, I did not have the “team” [made a quoting gesture with her hands] that you see now. But if you take a whole bunch of children who don’t know English and just put them randomly into a classroom and well...maybe they are showing their anxiety through being indifferent or being rude, or showing inappropriate behavior, and disrespect. It takes a while to get to the bottom of those problems. So, if my base is on nurturing and creating a team environment, but the kids don’t even know each other [laughs] and they are 7 or 8 years old and they are just worrying about how to
communicate all those little things besides actually doing a great job on their math and science lessons... that poses its own kind of ramifications... (Milica, Interview Session 1).

In addition to the challenges in socialization among students, teachers also shared that low level of English competency among many of their newly arrived culturally diverse students forces these teachers to find ways to compensate for the limitations in their own abilities to communicate well with these students who do not understand or speak English. The teachers acknowledged that often they communicate through their previous students who speak EAL and the same native language as the newly arrived student and serve as a mediator. But in doing so, the teachers feel that they are limiting the opportunities for these previous students to focus on their own learning and integrate well in the English-speaking group of the class. The dilemma of one such teacher is expressed in following excerpt:

_I do consider who is with...[what’s] the language of the person sitting next to. Right now, I have a student new from [states the name of a country] and who barely speaks a word in English and I had about a month before another student coming from [states the name of the same country] who is much stronger in English and probably a very good student I think. I think this new student that just recently came in my classroom has got some additional learning issues in addition to being ELL and I seated them right next to each other...Probably I should talk to the parents. I am not sure. You see this new boy is very quiet, doesn’t socialize and you know he is a little bit of an outcast at this point. I am having to work very hard, it’s being very hard to include him in the classroom... He does seem to enjoy P.E. I see him smiling playing P.E. but he... lots of time we start something, and he doesn’t start, doesn’t finish his work, and doesn’t speak with other kids. And you know I have this boy [referring to the student who has previously arrived]. I don’t know how exactly he feels about having to being not just a friend but also someone who is a teacher. I have to... you know, what it is doing to him? You know, this other boy was making inroads towards the other students in this class, so he was_
increasingly becoming more of a member of the prominent community in the class. And now I feel the expense to be with this new student is to hold him back to this [states the particular country’s name] world. It’s a tough one... (James, Interview Session 1).

The participating teachers shared that they find themselves more at loss when their newly arrived culturally diverse students are pulled out of their science or mathematics classrooms to get support for learning EAL. The teachers admitted that because of the “pull-out programmes”\textsuperscript{19}, often the students who are learning EAL are not able to fully participate in many science and mathematics activities, which in turn further affects these students’ achievement in these subjects. Following excerpt expresses teachers’ this concern well:

I have a resource teacher that frequently takes them [the new culturally diverse students with ELL designation] after lunch. And I leave it for those students to decide whether or not they want to go. Because sometimes we are doing science, so I want them to stay here and I give it to them where you think you should be because most of my ELL students, I think, have good self-efficacy. They know where they are going to be is most effective and is of value to them. I try not to do it now [teach science after lunch]. I mean so if I do get pull-out some of my ELL, I try not to do science. I actually don’t like pull-out. I worry about what they are missing. Where is the most valuable time for them to be at? Part of me kicks myself when three or four of my new girls from [takes the name of a non-English speaking country] are out of my [class]room and they are getting the specific instruction in EAL while we are working on science and I don’t think that science would have been any meaningful to them anyhow but I really try keeping them in so I am not pushing them out of the science curriculum entirely... (James, Interview Session 1).

\textsuperscript{19} The English language support programmes in elementary school settings that require culturally diverse students to move out of their regular classroom for certain hours during a school day and learn English in a separate classroom.
4.1.3.2 Students’ level of English competency as an influence on teachers’ teaching practices, and choices of resources

Expressing their concerns about the low English proficiency of their culturally diverse students, the teachers shared that at times they find students’ cultural diversity as “limiting”. The teachers shared that low English proficiency of many of their culturally diverse students restricts their choices about the teaching strategies that they could use in their classrooms. The following excerpt of Callum reflects one such concern:

*I don’t have a problem with where people come from or what’s the diversity. The problem I have this year is that I am very limited when you know a third of your class doesn’t know…couldn’t follow your conversation. You know if I want to tell a story they wouldn’t know what I am saying so if you have a third of your class that can’t just listen to story…you know I like teaching about ecology, ecological you know messages and environmental messages and you can’t even…the kids don’t understand what you are talking about. So, it’s like if you have one or two [students], you could just go ahead and explain things, but I can’t. If you know that a third of your class doesn’t understand what you are talking about. They can’t follow it.* (Callum, Interview Session 1).

Limited English competency of students also impacts teachers’ choice of resources. The teachers shared that they still prefer to use textbooks that are two-three decades old because of the heavy emphasis on language in the newer textbooks and certain programmes. The teachers feel that newer resources are inappropriate to use in their diversity-rich classrooms where many of their students have difficulty in understanding and communicating in English. The following excerpt shares how the teachers tend not to use resources that demand higher levels of English competency:

*I have been teaching Grade 3 math for quite a while ... over my 30 years of teaching, I have seen programmes come and go. So, the latest one, that our school has and is*
recommended but it is a very difficult math book to follow because of its high incidences of vocabulary. So, this is a sample: [states the name of a publisher] Mathematics Three and it certainly depends on students’ understanding of a huge amount of English vocabulary and reading. In fact, if I ask an adult, an English-speaking adult to do this question in a Grade three textbook. Yes, could you [opens the textbook and shows a chapter on Palindromes]. Yeah, so it explained what a palindrome is but for a student... ‘what are the palindromes between 400 and 800? And list all of them’ [reads a question from the textbook]. So, its language-based learning in a mathematics book and so you know it becomes a language-based issue. This is a very difficult language for an eight-year-old in Grade three and [it is] in English. For it [the new textbook] to give it to an English language learner is not appropriate. [The new resource is not appropriate] for a culturally diverse class because it relies too heavily on language and not enough on the conceptual understanding. It’s a language-based math programmes so I use some of the activities. Let’s say for enrichment and extension for some students. But I do use a very old version of a math textbook [shows that the book was printed in 1984] where there is a lot less language and a lot more practice. It has very cool examples... (Jessica, Interview Session 1).

4.1.3.3 Varied English competency levels among students compound the challenges of cultural diversity

Varying levels of English competencies among the student populations add to the challenges posed by cultural diversity for the teachers who in lieu of adequate professional training, are already struggling to design lessons to meet the needs of their diverse students. The following excerpt from an interview with Polina, who did not receive any professional training to support ELL students, but was assigned to teach ESL science and mathematics to ELL students at the secondary level, illustrates these realities:

I think it [teaching science and mathematics to ELL students] has been very challenging for me and for them of course and I am still trying. I struggle to figure out…you know. I think what I have been trained to do is taking account of all these learning abilities and
different intelligences and having diversity...you know you are always going to have
diverse learning needs in your classroom but adding this language barrier is making it
much more difficult because it is very hard to plan a lesson for that many different levels
[of English competency]. Because some people are understanding everything you are
saying, and other people are understanding 15-20 percent. So, it becomes very... it’s
really hard for me to diversify [the instruction] that much because I don’t know their
[English competency] levels very well. It took me a while to figure out the level where
people [the students] are at...do some oral reading to sort of start understanding how
much actually they understand so it is actually a very difficult thing as a teacher because
I am not trained in [teaching] ELL, right? So, finding those resources is difficult but
making a science or a math lesson that’s going to hit everyone at their [English
competency] level is really hard... (Polina, Interview Session 1).

4.1.3.4 System-based challenges in supporting learning of culturally diverse
students

It was noteworthy that the participating teachers were concerned about ESL placements
of many of their culturally diverse students because they noticed that such placements negatively
influence these students. As per the teachers, while they were aware that such ESL programmes
are designed to provide much needed English language support to designated students, they are
concerned about the negative impact of such placements on the self-esteem of their culturally
diverse students, many of whom are already experiencing culture shock.

This concern is well portrayed by one of the participating teachers, Polina, who identified
herself as being educated as an “ESL student” in Canada. In her interview, Polina shared her
dissatisfaction with the Canadian Educational System, which continues to label, discriminate and
isolate students based on their English language competency. As per Polina, these ESL
placements negatively affect students’ self-esteem. She shared her dilemma of being an ESL
science teacher who struggles to advocate for her students to be moved out of their ESL status
because she finds them resourceful and capable of navigating the regular science courses. She considered it discriminatory to not give students any credits for completing ESL sciences, which in turn delays these students’ graduation from the high school. She also shared her surprise and disgust about why there is no ESL mathematics and shared how she frequently adopts vocabulary to support learning of her students who are EAL in her mathematics classroom as well. Here is an excerpt from Polina’s interview:

When I am teaching my ESL class and seeing if they [the students] would pass, I would think can I have this student in my regular class, how would they fare if they are left on their own devices and a lot of students are really resourceful. So, you know their language might be weaker, but they are doing really well in science because they know how to find those resources. They are spending time on their own, they are on their computer, they are doing…translating, they are asking their parents. They are really using a lot of their resources to figure it out. And you know when we have our ESL department meetings, some teachers are going to say that he [the student] is too weak and talk about his being ELL and I am like well, he is weak [in English] but he is strong really academically. So, there is a bit of clash there where I feel like if you can do the work then you should move out even if your language is still struggling. I think absolutely it takes a toll on the students and as a teacher who has also been an ESL, so my first language is [takes the name of a language]. So, I know that feeling [of being an ESL student] and at least early on I didn’t have to spend high school through it [the ESL placement], but it is a struggle you know. I come from an ESL background as well and I think about these students...that is really being damaging [for the students] because I think that’s a hard thing for people here to see... which is, I mean we have students…it’s really hard for many of us [teachers] to gaze that all students come in here with their own world experiences, their own languages and they have tremendous amount of knowledge. The only difference between them and our regular students is that they can’t find an avenue to express that and that makes it insanely frustrating. That’s why I personally think that some of these [students] have to get out [of the ESL placement] and
they have to get out even if they struggle in regular science classes for their own self-esteem and I think they would alleviate way faster. I mean they don’t get credits for these courses. That’s not fair. You know what I mean? Here I have [students of] grade 8 to 11 in the same class. Some of them have been here for 2-3 years and they are not going to get credits for this and they are not going to graduate on time. So, it’s really backward... (Polina, Interview Session 1).

Thus, as indicated in teachers’ perspectives, English competency levels play a central role in culturally diverse students’ enrolment and engagement with the specific subjects in high school. Often, the culturally diverse students tend to take Chemistry or Physics as one of their sciences because these subjects are “less language heavy” than Biology as evident in Ashley’s following excerpt:

Because language is an issue for some of the students, their English isn’t great that they tend not to take Biology as much because there is so much language in it. So, I find the Chemistry class and I suspect the Physics classes would have... once kids are allowed to choose, the kids who don’t have really great English tend to take those ones [Physics and Chemistry] more than Biology because it’s tough to do Biology if you don’t have a strong command of English... (Ashley, Interview Session 1).

4.1.4 Theme 4: Lack of culturally relevant resources, support and training as an impediment to successful integration of Indigenous knowledges

While talking about the integration of Indigenous knowledges in their science and mathematics teaching, most of the participating teachers indicated their willingness to integrate these diverse traditional cultural knowledges in their science and mathematics teaching. Teachers talked about the new provincial curricular mandate in BC, which requires them to include Aboriginal knowledges in their teaching. However, many of them acknowledged that they do not
find themselves comfortable in integrating these knowledges. The various reasons behind this discomfort that the teachers’ identified in their interviews are discussed below.

### 4.1.4.1 Eurocentric or culturally neutral curriculum hinders inclusion of Indigenous knowledges

While talking about their discomfort around integration of Indigenous knowledges, most participating teachers shared that they find it difficult to integrate diverse cultural knowledges in their science and mathematics classrooms because of the curriculum reflecting predominantly Eurocentric perspectives. Following excerpt is an example of teachers’ awareness of Eurocentric history of science as well as willingness to invite diverse cultures:

> I know, I guess I do have this sense of that science is synonymous with European history… and I seldom… you know I am excited when an aspect of science is developed in another part of the world other than Europe because then it gives me chance to say something to that matter and then I don’t look so Eurocentric all the time… (James, Interview Session 2).

In the same vein, while talking about the textbooks especially the science textbooks that are provided to teach in schools, the teachers shared that because of the budget constraints they are still using the decades old textbooks, which are typically culturally neutral or Eurocentric. In some cases when there are newer workbooks provided, as per the teachers, even these workbooks are also similarly neutral and present science solely based on the Eurocentric knowledges. Ashley, who taught Chemistry 11 at the secondary level, echoes this concern in the following excerpt:

> For the textbooks that we have, it’s been the textbook for many many years. It looks like of 1987, yeah, 1987 and I believe that it has been updated many many times but for Chemistry there is not really any… from what I can see any sort of cultural references
within the textbook, so it seems to me pretty yeah to be pretty neutral. Although, that being said you know when you are talking about history of ... you know the history of the atom or history of development of certain processes and stuff it’s very... I would say Eurocentric so far. As the time you know the atom being developed and models of the atom... it’s all Europeans, right? Which is not to say that there were people in lots of other countries necessarily doing the same thing but if there were, it’s not in there so it’s very... the history stuff is very Eurocentric. You know this is the workbook here. The workbook is a little bit newer [shows that it is published in 2011] but still pretty [much the] same, same thing with the... culturally most of it is pretty neutral but the history is still very Eurocentric. It’s the same history you will find in this book [refers to the old 1987 textbook] as it is in this book [points to the newer workbook] ... (Ashley, Interview Session 1)

The teachers acknowledged that even though they are aware of the value of integrating diverse cultural knowledges they rarely include any during their teaching because the textbooks are only presenting Eurocentric or localized apolitical Canadian knowledges. Meera who taught Science 10 shared her perspective regarding effectiveness of textbooks, curriculum, and school policies in reaching culturally diverse students:

I don’t see that to say that the textbooks are really addressing the issues [of cultural diversity]. I am also using textbooks that are 20 years old or 25 years old, sometimes so [laughs] ... I think it [addressing diversity] was not the focus of the authors of the textbooks. I think that the authors of the textbooks were thinking that they were teaching a certain uniform group of students... may be Canadian students, Canadian born students, I don’t know... it’s just, I don’t think it is something that is explicitly considered when they [textbooks] are written so... well, see, I was thinking about my new Biology textbooks. But they have ... say only one perspective. There is not lot of encouragement of critical thinking part. There is no mention of other countries most of the times. Some of our science stuff talks about British Columbia quite a bit in terms of the ecology or the climate, there is really no talk about politics ever... (Meera, Interview Session 2).
4.1.4.2 Peripheral inclusion of Aboriginal knowledges

For participating teachers, even though as per the new curricular mandate in the British Columbia (which was introduced in the school year 2014-2015 when the data were collected), the newer textbooks include Aboriginal knowledges, this inclusion is superficial. The teachers were concerned that in the textbooks, the Aboriginal knowledges are mentioned at the periphery and do not include value-based discussions of Aboriginal perspectives. The following excerpt from Meera’s interview where she is talking about new science textbooks of Grade 9 and 10 better reflects this concern:

They are [Aboriginal knowledges] mentioned. Mentioned. But it’s not very in-depth. So, there was in the textbooks a very small mention about traditional like... ecological management practices which is a totally interesting topic because ...things that people have been doing many years, thousands of years and then it changed in last few hundred years... and now we are sort of referring back to them in some ways because they are proven to work... like controlled burning and different types of harvesting of trees or harvesting sea food so just ... but I wouldn’t say that the textbooks explicitly explain that there is like this traditional knowledge and there is an ideal you know science base. There is not any discussion of values like valuing Indigenous knowledge. There are one or two very small things [in the curriculum] about like Aboriginal perspectives. I think that the problem is that it’s not built into the curriculum very much, so if a teacher doesn’t know a lot about it [Aboriginal knowledges] or doesn’t have their own experience, they are not going to be an expert in it... (Meera, Interview Session 2).

Similar concerns are echoed in Polina’s voice, who finds the integration of Aboriginal cultural knowledges in the mathematics and science textbooks superficial and insufficient, and thus, not very helpful in her teaching:

In some ways I think that the textbooks are trying to be culturally responsive, but they are not doing it in a meaningful way you know. Like saying... referencing someone’s name
that isn’t a western’s name doesn’t really change that person’s connection to the book, you know. Just because I have seen an Indian name, I am not like oh…now I understand this better. So, I think that they are trying to make it more culturally responsive, but they don’t really understand that in math this doesn’t work the same way. You know what I mean… I feel like there is a bit of nod to it because there has been such a push to integrate Aboriginal content… but here [in the urban Canadian contexts] the separation between the culture and the classroom is too large… there is definitely mention of different First Nations groups around BC and I can see that they are making efforts…there is definitely more[Aboriginal] content in it [the textbooks] for sure…I feel like that they have just kind of given a nod to it so I don’t know if the textbooks are really that much better and I would not rely on the textbooks to incorporate Aboriginal content. I will always have to go out and talk to the people in the community and ask them… (Polina, Interview Session 1).

4.1.4.3 Lack of appropriate teacher support impedes successful integration of Indigenous knowledges

In addition to the lack of adequate culturally relevant resources, in their interviews, most of the participating teachers shared that the insufficient number of support personnel (such as multicultural workers, resource person etc.) and inadequate professional development opportunities, are two key issues that hinder them from successfully integrating Indigenous knowledges in their teaching. Many of the teachers acknowledged that it is their responsibility to integrate Aboriginal knowledges in their curriculum because it is mandated by the new BC curriculum guidelines, but in absence of appropriate support and guidance they are often afraid of being “disrespectful”. In the absence of any clear directions regarding disciplinary areas in which they should integrate Aboriginal knowledges, the teachers felt that integration of these knowledges is mostly an individual teacher’s decision and responsibility, as evident in the following excerpt:
I was concerned that I was going to be disrespectful... Also, with the Aboriginal learning and the Truth and Reconciliation movement right now, I think it’s my responsibility to be the gateway to the children’s education for that [Aboriginal knowledges]. [Aboriginal knowledges] doesn’t [don’t] really have any categories of science or social studies because it’s so new. It’s kind of prerogative of the teacher to how to introduce the material. It is initiated by them [the government and the school board] and as a teacher you have the autonomy whether or not you address it in your lessons... (Milica, Interview Session 2).

As teachers who wish to integrate diverse cultural knowledges in their classrooms, the participating teachers identified a lack of relevant resources and support personnel as key barriers in effectively reaching their culturally diverse students. As mentioned previously, teachers acknowledged the value of integrating Aboriginal knowledges, but they shared that their teacher education programmes did not prepare them well to do so. The ongoing professional development programmes and the existing resources and supports provided were also reported to be insufficient by these teachers, as evident in following excerpt by Claire:

*I do know that policies around Aboriginal education that’s very clear now and everybody is having a big push for it now, which is really good, but I think as well it’s not always easily supported. Like we had an Aboriginal worker here at the beginning of the [school] year but she unfortunately went off on leave and then we don’t have anyone else. So again, I am now going to have to go out and find that information [about Aboriginal knowledges] and to be honest you know I don’t have a lot of time to add that into my daily workload so... There is not a ton of professional development work that I have seen, and our worker hasn’t been around, and the year has almost passed. Although, I would guess that new teachers going through teacher education programmes, I would guess there must be a course on Aboriginal education but when I went through there was not anything...* (Claire, Interview Session 2).
It is unfortunate that this lack of relevant resources and adequate support is resulting in teachers’ consideration of teaching Aboriginal knowledges as an add-on work. More concerning is the fact that this inadequate support is resulting in the integration of Aboriginal knowledges as “fiction” as evident in the following excerpt by Milica, who even though afraid of offending certain parents, felt compelled to integrate Aboriginal knowledges in her lessons because she considered it her “responsibility” to “give back” but was not sure about relating these with science:

There are so many [online] resources but with Aboriginal learning there isn’t anything and that says something as well because there has been such disconnect. The families don’t speak the language, the parents don’t want to revisit any of it at all because it’s painful. So, a lot of the time the material isn’t there and that’s also why we need to kind of revive it [Aboriginal knowledges] and make sure that’s...even you know at first it began as if you have Aboriginal students in your class try to teach but I think even if I don’t... it’s still my responsibility to be educated on this. I consider it our apartheid or our Genocide; we need to give back the education that was taken from them [Aboriginal people]. I try to integrate Aboriginal stories, but I can’t relate these as science. For me I just put it [Aboriginal knowledges] in a category of fiction for me, right? And learning and respecting their [Aboriginal peoples’] wisdom. I know there are also families that are religious who take offense to hearing those stories, but I still have to teach them. I mean, I am not doing it on a regular basis it’s just once in a while to be able to show that there are different kind of understandings of nature and they take some of what they will, I am not going to make them have it in their mind what they have to believe or what not, I am just presenting the information as it is in the story ... (Milica, Interview Session 2).

4.1.4.4 Inadequacy of teacher preparation programmes in preparing teachers to teach for cultural diversity

Most participating teachers who all have completed their teacher education programmes in BC, indicated that in their teacher education programmes they did not have any formal courses
or training that could help prepare them to teach culturally diverse students. As per these teachers, the only aspect of students’ diversity that was touched in their teacher education programmes was about special education and exceptional students as evident in following excerpt:

*If anything, the focus was a bit more on adopting curriculum for children with special needs so that was my impression...so none of our course work that I recall really...as far as cultural diversity...It’s interesting. I do not recall it as being very much a discussion at all, more if anything more just the diversity between learners of any kind rather than culture... And I think especially now having Aboriginal content in our curriculum, that’s not new but new to some of us, it’s not something that I know a lot about and I knew it wasn’t there in my teacher training back then and maybe isn’t there now and I think that’s sort of something new and becoming very important to get professional development about. So yeah, I wouldn’t say and yeah, for me any way I don’t think I have taken any of the professional development specifically about how you look at the diversity of a classroom...* (Claire, Interview Session 1).

These teachers felt that their teacher education programmes did not prepare them for the reality of today’s culturally diverse classrooms. As per the teachers, the courses taught in their teacher education programmes were disconnected from the realities of schooling as they mostly focused on theory and did not inform day-to-day teaching practices as echoed in Milica’s voice:

*I have been working harder on [teachers’ professional development] workshops to develop my science and math background. I must say I wasn’t happy with my courses that they teach you in the [teacher] education programmes. A lot of them did focus on psychology, which I had already taken. But a lot of the professors have not even ever been in a classroom. So, they were telling me to develop my pedagogy. Like principles on what was their theory not what was actually practiced in the classroom. And then when I got to the classroom I had to spend a lot of time just acquainting myself with the basics. How do I teach printing? How do I teach basic math skills? Because those weren’t taught...*
to me in those courses only the principles. So, I spent a lot of my beginning years of teaching just figuring out how to do the very basic lessons in the classrooms and feeling very frustrated [that] those weren’t taught to me. I did take courses on understanding gender in the classroom in regard to phrases that are unkind and biased towards females. Such as she throws like a girl, he acts like a FAG…those kind of derogative comments [such as] he plays like a homosexual. [I have a] dislike for that… but that was actually part of my other degree that I chose as an elective. [It was] of Bachelor of Arts. But I must say I wasn’t happy with my courses that they teach you at the [teacher] education programmes. They teach you theory but do not teach how to apply it in practice. I had to spend one whole year to develop my own math programmes that would work in my class where I have students from so many different cultures... (Milica, Interview Session 1).

Only a few of the participating teachers reported getting some information about diverse cultures and/or schooling in certain countries. It is noteworthy to mention that this information was gained by the teachers only through one- or two-day’s professional development workshops or days during their entire teaching careers, which ranged between 8-30 years. Following excerpt is reflecting what the teachers gained in these workshops:

I am trying to think back if there was a course in that [cultural diversity] ...I would say...No. Not specifically science and math we did. It’s been fourteen years that I am teaching. We have a had a few professional [development] days where we had our multicultural workers come in and [they] talked to us very specifically about sort of what schooling is like in China and in Korea. And we haven’t had any thing at least our person hadn’t had anything for any other cultures...that [information] was about just those two [countries]. It was a few years back, at least four years ago. I think it gave me insight into how the students are from those particular countries sort of view education and what it’s like in there, what they [the students] are used to... (Ashley, Interview Session 1).
Thus, as per the participating teachers, their teacher education programmes did not help them in preparing to teach for cultural diversity. Moreover, as per the teachers, the teacher education programmes they had were based on a static system which was primarily academic and did not take account of their life experiences or create any spaces for them to utilize their prior life experiences for becoming a teacher, as reflected in Callum’s comments:

*I think they [the teacher education programmes] had some prejudice. I was more like a construction worker [had worked as one, prior to joining the programmes] and I didn’t look like to them as a teacher, like the idea they had for a teacher. What a teacher looks like, supposed to be. I didn’t fit that. So, I think I had faced some discrimination in the school system, in the teaching where you learn to be a teacher, right... [in teacher education] they don’t really value the life experiences. They have tried to change teacher education. They have tried to change that more because they realized that a lot of people that are very good at academics are not good teachers. And an example is that all the university professors I had, a lot of them were very poor teachers. They couldn’t communicate, and they just couldn’t. But they... yeah...the thing is they were very poor teachers, right?* (Callum, Interview Session 1).

4.1.5 Theme 5: Contradictions in teachers’ perceptions of science and mathematics, cultural diversity and Canadian culture

As mentioned previously in Theme 2, most of the participating teachers identified cultural diversity as a strength as well as a challenge in meeting the needs of diverse students in their science and mathematics classrooms. While it was interesting to see that these teachers identified various reasons that could have contributed in making cultural diversity as a challenge (please see Theme 3 and 4), many of them were oblivious of their own beliefs and attitudes that could have led them to consider cultural diversity as a challenge. These contradictions in teachers’ perspectives as deciphered from their interviews complemented with the informal observations to their classrooms are as follows:
4.1.5.1 Science and mathematics perceived as culturally neutral, abstract, universal subjects

While all participating teachers indicated their willingness to make their teaching of science and mathematics responsive for their diverse students, it was interesting to note that many of these teachers viewed science and mathematics as abstract and fact-based knowledges. These teachers believed that the content of science and mathematics is universal and therefore, teaching of these subjects is neutral and not influenced by the culture as evident in following teachers’ quotes:

Sometimes I feel that science does exist in a vacuum that the culture cannot, doesn’t have the same influence over that say like... art or reading or writing. You know, the objects fall to the earth at a rate of 9.8 meter per second squared in Canada, U.S.A., China... you know and those experiences that you have with the students will be the same regardless of the place where they came from... (James, Interview Session 2).

Emphasizing that mathematics and science are not influenced by the cultural backgrounds, the teachers emphasized that these subjects are culturally neutral because the basic concepts of these subjects are universal and “same” as expressed in Ashley’s following quote:

I feel like...because a lot of it [Science] is pretty, I would say is culturally neutral. If you look at lot of the stuff in Chemistry 11, means chemicals or the chemical reactions are the same everywhere, you know that very well, so it’s not really influenced by the culture… (Ashley, Interview Session 1).

In the same vein, mainly focused on the concepts that should be taught, Claire described her teaching of science and mathematics as “content focused” because she did not find that these subjects could be easily related to culture. She admitted that she does not plan to include cultural
knowledges in her math or science lessons but does so “spontaneously” if there are any such cultural connections brought forth by any of her students, as expressed in her following excerpt:

> For especially science and math, I am not really thinking about [students’] cultural background. If you are talking about language arts or social studies I think those subjects lend themselves easier [for integrating cultural knowledges] and perhaps that’s why you chose math and science [for this research] because maybe it [integrating cultural knowledges] is not as easy or often thought of when you are planning your curriculum. So, I would say that ...yeah when I am doing my science or my math, no I am not, I am not really thinking about where the kids are from or what their [cultural] background is. I am more thinking about the content of what we are teaching and if it [cultural aspects] happens to come spontaneously like it has quite often in the lessons, I have done [integrated cultural knowledges] then. It’s more spontaneous thing and we will address it and connect with, but I don’t set out to plan my lessons to think about students’ cultural diversity. Integrating cultural contexts in social studies is easier a little bit more because it lends itself like because the curriculum for social studies is about families, right? So, families right away lends itself to looking at cultural diversity whereas in science it’s just so much more factual you know like parts of the plant, can you talk about the life cycle of a...so in [science and math] for me those [subjects] not necessarily lend itself easily on culture. I am not probably going to investigate the native plant of country of a student and then bring that in. I wouldn’t go that far in my planning I guess but if it comes spontaneously like the child says: ‘Oh, yeah, we have a plant like that and wherever.’ Then I might say: ‘Oh, maybe it grows there for that reason.’ So, it’s not in my brain to specifically think about where the child is from and connect that to my lesson... (Claire, Interview Session 2).

4.1.5.2 Culture of science as limited to outdoor education and local Indigenous culture

Some of the participating teachers considered that science and mathematics could have cultural connections, but for them this cultural integration was limited to learning about local
environment and accidental inclusion of local Indigenous culture. Following comments from Louise reflect how she attends to culture in her science teaching through outdoor education:

*As far as planning a cultural science activity, well, I don’t think that I do. We do most of... it is plants, animals, outdoor learning and like I said most of that the culture is we try to do local. And you know ten years ago when people were teaching they were teaching kids about elephants, lions and tigers but the elephants, lions and tigers don’t live here. So, I want these kids... is to learn about our local environment because that’s where they live, and they need to protect it. So, for me the focus culturally in science is probably the local environment so I am not thinking so much about... I mean I am not thinking about how to integrate other culture’s teaching you know what they are doing. I am doing culture in what I am doing in my local environment and Musqueam learning may come up when it comes up...* (Louise, Interview Session 1).

4.1.5.3 Emphasis on treating all students similarly/as a collective

It seems that in order to become “fair”, many of the participating teachers tried to remain culturally neutral. Some of them emphasized that cultural diversity is not an issue in their classrooms, while others shared that rather than looking at their students individually they look at their students as a collective. Many others suggested that they teach their all students in a “similar” manner as expressed in the following excerpts:

*I generally try to keep all my students as... treat them as similar, as similarly as possible so that they [the students] don’t feel like as if they are despised for them or against them. Of course, I would give them what they need to get started. So I would show them where we are at in the class or what we have covered so far in the year, find out where they are at and what they have learned and find ways to kind of...to bridge the gaps and make sure that they kind of affiliate with a small group [of students] at least and that might change that person might fit better with the other group later on but other than that I treat them same...* (John, Interview Session 1).
In the same vein, despite being aware that the students coming from different countries had different previous experiences of schooling, the teachers did not want to acknowledge this difference and accommodate their teaching. Instead, they wanted these students to bring a “clean slate” so that they can adjust into the Canadian mode of schooling, as expressed in the following excerpt of Milica:

Well, it’s just... I guess, to be honest I struggle with the word diversity. Because I really don’t want to see the kids as being different. I see them coming to me with experiences and maybe they have had more background knowledge in certain areas than others but when I, when I meet them I want to have a clean slate with them if that makes sense? And they’ll show me what they know and then, but as a group, I want us to come together to experience may be newer things that they haven’t had a lot of exposure to. Clean slate in terms of behaviours I guess. I mean...and it could be...it could be with math...There are a lot of countries from where the kids come. Even in England a math lesson is consisted of ‘Ok, children, open to page 74 and do five pages.’ No interaction with the teacher. Just worksheet after worksheet after worksheet. So, if the child is used to that I don’t want them coming into my class being just used to that. I want a clean slate from that you know. Just open your mind and let’s make it more hands-on or you may be at your old school you are really problematic in science and math classes. Maybe you caused a lot of trouble for your teacher but now you are in my classroom and I am not going to judge you how you were in your past learning environments. I will give you a clean slate on that... (Milica, Interview Session 2).

4.1.5.4 Reluctance to identify cultural diversity as an issue at the elementary level

It was interesting to note that while all participating teachers acknowledged linguistic differences especially the level of English language competency among their culturally diverse students as a challenge, some of the elementary teachers did not consider culture and cultural diversity as the factors that should be taken into consideration while teaching science and
mathematics to the younger students. As per these teachers, the students at the elementary level are not aware of and are not influenced by the cultural diversity as evident in the following excerpt of Claire who was teaching a combined K-1 class:

*Luckily for me at this age group, the kids just see the kids, they are not really... and they want to help and be friends and all that... So, the cultural part doesn’t, for the most part it doesn’t really have any impact on my teaching...* (Claire, Interview Session 1).

It is ironic to see that this same teacher Claire talks about an “incident” where one of her parents approached her complaining that their daughter was very upset because she was excluded by her peers who had formed a “brown hair club”. Here is what Claire shared:

*At the beginning of the school here we had a group of girls in the class who were making a club and you had to have the brown hair to join the club. And of course, there was this girl who had blond hair and she wanted to join it. So that was a very good opportunity to discuss about how we include everybody, and you can’t have a club that excludes somebody so a few things pop-out like that at times, but I don’t think that the socio-cultural background and cultural diversity is an issue at this age. I don’t think that they [the students] realized when they exclude people that they can be excluding on the basis of race or your nationality or background. But once you explained why that’s not a good thing and not appropriate, they do seem to get it. And you know then things like that didn’t happen anymore. At those younger ages the kids are so much more accommodating, and you know I think for them again at this age, a friend is a friend regardless of... yeah, so it was more that [laughs] a child wasn’t allowed in the brown hair club who had blond hair... [the student] went home and told her mom, right? And so, it wasn’t the child that told me. I didn’t know anything about the club. So, it was her mom who came and talked to me and the mom you know wasn’t super upset either. But obviously that’s not an okay thing and then the parent of one of the child who was in the brown hair club was very appalled that her daughter had said this [inaudible because of the announcement from the office] so in the end it all worked out and they [the parents]*
realized that the kids didn’t really mean to exclude anybody on the basis of typically something that could be very cultural... (Claire, Interview Session 1 and 2).

Thus, the teacher in this case is contradicting herself when despite of experiencing this incident where her young elementary students made exclusionary groups based on racial and cultural identities, she is not consciously admitting that cultural diversity is in fact a critical issue that should be taken into consideration and addressed explicitly while teaching diverse students even at the elementary level.

4.1.5.5 Wish for “all Canadian” classroom(s)

Referring to their teacher education programmes that did not offer any formal training on meeting the needs of culturally diverse students, some of the participating teachers wished for an all “Canadian classroom” as evident in the following excerpt:

I am sure we talked about teaching in a culturally diverse classroom [in the teacher education programmes] but nothing it never... [It] didn’t really resonate with me. It was just a token mention, but I don’t think there was too much emphasis put on [cultural diversity]. Certainly, they mention that it was a reality there are a lot of students who are [culturally diverse]. We had a course about teaching...inclusive teaching, that’s the most specific course I remember. But that was not so much about students from different cultures. It was more about special needs students. We are in a context... in Canada we have students who are, who come from different cultures. We certainly time to time talk about different schools; how they [the students] are taught in different schools, they [the students] might have trouble adjusting to a different school, the curriculum or the Canadian style teaching. I mean we talk about it, but I never really had any formal training on how to include students with different cultures with different cultural needs. Well, pardon me, sometimes, I just wished; I had 30 kids all from Canada that they all understood me. In certain aspects that would make my life easier... (James, Interview Session 1).
This teacher’s wish for students who can “all understand” him indicates his desire to support learning of his students. However, this desire to have students “all from Canada” is contradictory in itself because it involves an illusionary mono-cultural image of Canada and negates the multicultural nature of the country, and thus, the inherent culturally diverse nature of the student populations in Canada.

4.1.5.6 Canadian Culture as cohering around national symbolism and local teaching practices

It was interesting to note that most of the participating teachers identified their science and mathematics curriculum and teaching style as adhering to the “Canadian culture”. However, their characterization of “Canadian culture” was limited to certain national games and local teaching practices as evident in following excerpts:

Many of the textbooks would include examples ... for example, in problem solving section they would include some questions with Canadian culture. So, there will be a question on ice hockey game. There might be a question related to particle accelerates down close to home. So, if the students have more exposure to these things [the ice hockey game in this instance], they would be better able to understand how it [the question] works. Or it may be backwards, with these kinds of questions they might lead to a discussion [about the ice hockey game]. Open discussion of the question in the classroom and maybe they [culturally diverse students] can learn little bit about Canadian culture that way. (John, Interview Session 2).

In the same vein, while responding to culturally diverse parents’ concerns about their teaching of science and mathematics, the teachers defended their teaching as “relevant and real way of teaching” based on “Canadian culture” as evident in following quote from Jessica’s interview:
My difficulty in science and math is convincing parents that are not from Canada that the way I teach is relevant and a real way of teaching — teaching in cooperative groups. You know teaching things that to them seem too easy for their children. And so, I do extensions and tell them it’s a lot about language and problem solving and they want to see more practice of things that they already know. And I find that quite upsetting. It’s mostly the parents coming from [takes the names of countries from Asian continent] who come in second or third day of school and say, “my daughter is not going to do the ‘baby math’ any more [in Grade 3]”, and I am like: “What? This is baby math”? Okay. So, parents come often and tell me that their children are capable of doing more than what I am doing, which is fine. Some of them get even very emotional. I have had parents who come and say that: “By making them [students] do multiplications that they had been doing since grade one, I am holding their children back”. I do give their children harder problems, but I do have to teach the curriculum and can’t teach the whole class above the level of age appropriateness, you know because we are not all at the same level, but it is very difficult in September. Maybe they [culturally diverse students] [are] doing computation at Grade 5 or 6 level. I tell them, this is not what we do in Canadian culture.

In science, I do a lot of hands-on exploratory project-based learning and they [the parents] would want more book-based, I think they would like… I have another science textbook which is quite good… (Jessica, Interview Session 1).

It was ironic to see that while all participating teachers acknowledged that they respect diverse cultures and value cultural diversity, many of them were reluctant to move away from their prescribed curriculum or alter their teaching styles to accommodate needs of culturally diverse students. Labeling teaching practices of certain other cultures as “stereotypical”, these teachers justified their teaching of mathematics and science as based on the Canadian curriculum. Defending their classroom practices as informed by the “Canadian culture”, these teachers stressed that instead of expecting the teacher to “fit” their students’ diverse cultures into the school curriculum, the culturally diverse students and their parents who have come to
Canada, should accept the “culture” of Canadian schooling. One example of such paradoxical understanding of teachers is also evident in the excerpt from Claire’s interview shared previously in Theme 2 section 4.1.2.3, which focused on parents wanting children to go to Kumon math.

4.1.6 Theme 6: Diverse understandings and manifestations of culturally responsive teaching

Interestingly, although none of the participating teachers explicitly acknowledged or mentioned utilizing CRT strategies or their familiarity with CRT, glimpses of cultural responsiveness were present in the thoughts and actions of these teachers who tried to tailor their teaching to meet the needs of their diverse students in varied ways.

4.1.6.1 Broader understandings of culture and respect for students’ diverse cultural perspectives

It was interesting to note that even though many of the participating teachers adhered to national symbolism while referring to Canadian culture (please see Theme 5 subheading 4.1.5.5 and 4.1.5.6), they reflected a broader understanding of culture when they talked about the cultural diversity of their students. These teachers viewed culture as being informed by one’s lifestyle and cultural upbringing as well as schooling experiences. It was also noteworthy to see that these teachers were able to recognize that the students bring these diverse cultural understandings with them in the classrooms, as evident in following excerpt:

Culture for me is part of how they [the students] bring their lifestyle...how they bring their principles...how they bring their beliefs, even their interests and how they can express these in a language...and may be their strengths and their weaknesses. Again, these would be emphasizing their own cultures. Part of these things, they [students] bring all these things into the classrooms (John, Interview Session 2).

Similar broader understandings of culture are also evident in Meera’s following excerpt:
It’s more like even within the same culture there is lots of differences because of the parents, and books they read…I guess its [culture is] sort of set of values or the things you are familiar with, common ways of behaving and ways of assessing value in the world or something like that… (Meera, Interview Session 2).

Thus, identifying the multiplicities of understandings that can exist within the same culture, Meera talks about the “set of values” one may develop because of growing up in a particular family and/or socio-cultural contexts. Callum takes this understanding further by pointing out that nationality or country of origin are not the only factors that influence one’s culture. Talking about the cosmopolitan cultures a country may have and the multiplicities inherent within a culture, this teacher emphasized the role schooling and past educational experiences may play in shaping the culture of a student as reflected in the excerpt below:

Well, broadly speaking everybody is influenced by their nationality or the country they grew up in so there is something that a lot of, all Canadians in general have in common, no matter what. So that’s when you know …but also there are so many cultures within a culture, right? So, it’s very…there is no such thing like one, one type of culture which is like when somebody comes from India you could have many different… in India there are many cultures… So, you can’t make assumptions. It’s important not to make assumptions about anybody’s culture because the culture is just not just the set of values that you have been raised with, but it has also a lot to do with where you went to school because school is very major influence in kid’s lives… (Callum, Interview Session 2).

4.1.6.2 Taking consideration of individual student’s needs and accommodating for their strengths and weaknesses

Recognition of culturally diverse students’ varied strengths and weaknesses and adapting their teaching strategies to support the learning of these students was evident in many participating teachers’ perspectives and their teaching of science and mathematics. John’s
interview is one such example, where he is keen to investigate and support students’ different ways of approaching Physics problems in his secondary classrooms:

*I have noticed that sometimes in different classrooms they [diverse students] have solved a problem in different ways... The example that I am thinking about right now is circuits, the circuit analysis...solving circuit problems with resistance. I find sometimes the [states the names of some Asian countries] students they are very good in solving circuit problems. They know these rules and they meticulously use these rules and they solve problems, many, many problems and get results. The way I love to teach is...I like to start with first principles and explain how things fit together and how things work... and then they can use those first principles to solve the problems. Now there is often going to be multiple kinds of problems but the emphasis there is [on] understanding, I want them to understand what they are doing with the problem and I find the Asian group, they solve problems really fast because they are very good in solving problems. The only thing lacking in there is that they may not be able to explain why that thing works. And sometimes I would put a mark on their work and sit down and think it through really carefully to convince myself that whatever rule they have followed may be that really works. And sometimes that’s not easy and I may at times have walked them through their work and showed them this is because how this works... (John, Interview Session 2).

In the same vein, Milica in her Grade 2 classroom emphasized that supporting individual student’s success and knowing the story of the child makes her feel successful as a teacher. The following is an excerpt from her interview:

*I think that there is a different bar that I set for each child at the beginning of the school year that I think is appropriate for them to rise to in terms of their learning of education. One student in my class has gone up twelve reading levels so as a team we applaud that, we recognize it. There is another little girl who doesn’t have much English but now chants really loudly our beginning day chants, I am respectful, I am responsible...and it brought me such a smile because she was so quiet at the beginning of the year and now she so proudly says it as a member of the team. Another little boy who doesn’t speak
much English as well has now learned his letter sounds and wrote his story for the first time. I found that an incredibly joyous moment because you have to celebrate the success of each student no matter what their cultural background is because backgrounds are complicated. They are not black and white, so I know sometimes you can have children who can speak limited English but are having learning difficulties, but you cannot know that because you are having the language barrier. Though there are many many diversities in the classroom but as a teacher I feel my strength is that I want to know the story of the child so might not be that the story is Geography based but sometimes it is. Suke is from up North and he used to be with very very close, large family that are around all the time but he was struggling in the classroom because now most of the time he was alone with his mother in this city so that was preventing him from doing the basic skills that he needs to do in math because it was his self-esteem that was bringing him down. So, you have to know the story of the child and that is complicated, and it has different backgrounds. And sometimes you know the child is going through the parents getting divorce, and I have seen that completely changed a child’s personality where they were good student; they were engaged to being listless and not wanting to focus. So, I try to make the children just feel supported and nurtured, and just to let them know in different ways that I understand, and if they need to talk to me, they can. But we also need to figure out and problem solve how we are going to meet their needs of learning differences when I am teaching science or math... (Milica, Interview Session 1).

4.1.6.3 Cultural responsiveness translated as permitting use of native languages and collective team work

While talking about the English competency levels and how they influence the socialization and learning processes of culturally diverse students many of the participating teachers shared that they are cognizant of the difficulties that their culturally diverse students may experience when they are expected to hear and learn all subjects by using only English throughout the day. The teachers reasoned that it is essential that they allow culturally diverse students to communicate in their native language at certain times to help facilitate correct
comprehension of instructions and concepts as well as to create a safe and comfortable learning environment where culturally diverse students feel belonged. James’ following excerpt includes his reflection on his own experiences of being in a situation where he had to hear and use a foreign language for an entire day and how he felt in such situation:

At the beginning of the [school] year a lot of my parents requested that their child [should] not sit next to somebody who speaks the same language as them. Yeah, they want their child [to] sit next to somebody who speaks English. So now it’s impossible. I can’t do that anymore. I have got so many new [states the name of a non-English speaking country] students in the last few months that I have just...they sit next to somebody who speaks [language of the particular country] language and they get help from them how to do the [math] problem. You know, I think it is a long day to drawl strictly in English and ask them [the students] to speak English entirely, think in English all day long. [It] is too much. I think if I had to speak...I do speak, I speak Dutch as my second language. I played hockey in Europe and I got myself in situations where I spoke Dutch all day and I was tired thinking in a different language, talking in a different language and listening in another language. I found there were times I tuned out. It’s too overwhelming. It’s too much work. So, I have that same sympathy. I don’t mind it so much that they [the students] speak [native] languages in class. I don’t lose my sleep over that. I think there is research out there that suggests that such a lenient approach is probably beneficial. So, they don’t speak English all day…I make sure that they produce the work and show me their work in English... (James, Interview Session 1).

Similarly, acknowledging the diversity of abilities, skills and personality traits that students bring with them, Milica emphasized that her focus is to ensure that her all students develop supportive attitudes and learn to work collaboratively as a team so that everyone can feel supported in their learning as expressed in the following excerpt:

My basis of teaching is that I always want the kids to be supportive of each other and I spend a lot of time talking about that. Someone that isn’t necessarily high in their skills in
math but can be very supportive, I would put that child with someone that has average skills in math. Just so [that] the level is a little bit higher. I don’t want there to be a big valley between the children. It doesn’t matter gender wise. Although some kids [are] just more comfortable with the same gender...but I wouldn’t say that because someone is from certain place they are going to be higher [in math skills] or if someone is of particular gender, they are going to be higher in certain skills. I would, I guess, I look at their personality. Children bring with them their personality, whether or not they are going to play fairly, be responsible... I always just see the children for the personality that they give me. Also, I don’t like to use the word shy but some kids who have difficulty with English don’t take so many risks, so they will need someone who is very supportive team mate. I think I just see the kid’s personality when I group them. Those are actions that they show how they are responsible or focused especially by this time of the year [It was April, the beginning of the third and final term of the School Year]. So, I don’t look at how they are diverse, I look at how they are coming together as a team and are collective instead... (Milica, Interview Session 1).

4.1.6.4 Responsiveness as integration of cultural knowledges

In their interviews, participating teachers shared their cognizance of cultural influences on one’s teaching and learning and shared their efforts to integrate cultural knowledges that students bring into their classrooms. John’s interview provides some glimpses of how he invites students’ diverse cultural knowledges in his science and mathematics classrooms:

First of all, it is very important to be respectful of all the cultures but what does that mean being respectful to all the cultures? I would say take an interest in the cultures, through discussion, in discussion. I think that’s a good strategy. It’s just being able to have them involved in, bring the cultures in [into the classrooms] in some way or the other of sharing their culture. It could be very different in terms of sharing... just explaining things...it could be sharing something in front in the beginning of the class, it could be a someone sharing a joke may be based on something...they have experienced about in their native land... (John, Interview Session 2).
Additionally, in their efforts to invite diverse cultural knowledges in their classrooms, the teachers, especially the teachers at the elementary level, tried to celebrate festivals of diverse cultures in their classrooms. Following excerpt from the first interview with Louise provides an example of teachers’ such efforts:

*We celebrated Diwali in October which is the celebration of light and you know a bunch of different families all got together, and we had the children doing Rangoli patterns, they were making oil lamps, they were doing the henna on their hands with markers. We had dancers; they had traditional foods, and traditional clothing. So, it just really made nice celebration of the week. We just celebrated in all different ways and talked about the culture which was really fun and it’s a really good experience for children... Same for Lunar New Year, which is in January, it is a big school wide event because obviously we have a big Asian population and we celebrate everything and the kids just really love it...[takes the name of a child] grandfather came in this year and playing traditional Chinese instruments and teaching us writing of Chinese characters... Those events are more about the traditions, the activities, the histories, the music, stories, songs you know the tradition of the event and the background of culture... I think you can find curricular activities related with science and math within them, but I don’t necessarily plan those events with the curriculum in my mind.* (Louise, Interview Session 1).

It was noteworthy to see that many of the teachers especially, the elementary teachers reached out to the parents and community members and invited them for sharing their cultural knowledges in these teachers’ elementary classrooms. Claire’s interview indicates her efforts for integration of diverse cultures in her K-1 combined classroom through parents’ and community involvement:

*I like the fact that the families bring something from their culture and share it with the classroom. We have a potluck at the beginning of the year and it was a multicultural potluck you know. We talked, we have people ... parents brought food from their culture.*
and its just such a nice coming together. [The parents] get to know you and [we] make ourselves a school, a class community, right? And it didn’t matter where you are from. We just come together and share. So yeah… I think it’s always nice to find a connection through the kids wherever you are from. So, you know, we will talk about obviously different holidays throughout the year but every holiday no matter what you talk about, it has to deal with family, it has to deal with food, it has to deal with being together and so I like the fact that we can tie, always tie everyone back to each other no matter where you are from. Children will, you know, for Show and Tell [an in-class activity] bring something that you would never have thought of because it is may be coming from their family, or from their culture. So, I love that kids are willing to share and it's about them and I learned a lot as well. Like, I certainly know more about Hanukkah and we just had a family here last week talking about Baisakhi and so I learned all about you know Punjabi region and it was really interesting learning for me as well as for the kids. And you know that parent said that it was really well you know because her child is the only student, she can think of in the school that is Sikh. And she, you know, wanted children to understand why they don’t cut her hair and so that her child feels comfortable here and I thought that was exactly what it’s about… to come and share your culture so having the parents involved and learning with them has been really rewarding… (Claire, Interview Session 1).

4.1.6.5 Cultural responsiveness translated as accommodation for diverse ways of students’ participation

Recognizing that cultural expectations as well as previous schooling experiences of culturally diverse students might affect these students’ participation and engagement in their science and mathematics classrooms, participating teachers shared various ways they try to alter their communication as well as teaching styles to accommodate for these students’ learning needs. Louise shares one such example:

I had some children like when they first came to Canada and I would be wanting them to look at me when I am talking to them. But you know, the cultural worker explained to me
that there are schools where the child is not allowed to look up and look the teacher in the eye. So, I am demanding you know, I am saying “look at me, you need to look at me” and the child is like but “I am not supposed to look at you”. So, if I don’t know that then I am thinking why wouldn’t you look at me and you know I am trying to be friendly and they are seeing it as being disrespectful, right? So just understanding those things as you go to get along, but you know taking the time to determine: Is this a behaviour, is it a cultural behaviour, is it a learning disability, is it something that they have been taught? Like what is it that this child is doing, is up to me to understand, right? (Louise, Interview Session 1).

Similarly, recognizing the diversity of schooling experiences that students may have, Ashley shared how she utilizes these understandings in promoting collaborating learning and students’ participation in her Chemistry 11 class:

Cultural diversity among students has forced me to be more...I guess creative in how I get students to verbally participate because the other thing that I find with students who don’t have strong English skills is that they are very reluctant to participate in verbal discussions. You know, I’ll ask a question and I know that ninety percent of the class knows the answer, but they don’t want to say that loud [paused because of the announcement from the office] Oh yeah, so we were talking about students verbally participating ...so, yes, it’s just asking a question or trying to start a discussion doesn’t really work very well when you have a class with large number of students who don’t speak English. So, what I do actually is we had a really amazing professional development seminar with the speaker who kind of specialized in how kids learn with respect to how brains work but he had really good suggestions as far as getting. So rather than just throwing out a question and asking them [the students] just on the spot answer it’s just like you would say to them that I am going to ask you this, discuss it with your partner and then we will answer it after that. Then they get a chance to work it out or you would even say that I am going to let you discuss it with your partner and as these students are discussing it, you might go to this student and say I am going to ask you and
I am going to ask these guys so then they know that it’s [the question] coming and they get time to formulate the answer if they want to write it down and just read of what they have written. So, it’s kind of prepares them in or just getting them to tell each other instead of telling it to whole class then they are less likely to be super nervous and I think those things are helpful regardless if you are an English speaker or not... (Ashley, Interview Session 2).

Describing teaching culturally diverse students as “exciting” as well as “challenging”, Jessica shared how she encourages diverse students to share their cultural knowledges and contribute in advancing their own and their peers’ learning in her Grade three math and science classrooms. As per this teacher, since vocabulary of science and mathematics is “new for everybody,” these subjects serve as “leveling” fields, which allow non-English speaking students to have greater “potential to succeed” and demonstrate their learning by “doing,” and “learn from each other” in cooperative, collaborative groups. Sharing her strategies of using hands-on activities, manipulatives, and problem-solving strategies in her science and mathematics classrooms, this teacher takes pride in creating a “very good” classroom environment where as per her; everyone’s knowledge and skills are being appreciated. In her classroom, regardless of their level of English proficiency, all students including students who are English language learners get the opportunity to contribute in their own and their peers’ learning. This excerpt highlights Jessica’s perspectives:

I think its [teaching science and math to culturally diverse students] very exciting because they learn from each other. They learn by doing in both science and math. So, it isn’t language based. So potential for them to succeed is much higher, the potential for non-English speaking students to succeed in science and math is much higher. Also, for them [the students] to be successful, to show that that they get it, right? Like the multiplication phrases, so they feel very good about themselves. So, teaching is a little bit
of a challenge sometimes. It’s always vocabulary. So, making sure that they understand the language of math, so for problem solving, it becomes a more cooperative, collaborative thing where they are working on problems with other students who can speak English, so they can learn about how to write equation, or make or do the survey or make the graph or whatever. So, they understand the mathematics, but they need to understand the questions, so they can work together. So, it is about vocabulary but with instructions it’s may be clear in modeling what the concept is and then getting them to do practice, lots of practice but also doing lot of hands on and using manipulatives... So, vocabulary for everybody is new. So, it’s not just new for only English language learners but for everybody also for English speaking Grade threes. So, I think science and math are the leveling ones, where everybody appreciates everybody’s [knowledge] right? Because you draw in class, you make beautiful graphs once you got the numbers, you got the questions right, you understand. So, I think; it’s actually very good. They understand it...it is fine if they are thinking but they don’t do it in English. It does not matter because they can demonstrate their scientific knowledge through diagrams. And you know there might be a lot of vocabulary, but you understand that they can show that they understand it through illustration, through getting, solving problems, by getting the answers correct, by measuring things correctly. It’s the structure of science and math, a lot of English language learners are very successful because they are creating things, and it’s a lot more observations or independent work that I guess. And the language and writing, there is little less writing in science and step by step of explaining things and you have to show, you have to be able to show your knowledge that you understand what you are doing. We do a lot of activities where students share their own connections. Show and Tell is a way to share their understandings of science and the world. They have choices of objects: money, pictures of trips, show their own way of solving Rubik’s cubes... (Jessica, Interview Session 1).
4.1.6.6 Efforts to simplify language in teaching and assessments to accommodate for culturally diverse students’ English proficiency

Considering the differing English competency levels of students coming from diverse cultural backgrounds, it was noteworthy to see and hear from the teachers about how they make cognizant efforts to simplify the English that they use while teaching as well as while assessing science and mathematics learning. Polina’s interview provides some examples of how this teacher modifies her teaching strategies, vocabulary and utilizes visuals while teaching science and mathematics to facilitate understandings among her diverse students, many of whom are designated ELL students:

*I am trying to use a lot of different methods. I am using PowerPoints, but I also use demos, labs that are more hands-on. I try to allow time for them [students] to translate work into their own language before we even get into it. So, if I gave them a lab, I will get them to write, I will give them all the steps but there is a chunk of space that really just to translate those words. And I’ll have to walk around and sometimes the most difficult thing is that in science, science language, academic language is especially difficult because you have a lot of terms that are similar that they are in everyday English. Like if I am looking at the states of matter, matter means very different things in everyday regular English, so we have to really... I always try to be very very aware of that and it is really hard. I have to think about how to specifically unpack those terms because you know weight? Weight is... actually is different in science than the way it is used in everyday language. So, as I am looking through all my information and my PowerPoints. I try to see that okay where would these words come up again in everyday language and how easy it can be for them to get confused, right. So, I always try to really have explicit conversation with them [the students] about the terminology and how in science we have this one word that we have to unpack that actually means more than... the whole point of science is to have condense language, right, that can tell you a lot of stuff ...but you see that same word every day and it has only one meaning. So, it’s incredibly complicated... terms in math such as parallel lines, intersections they seem to be more straightforward. I
mean I try really hard to go through the steps and show them parallel lines. I mean there is a lot about just using language and actually showing them what a parallel line is. That seems to be... from what I can tell... it hasn’t been that challenging in math. I mean there is definitely overlap in lot of terms in math and real world too, but I think in context of math it almost makes more sense and they can kind of pull those vocab[ulary] words apart more than they can in a science context... (Polina, Interview Session 1).

In the same vein, Ashley who teaches various science subjects at the secondary level tries to simplify the language of the tests and quizzes that she gives in her science classroom as evident in her following excerpt:

You know one of the things that I have definitely changed is that I am very conscious of now, now that there is so much diversity of students in my [science] classroom that when I make up the test questions ...[I] really try to keep the language very basic because I’ll find that I’ll ask a question but the part of the question that’s not even the part that is testing your knowledge... they [students] don’t know the words. Like for example, ... I may I have had that written that “crossing over would occur...” but then I end up with a whole bunch of hands that “what do you mean by ‘occur’”? So, then I try to change it to something simpler and so it’s [paused because of the announcement from the office]. So, then I changed it to: “Crossing over happens when...” (Ashley, Interview Session 2).

Similarly, while giving a math quiz to his grade three students, Callum tried to explain certain English words used in a math word problem and also the math vocabulary that was new for his culturally diverse students. As the students were working on a math quiz, one of the students came up to Callum to inquire about certain questions. Here is his conversation with the student:

A flower pot...it’s just like a something you put flowers in... it’s a pot there is some dirt in there and you put flowers in it and you give water in it...you don’t need to understand it for solving this problem...Choose correct quotient. We talked about quotient in class
earlier today... What does quotient mean? What does quotient mean [takes the name of the student who asked the question]? It’s like... [addresses to the whole class and asks other students to answer] ...it’s [the quotient is] a dividing question’s answer so that [the question] wouldn’t ask you a quotient when you are multiplying, only when you are dividing, so choose the correct answer. Do you see operations? Adding is an operation, multiplying is an operation, dividing is an operation, so you have to read the question and decide... which one would you do to find the answer? That’s an operation. It’s not when you cut somebody to do the operation to remove their kidneys or something... It’s like operation when you change something, right? Change something by adding or subtracting or dividing or multiplying, that’s an operation... (Field notes of informal observation in Callum’s math classroom).

4.1.6.7 Contextualizing science and mathematics to make these relevant and accessible to diverse students

While talking about the relevance of their science and mathematics curriculum for diverse students, many of the participating teachers equated relevance with the accessibility of these subjects. To ensure the accessibility and meaningfulness of their science and mathematics teaching for their diverse students, the teachers used diverse ways to contextualize learning of these subjects. One such effort of contextualization is evident in following teacher’s excerpt, who shares about the learning of specific science and mathematics concepts by connecting these with the experiences that students may encounter in their everyday “real-life” contexts:

*I frequently start a math lesson where I explain where we use this math in real-life: the importance of using mathematical precision, mathematical language and how it’s a language in itself, where we use it. I give examples of my own life how I need to use multiplication, geometry... and then I try to give examples...I try to make use of cross-curricular activities so that [students] can use the mathematics in an authentic and meaningful way. So, what we are doing this thing in class [is] called “Genius hour”. That’s where I give students two hours a week in order to explore... anything that’s of*
interest to them. So... it's quite a lot of work getting it started but it starts with a question, they have to reinforce it with reasons why they think it is important, why they are interested in this subject, they have to show me where they are going to do the research of their subject, so I have the evidence of their research and finally have to show me the finished product. So, a lot of my [states the nationality a particular country] students are doing how can we create our own comic book character. So what I have done to get them started is...we are looking at the origin of comic books, [students are] looking at comic book heroes, and plot graphs so there is an example of graphing a practical application of understanding a real-life...sort of like a timeline but it's of interest versus time and what are the key events that happened with all superheroes like how they all started like if he [the superhero] was a scientist working in a lab there is an intro, something happens there is a rise in action and the climax is he becomes some superhero with a strange new power, right? So, there is one example where we are taking the graphing, we have learned how to graph in math class and now I am giving them an example how to apply it and make it about something that speaks to them... (James, Interview Session 1).

Similarly, the teachers try to diversify and differentiate their teaching of science and mathematics by broadening the learning objectives to interdisciplinary areas, and by using online resources and hands-on manipulatives. Milica shares some of the techniques that she utilizes to make her science and mathematics curriculum accessible and relevant for her students:

If there was, an easy hands-on programme to do math games that has also been a focus of mine. I [try] to do math games more often. I do place-value math with manipulatives in terms of stations. I would like a programme that would just set up activities with all the materials in a bin, ready to go. Because I find that those activities really do attract the interest of all the diversity in the class because children love games. And learning math [is hard work] and if they think that they are not doing hard work during those math games, then that works [laughs]. What they present [in science curriculum] is quite dry. I like to make sure everything is three-dimensional. So “students discuss the properties of air” is a dry concept in itself. So, for me, that has to with Wind mills and Notebook
presentations, little booklets and acting it out in a play so that’s across the curriculum.... It’s relevant because it is accessible. You have to make the subjects accessible to all the children. But also, to… if they [the students] are just used to do page after page of 9+4, 2+3…then that’s not opening their learning for a different way. And I think it’s incredibly important that when they are doing say, you know 24+29, sure they can do it on paper, but do they know those numbers actually represent an amount, they symbolize things? So, we need to make sure that they [the students] understand that numbers are connected to symbols and they [the numbers] are representations of actual amounts. So, we will use tens box and single ones and making sure that they [the students] transfer that knowledge what those numbers actually mean and not just memorize (Milica, Interview Session 1).

4.1.6.8 **Strength-focused assessments and a wish for “grade-less education” to promote healthy citizenship**

Perplexed with meeting the needs of their culturally diverse students amidst the expectations of the prescribed curriculum and demands of the parents, the participating teachers felt that removing the requirements of grades or giving marks would help in easing the tensions that they and their culturally diverse students constantly endure. The teachers felt that English competency levels and different cultural and prior schooling experiences often influence their culturally diverse students’ grades in science and mathematics. As per the teachers, many of their culturally diverse students are under tremendous pressure to excel academically because of the greater parental emphasis on grades as also discussed previously in Theme 2 subheading 4.1.2.4. The teachers shared that to support their students’ learning; they utilize strength-focused assessments and wish for a “grade-less education” where rather than focusing on evaluating students’ learning to assign marks and grades, they could encourage students’ improvement to promote healthy citizenship. The following excerpts best reflects teachers’ desires:
They [culturally diverse students] are pressured to do better especially in science and math but their grades are compromised because they are ELL. Many times, they miss a class [because of the pull-out programmes] or miss the point of the activity [because of language barrier]. With the science posters, my kids from Canada, [they were] bugging me to have poster projects because they really wanted to do poster projects. A lot of my students from other parts of the world had never done that, had never seen one so they don’t do them [the posters] in their schools so they were on pavement. I went through the criteria what were the expectations you know they had to talk about the specific habitats, the adaptation, what will be a threat etc. The posters I got from them [the newly arrived culturally diverse students], they missed the point. They [the posters] were very cute, lots of drawings, they talked about the movies with those animals plummeting in, but they were disorganized, and they missed the point of the criteria, they missed the science component of it. I think they [the students] couldn’t, they didn’t really understand the criteria. I sort of explained what the expectations were, they missed those point. They hadn’t the experience. Like if the kids start school in Kindergarten here in Canada, they see the posters made by grade 3, 4 and 5 walking down the hallway, what a poster looks like for science. I mean that’s part of the learning process. I didn’t know. I wrote it [the criteria] down, gave it to them [the students] but maybe I can see it now in hindsight. Maybe I had to go slow, why did I just focus on looking at the finished product? I actually talked with the parents when they came to conferences [parent-teacher conferences] that they [the students’ posters] actually missed the point. It doesn’t seem like a science poster. And the parents were upset that their child may lose marks. I wish I could convince the parents of these students that there is more to education than just grades, and that there are other important things in life other than just grades. I hope we could move towards a grade-less education. I can see that I can see the merit in it. The kids would love it because if that’s the incentive ...the learning because emphasis on the grades drives some of them [the students] nuts. Well, I don’t know. I am not sure how might that transition look like in high school and university but if our goal is producing healthy, good citizens who are capable of doing, forming a world, the things need to be done creatively. Do we need to drill literacy, numeracy? It’s not all about giving them
[the students] grades. It’s setting them up for more. The research shows that you focus on what they [the students] need to improve rather than telling them what they get out of ten, then they are set for greater improvement. So, I am for, I am trying to focus on my assessment with what they did well and what they need to improve on and not as focusing on what they lacked… (James, Interview Session 1).

4.1.6.9 Conscious efforts to reflect on their own cultural and experiential backgrounds and related biases

It was interesting to note that while acknowledging the cultural diversity as a challenge (please see Theme 2, subheading 4.1.2 and Theme 3, subheading 4.1.3), many of the participating teachers recognized that through their own cultural backgrounds and past teaching and learning experiences, they might have accumulated certain biases, which could influence their teaching of science and mathematics as evident in following quote:

Well, I guess, I know its…I go with what I know. And I know have probably what I have learned in these many years have accumulated probably lots of Eurocentric bias. It’s really challenging to weed through what I know and label this as Eurocentric versus like a worldview that I have acquired… (James, Interview Session 2).

Reflecting on how their own cultural upbringing and schooling experiences might inform their teaching, participating teachers shared how they consciously try to use examples from diverse cultures and use inclusive language to avoid “masculine, white” superiority in their teaching. Following excerpt from Louise’s interview reflects these perspectives:

Yeah, I think in my own culture, cultural background is only the white what I am familiar with. But actually, you think back and look at how you were taught and how you learned things and honestly… since then I was exposed to a lot of different nationalities and culture. So, I can bring some of those other ideas in[to] my teaching and learning. And I do try to use…even though little things like trying to use different children’s names like when I am using an example… I would just say that I could have used Suzi and Dave, you
don’t use those Canadian names, but you can say like Ranveer and Ching Se are playing or did well on this math activity. So, I am more sensitive to things like that...as I am sensitive to gender as well. You know I am not using phrases like boys and girls and you know making those differences so just trying to make things a little bit broader and inclusive as I address children... So yeah, I think I am definitely trying to take some of the “white” [used hand gesture to indicate quotation marks] out of my teaching in any way I can. I think I have done that over the years as well (Louise, Interview Session 2).

Some of the participating teachers acknowledged that while other people might consider science and mathematics as cultural, their Canadian upbringing might have contributed in shaping their views about science and mathematics as being acultural as acknowledged by Meera:

_When I think about my own feelings of science and mathematics, I don’t feel a lot of... I mean my own culture. It’s hard for me to recognize so I don’t see them as being culturally based but then I… that’s coming from Canada. So, in other people from other countries, I know, will have different perspectives… _ (Meera, Interview Session 2).

### 4.2 Summary

The findings presented within this chapter provided in-depth, phenomenographic analysis of teachers’ perspectives elicited through two individual interviews complemented with four informal classrooms observations to each teacher’s science or mathematics classrooms. In light of the study’s research questions, the constant comparison and triangulation of these perspectives through the lens of theoretical perspective of the study, revealed six overarching key themes, which are as follows:

1) Cultural diversity as a mosaic

2) Cultural diversity as a strength as well as a challenge
3) Level of English language competency as an influence on level of students’ learning and engagement, and teachers’ teaching practices

4) Lack of culturally relevant resources, support and training as an impediment to successful integration of Indigenous knowledges

5) Contradictions in teachers’ perceptions of science and mathematics, cultural diversity and Canadian culture

6) Diverse understandings and manifestations of culturally responsive teaching

The final chapter includes analysis and discussion of these themes in response to the study’s research questions. The dissertation concludes with implications and recommendations for further research.
Chapter 5: Discussion, Conclusion, and Implications

This study investigated the perspectives of ten K-12 teachers about the effect of cultural diversity on their science and mathematics teaching and about the viability of CRT in their classrooms. The need for this study emerged from the fact that student populations in Canadian classrooms are increasingly becoming more culturally diverse and students’ diversity has been identified as one of the greatest challenges by teachers. Moreover, science and mathematics have been traditionally viewed and taught as acultural, fact-based subjects.

This study took place in two schools: one elementary and one secondary school in Vancouver, Canada. Ten teachers who were involved in teaching science or mathematics at the elementary or secondary level for 8-30 years volunteered to participate. Out of these ten teachers, six teachers were involved in teaching at the elementary level and four were teaching science or mathematics at the secondary level. Two individual interviews with each of these teachers provided insights into their perspectives. These interviews were taken prior to and after four informal observations of each teacher’s science or mathematics classrooms, which helped in contextualizing perspectives within the contexts of their classrooms. In this final chapter of this dissertation, I discuss and summarize the findings in response to the study’s research questions. I conclude with implications for theory, practice, and research in multicultural science education.

Guided by the study’s theoretical framework, analysis of the data revealed six overarching themes. The first four themes address the first research question, which seeks to investigate K-12 teachers’ perspectives about the effect of cultural diversity on their science and mathematics teaching: 1) Cultural diversity as a mosaic 2) Cultural diversity as a strength and a challenge 3) Level of English language competency as an influence on level of students’ learning
and engagement, and teachers’ teaching practices 4) Lack of culturally relevant resources, support and training as an impediment to successful integration of Indigenous knowledges. The remaining two themes inform the second research question of the study, which explored teachers’ understandings of and their perspectives on CRT as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms. These themes include: 5) Contradictions in teachers’ perceptions of science and mathematics, cultural diversity and Canadian culture and 6) Diverse understandings and manifestations of CRT. In the following section, I discuss each of these themes in response to study’s research questions.

5.1 Research Question 1
What are K-12 teachers’ perspectives about the effect of cultural diversity on their science and mathematics teaching?

5.1.1 Cultural diversity as a mosaic

As evident in the findings shared in the Chapter four’s section 4.1.1, one of the teachers described cultural diversity of their students’ population as a multi-ingredient “chocolate chip cookie”. As per the teacher, the dough of the cookie represented the students of one dominant culture and the chocolate chips represent the diverse student populations of other “minority” cultures. Although, this conceptualization of cultural diversity may seem to indicate teachers’ recognition and appreciation of students’ cultural diversity, it in fact neglects intersectionality and multiplicity of students’ cultural identities.

The teachers in this case identified their students’ culture purely on the basis of nationality, race, and ethnicity. Teachers’ conceptualization of cultural diversity resonates with the notion of Canadian multiculturalism as a “mosaic,” where multiple cultures are present
together, but each culture is visualized as a distinct entity (Kirova, 2008, p. 119). According to Kirova (2008), such a conceptualization of cultural diversity often leads to mere “celebration” of difference and “folklorization” of cultural ways of knowing (p. 107). Symbolizing the culture only in form of the 4-Ds — dialect, “dress, dance, diet”— such efforts are often limited to knowing the Others through holidays and festivals (Levin, 2009, p. 124). These findings reinstate that newer ways of thinking about culture, which emphasize understanding culture as complex, porous and emergent as expressed through metaphors such as cultural hybridity, figured world, and third space, are yet to be taken up fully in Science education research, Science teacher education and Science teaching (Carlone & Johnson, 2012; Seiler, 2013).

Additionally, teachers experiences of having greater diversity of students’ populations reiterates the fact that the student populations in the urban centers across Canada are increasingly becoming diverse in nature because of the increasing number of immigrants as well as more of these settling into major urban cities (Chui & Flanders, 2013; Statistics Canada, 2013, May 8). Also, as reflected in the teachers’ perspectives, the culture of their schools demanded that all students should demonstrate and maintain higher academic performance in science and mathematics if they want to survive and sustain in the schools’ highly academia-oriented environment.

The teachers shared that many of their culturally diverse students have tutors and/or enroll in after-school study programmes for these subjects to meet the higher academic expectations of the school. Thus, reflecting the “rhetoric of achievement gaps” in British Columbia schools (Mathison, 2012, p. 70), the narrative of accountability in these participating schools focused on students’ performance in the provincial exams and on the grades that could enable these students for entrance into post-secondary institutes. As evident in teachers’
perspectives, such a school culture with much greater emphasis on academic achievements has resulted in extended study times for many culturally diverse students. It also reflects a deficit-based perspective where students could be considered culturally deficient if they do not perform well (Gay, 2010b; Hollins, 2015; Mathison, 2003).

5.1.2 Cultural diversity as a strength as well as a challenge

As evident in the findings presented in the second theme 4.1.2, teachers described the cultural diversity of their students’ populations as a strength as well as a challenge. They acknowledged that having culturally diverse students in their classrooms creates opportunities for them to make their classrooms more “exciting” by connecting the learning of the specific concepts with the diverse cultures experiences that students bring with them. As per the teachers, having culturally diverse students who have different prior learning experiences also helps them in creating diverse collaborative groups and broaden their own cultural understandings, as well as reflect on their teaching practices and biases. Teachers’ attempts to reflect on their own biases as well as gain deeper knowledge about their students’ cultural experiences indicates their cultural responsiveness (Young, 2010). The teachers also shared many challenges associated with this cultural diversity, which included their experiences of confronting gendered cultural practices, religious restrictions as well as the challenges in creating diverse learning environments for their culturally diverse students.

Teachers’ identification of cultural diversity as a strength and a challenge may have great implications for their teaching, and also for their culturally diverse students’ learning. Research suggests that teachers’ positive attitudes and beliefs about students’ ethnic, racial, and gender differences lead to positive expectations and actions towards diverse students, which, in turn, have positive effects on culturally diverse students’ learning and outcomes whereas, negative
teacher beliefs produce negative teaching and learning behaviors (Gay, 2010a; 2013). Students’
etnicity, race and socio-economic status and gender, as well as their work habits and confidence
as perceived by the teacher serve as key variables that may shape teachers’ expectations
regarding the intellectual abilities and academic achievements of their students (Babad, Inbar, &
Rosenthal, 1982; McKown & Weinstein, 2002; Rosenthal & Jacobson, 1968; 1992; Stiefel,
Schwartz, & Ellen, 2007; Timmermans, de Boer, & van der Werf, 2016; Tobisch & Dresel,
2017).

Teachers’ perceptions of their instructional efficacy may vary based on the subject matter
involved, and by the nature and amount of students’ diversity in their classroom (Goddard, Hoy,
& Hoy, 2000; Knoblauch & Hoy, 2008). The exceptionalities that the students may have further
exacerbate the challenges associated with the cultural and linguistic diversity (Chu & Garcia,
2014). The teachers in this study were concerned that the exceptionalities that their culturally
diverse students may have could remain hidden because the limited English competency levels
of these students could mask their exceptionalities. Additionally, as the teachers reported,
parental resistance to get their child tested for exceptionalities also hinders the process of
qualifying and providing these students the needed support and special education services they
deerve.

Gendered cultural practices demanding specific treatment of students based on their
gender was another significant challenge that the participating teachers experienced in their
science and mathematics classrooms. As evident in the findings, the participating teachers in
some instances were faced with situations where they had to “correct” the behaviour of specific
male students in their classrooms and remind them they are responsible “to do your [their] part”,
and not expect their sibling or other female students to “clean-up” for them. Additionally, the
female teachers reported that just because of being a female, it becomes harder for them to maintain their authority as a teacher in classrooms, which include male students from certain cultural backgrounds. As per these teachers, since many of these male students have seen females considered and treated inferior and subjugated in their home environments, they do not see the female teacher as an authority figure and often misbehave in their classrooms (please see 4.1.2.2).

In contrast to this different treatment received by female teachers, in some instances, it was the male teacher whose authority was questioned. As evident in the perspectives of one of the participating male teachers, Callum, parents from a certain cultural background did not want their daughter to be taught by a male teacher. The specific incident that the teacher shared involved the issue of “touching” the student. Even though the teacher tried to defend and justify his action of placing hand on the student’s shoulder as his usual manner of caring and encouraging students during his teaching, the situation is complex because unconsented physical contact in any form could be perceived as sexual and/or abusive.

However, one may wonder if similar parental concern would have arisen if the teacher involved in this case of “touching” was a female. The ethics of care is predominantly considered to have arisen from women’s experiences and males in education have yet to establish their role as a “carer” (Noddings, 1984; 2012). Many male and/or homosexual teachers often find themselves as objects of suspicious gaze manifested in the form of parental distrust and threats of litigation because these teachers are perceived as being sexually dangerous to students in many societal contexts (Johnson, 1997; Tobin, 1997). These gendered cultural and social norms breed moral panic and force many teachers to adopt a “no touch” policy (Johnson, 1997, p. 106).
While a policy of “no touch” may protect teachers from any possible legal suits, the total absence of touch may affect the development of trusting adult-child relationships and “caring encounters” in the classrooms because tactile communication has been identified as a critical stimulation for healthy child development (Johnson, 1997; Muir, 2002). Indeed, such unfortunate and complex situations that create agony for all people involved demand empirically supported interventions that could enhance teachers’ abilities to connect with diverse families and help build effective home-school relationships to support the learning of their culturally diverse students in a responsive manner (Hughes, Gleason, & Zhang, 2005).

Teachers in this study also reported facing religious resistance to the teaching of science topics such as evolution, sexuality, and the inclusion of certain relaxation or meditation techniques such as breathing. Facing resistance to the teaching of evolution because of certain religious beliefs is not new, as previous studies have reported instances of teachers’ fearing students’ and parents’ pressure to not to teach evolution or simultaneously include non-scientific alternatives to evolution while teaching it (Asghar, Wiles, & Alters, 2007; Berkman & Plutzer, 2012; Friedrichsen, Linke, & Barnett, 2016; Romine, Barnett, Friedrichsen, & Sickel, 2014).

In some instances, the teachers in this study underplayed the responsibility of being aware that learning about certain science topics, such as sexual reproduction, may evoke cultural and religious oppositions, and as a teacher one needs to at least alert or give advance notification to their students in a diversity-rich classroom. Presenting science as an “uncontroversial” objective knowledge, the teachers in these instances continued their discussions in a mixed gender classroom by justifying that “We are not talking about anything controversial we are talking about science behind say reproduction or sexually transmitted diseases” (please see 4.1.2.3 for complete excerpt). Thus, rather than making it explicitly clear for students to be
mindful about certain cultural considerations and not entertain “funny” questions that might be humiliating for students of certain cultural backgrounds, the teacher in this case, justified her teaching by calling it a “Canadian style of teaching” science as per the mandated provincial curriculum. Teachers’ adherence to teaching the way they were taught (Ferner, 2013; Nashon, 2005; Oleson & Hora, 2014), as per the “Canadian style” in this case, does not reflect authentic relational caring, another key element of culturally responsive teaching that emphasizes treating others as they would like to be treated (Gay, 2010b; Noddings, 2012). Teachers’ actions also indicate their consideration of the official curriculum as the only legitimatized knowledge that they should teach (Apple, 2012; Hodson, 2010; Ladson-Billings & Brown, 2008; Sleeter, 2012).

Teacher’s dismissal of students’ religious beliefs about evolution as “really interesting” and leaving the matter as “if there is nothing that can change your mind then you are not really learning science you are talking about something else, which is faith or religion” (please see 4.1.2.3 for complete excerpt), is also problematic. Avoiding science/religion issues that are of relevance to some students may lead to poorer understandings of the Nature of Science (NOS), and for many of these students, science may remain totally irrelevant and unconnected to their worldviews (Blancke, De Smedt, De Cruz, Boudry, & Braeckman, 2012; Cobern, 2000; Reiss, 2009; 2010). In the absence of opportunities to discuss the historical and contemporary interactions of science with religious and philosophical beliefs and understand how religious beliefs may interact with science, students will be ill equipped to make worthwhile decisions and discuss the ways in which scientific knowledge differs in methodology and scope from religious knowledge (Loving & Foster, 2000; Matthews, 1996; 2014).

Teachers’ own religious beliefs as well as their understandings of the NOS, their pedagogical practices, and their level of familiarity with the available education resources may
play a crucial role in preparing them to deal with the religious oppositions they may face in their science classrooms while teaching sensitive topics (Asghar et al., 2007; Mansour, 2011).

Ignoring science/religion issues may also indicate teachers’ affirmation of scientism, which embraces the radical empiricist viewpoint proclaiming science as the only “one reliable source of objective knowledge” (Cobern, 2000, p. 233). Unfortunately, such a “scientistic view”, which enforces a strict separation of reason and faith, knowledge and belief, rationality and irrationality, does not serve the educational objective of “Science for All”, and spreads the “myth of school science” by teaching strictly objective, hypothetical deductive methods of factual knowledge (p. 233-234).

Hence, as evident in the findings of this study, religious resistance to teaching certain aspects of science and mathematics, gender-based cultural understandings, and diverse parental expectations regarding academic achievements and students’ participation in science and mathematics classrooms influenced the participating teachers’ perceptions of cultural diversity as well as their self-efficacy to meet the needs of their diverse students. Given the established correlation between teachers’ attitudes and beliefs about various dimensions of students’ diversity and their instructional behaviors, which in turn influence students’ achievements (Bergh, Denessen, Hornstra, Voeten, & Holland, 2010; Kaiser, Südkamp, & Möller, 2017; McKown & Weinstein, 2002; 2008; Rubie-Davies, Hattie, & Hamilton, 2006), these findings demand careful consideration regarding providing adequate teacher support as well as parental counselling.
5.1.3 Level of English language competency as an influence on the level of students’ learning and engagement, and teachers’ teaching practices

The level of English language competency was identified as one of the key challenges by the participating teachers of this study. As indicated in the findings in Chapter Four, theme three 4.1.3, low English competency levels often create cultural and social barriers that influence culturally diverse students’ academic achievements as well as negatively affect their socialization processes and hinder cross-cultural communication in their science and mathematics classrooms. The teachers also reported an increase in disciplinary issues due to language barriers. The teachers shared that the varied English competency levels compound the challenges of cultural diversity. They admitted that the low English competency of many of their culturally diverse students limits their choices of resources and teaching strategies. As a result, they try to find ways that could compensate for their lack of ability to communicate effectively with many of their culturally diverse students.

As experienced by the participating teachers in this study and also reported in literature, many culturally diverse students who are new to the North America not only find academic English daunting, but they also struggle with everyday English (Dong, 2016). Most of the participating teachers found it challenging to ensure equitable cross-cultural communication and participation among their culturally diverse students. Many of these teachers reported that the increasing numbers of cohesive “cultural bubbles” of native language speakers in their science and mathematics classrooms is not only hindering participation and achievement of students who are learning EAL, but the predominant use of native languages in schools is also forcing many English speaking Canadian students to feel like “outsider[s]” who may eventually choose to transfer to other schools (please see 4.1.3.1 for details).
The participating teachers’ efforts to encourage the participation of students who speak EAL such as allowing use of native languages, are consistent with culturally responsive pedagogy and multicultural Science education (Averill et al., 2009; Delpit, 2006; Krugly-Smolska, 2013). Culturally responsive pedagogical practices emphasize maintaining students’ cultural competency by allowing them to utilize their native language while they are trying to acquire the discourse of standard academic English. By permitting students to express and share their ideas in their native language and then translate these into English facilitates the development of “code-switching” skills and helps students in becoming knowledgeable and comfortable in both languages (Ladson-Billings, 1995, p. 161).

However, as reported by the teachers, system-based “pull-out” and ESL programmes for culturally diverse students who are designated as ELL do more harm than help as they negatively influence students’ self-esteem and often hinder their full participation in science and mathematics classrooms. English competency levels also play a central role in culturally diverse students’ enrolment, and engagement with the specific subjects especially at the high school level.

How might such ESL programmes serve as a mode of perpetuating structural inequities is clearly evident in one of the participating teachers’ perspectives. This teacher who also self-identified as being educated in the Canadian school system as an “ESL student”, and who was involved in teaching ESL science at the secondary level during the study, shared how such structural disparities subjugate and alienate students who are learning EAL and deprive them from equitable educational opportunities. This teacher commented that while participating in the school-based committees where decisions about students’ ESL placements and transitions to regular classrooms are made, she has noticed that many of her fellow teachers who are
predominantly “white,” hold deficit-based perceptions about culturally diverse students’ abilities just because they are ELL.

This is consistent with literature where many well-meaning “white” teachers are reported to see their culturally diverse students negatively as “problems” (Moodley, 1995, p. 806) that need to be fixed (Gay, 2010a; 2010b; Ladson-Billings, 2001). This unfortunate reality is reflected in the experiences of the participating teachers of this study, who shared that the decisions made in such school-based committees are biased as they are often made by people who do not understand or have never experienced the difficulties of non-native English speakers. Rather than commending the efforts of students who learn the English language in addition to their native language(s), the systemic protocols serve to label and identify non-native English speakers as “ESL students”, who are stigmatized through placements in ESL classrooms or deprived from full participation in regular classrooms because of “pull-out” programmes for ELL students. These students are often misjudged because of misrecognition of their learning abilities by their teachers (Lew & Nelson, 2016).

Delpit (2006) mentions that there is a “culture of power” enacted in every classroom, which may exclude or include students’ of certain cultural backgrounds (p. 24). In schools, teachers have historically been the dominant figures in passing this “culture” to students. According to Delgado-Gaitan (2006), the cultural manifestations in the classroom are embedded in multiple components: the cultural backgrounds of students and teacher(s), the school culture manifested in form of school policies, the formal curriculum and prescribed textbooks, the student-teacher interactions, and the language used for instruction, which all comprise the culture of classroom.
Thus, students’ mis/behaviour and (in/ex)clusion in a classroom could be the result of miscommunication or misunderstanding caused due to the communication gap among the ELL students, their native English-speaking peers and the teacher (Lew & Nelson, 2016). Considering the increasing disproportion in the ratio of cultural diversity in the teaching workforce and the cultural diversity among student populations in Canada (J. Ryan et al., 2009), one may imagine the consequences such misunderstandings may have on the academic engagement and achievements of culturally diverse students in Canadian classrooms.

Even though due to their shared backgrounds certain teachers may have self-perceived higher empathy towards students who are placed in ESL programmes, only personal experiences and empathy are insufficient for providing appropriate support and targeted instruction (Faez, 2012). In fact, most of the participating teachers in this study found it challenging to support the leaning of their culturally diverse students in their science and mathematics classrooms. These teachers reported their dissatisfaction with their teacher education programmes and in-service professional development days/workshops and considered these inadequate. Ironically, without having any appropriate training, all the participating teachers have to support the learning of many of their students who speak EAL and/or are designated as ELL, in their elementary and secondary science and mathematics classrooms. Some of these teachers are even assigned to teach ESL Science at the secondary level, which in itself indicates systemic disparities inherent in contemporary Canadian educational system.

5.1.4 Lack of culturally relevant resources, support and training as an impediment to successful integration of Indigenous knowledges

In the same vein, teachers shared their discomfort around integrating Indigenous knowledges in their science and mathematics classrooms. They shared that the Eurocentric
nature of official curricula and textbooks, as well as inadequate teachers’ training and insufficient in-service professional development support hinder the appropriate integration of these cultural knowledges. The new BC curriculum encourages teachers to incorporate Traditional Ecological Knowledge (TEK) examples into their science curriculum by utilizing a place-based experiential approach to the learning of the natural world and building on existing understandings, including those of First Peoples (British Columbia Ministry of Education, 2015a; Snively & Corsiglia, 2001). However, the participating teachers in this study indicated that the newly revised science textbooks and curriculum merely “mention” Aboriginal knowledges and worldviews, and their inclusion in textbooks is purely peripheral (please see 4.1.4.2).

In absence of adequate training, support and resources, the teachers’ attempts to integrate Aboriginal knowledges in their classrooms were limited to sharing Indigenous stories, which were introduced as historical epics of Aboriginal peoples and characterized as “fiction” (please see 4.1.4.3 for details). Such characterization of Indigenous knowledges as “fiction” emphasizes their representation as “relics from the past” (Ninnes, 2003, p. 175). Moreover, peripheral and cursory inclusion of Aboriginal and Other(ed) cultural knowledges contribute in perpetuating the “epistemological hegemony and cultural imperialism” of WMS (Snively & Corsiglia, 2001, p. 7).

According to Cobern and Loving (2001), this displacement of Indigenous knowledges as well as certain other domains of knowledge such as art and religion is because of “scientism—the cultural hegemony of science” that holds a hierarchical view of knowledge with WMS placed at the epistemological climax (p. 62). To resolve the issue, these authors have suggested
considering including Aboriginal and other cultural knowledges as a separate Standard form of knowledge:

Western science would co-opt and dominate Indigenous knowledge if it were incorporated as science. Therefore, Indigenous knowledge is better off as a different kind of knowledge that can be valued for its own merits, play a vital role in science education, and maintain a position of independence from which it can critique the practices of science and the Standard Account. (p. 50)

However, Snively and Corsiglia (2005) argue that it is essential that Aboriginal knowledges and wisdom are recognized as “real science”, and rather than one subjugating the other, both WMS and Indigenous Sciences should be taught “side by side” (p. 910). Thus, one should still commend the participating teacher’s efforts, who acknowledged herself as a “perfect stranger” with regards to the Indigenous knowledges (Dion, 2007; Peltier, 2017). And despite of her initial discomfort and fear of being “disrespectful,” this teacher committed herself to integrating Aboriginal knowledges in her classrooms even when she was faced with resistance from certain parents because of their religious beliefs.

Even though she faltered, the teacher’s efforts in this case reflect an inherent tension of privileging certain cultural knowledges over the others, which many teachers are forced to embrace and sustain without receiving appropriate support and training to integrate these in their classrooms in a meaningful manner (Arnold, 2018; Egbo, 2009; Kanu, 2011). In fact, knowingly or unknowingly teachers find themselves standing between Western and Aboriginal ways of knowing, which are two diverse knowledge systems (Aikenhead, 2002).

Thus, a decolonized culturally responsive science education in Canadian contexts requires teachers to become “cultural brokers… who could smooth students’ cultural border
crossings into school science” (Aikenhead, 2002, p. 290). It requires a successful border crossing between the teachers’ life-worlds and community knowledge, and a renegotiation of the culture of school science towards a co-existence of Western and Other(ed) cultural knowledges including Aboriginal ways of knowing (Aikenhead, 2002; Aikenhead & Elliott, 2010; Aikenhead & Michell, 2011; Snively & Corsiglia, 2001; Snively & Williams, 2006; 2016). To recognize and appreciate the international, cross-cultural contributions and co-existence of multiple ways of knowing Science in contemporary classrooms, Krugly-Smolska (2004) has urged to conceptualize Science as a “trans/national” Science (p. 421, original emphasis).

In summary, teachers’ perspectives about the effect of students’ cultural diversity on their science and mathematics teaching were full of conundrums. The participating teachers identified their schools as “uniquely multicultural” because of the presence of greater cultural diversity among student populations, which are also highly transient. The teachers took pride in sharing the greater academic focus and high ranking of their schools and reasoned that the “privileged” geographic location of their schools, bordering a large research university on the West side of the city, contribute to the characteristically unique multicultural nature of their schools.

On one hand the teachers view their students’ cultural diversity as a strength, as a “gift” because students’ cultural backgrounds and prior learning experiences help them in determining student groups and also in avoiding generalized or stereotypical assumptions about diverse cultures while teaching science and mathematics in their classrooms. On the other hand, these teachers also considered this cultural diversity among their student populations as a challenge. They shared their experiences of confronting gendered cultural practices, religious and cultural resistance as well as difficulties they encounter in ensuring diverse classroom environments due to differing parental expectations. The level of English language competency was identified as
one of the biggest challenges that hindered these teachers in teaching science and mathematics effectively to their culturally diverse students. The teachers acknowledged their willingness to integrate diverse Indigenous knowledges, including Aboriginal knowledges in their science and mathematics classrooms but found it challenging to do so.

5.2 Research Question 2

What are the teachers’ understandings of and perspectives on culturally responsive teaching as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms?

5.2.1 Contradictions in teachers’ perceptions of science and mathematics, cultural diversity and Canadian culture

Interestingly, while most of the participating teachers appreciated the cultural diversity that students bring into their classrooms (please see 4.1.2.1); many of them acknowledged that they did not take account of this cultural diversity while teaching science and mathematics because they considered these subjects as culturally neutral, abstract, universal subjects (please see 4.1.5.1). These findings are noteworthy because similar “culture-free” perceptions of science and mathematics among Canadian teachers were also reported nearly two decades ago in a larger study of cultural diversity in secondary school curriculum in Alberta, Saskatchewan and Manitoba by Blades et al. (June, 2001).

A few participating teachers in this study recognized cultural aspects of science but for them also the “culture” of science was limited to outdoor teaching and at the most occasionally mentioning some features of local Indigenous cultures. This localized approach to teaching about local environments in their science classrooms is consistent with the goals and rationale of the new BC curriculum for Science, which encourages teachers to utilize a place-based experiential approach to promote the learning of the natural world and build on existing students’
understandings, including those of indigenous peoples (British Columbia Ministry of Education, 2015b). However, their “unplanned” attempts of such cultural integration may result in only superficial inclusion of Aboriginal cultural knowledges and exclusion of certain other cultural knowledges. In fact, these efforts to “localize” the science curriculum unknowingly resulted in the ignorance of prior cultural experiences of culturally diverse students. One example of this was evident in one of the teachers’ perspectives who admitted to deliberately not teach about “elephants, lions and tigers” because they were not part of local BC environment (please see 4.1.5.2).

Additionally, as evident in the findings shared in Chapter 4 section 4.1.5.3, the teachers emphasized that they are aware of the cultural diversity of their students and in order to be “fair” they treat everyone in a “similar” manner, or rather see their students as a collective and not as individuals. Some of the elementary teachers emphasized that they do not see cultural diversity as an issue in their elementary classrooms because as per these teachers, the children at this young age do not differentiate their peers based on their cultural diversity and “the kids just see the kids” (please see 4.1.5.4 for details).

It is noteworthy to mention here that these same teachers shared instances where elementary students were engaged in making “clubs” based on hair colour, as well as situations where they found their teaching practices challenged because of the differing cultural expectations of students and their parents (please see 4.1.2 and 4.1.3 for details). Also, of importance is the fact that research on child development suggests that children between 3-5 years of age have strong implicit racial biases against races other than their own, and they may have developed these biases during toddlerhood or even earlier (Qian et al., 2016).
Moreover, such implicit biases are governed by a domain general mechanism, which is fully in place by age 5 and is more or less stable throughout the life of an individual. Considering the low malleability of once formed implicit biases even in adults, this research underscores the importance of first impressions that could shape children’s implicit biases (Gonzalez, Dunlop, & Baron, 2017).

Furthermore, young children can develop novel social biases from a brief exposure to nonverbal biases demonstrated by adults and they often generalize these biases to other individuals of the same racial in-groups as was the targeted person that they saw in the adult interactions (Skinner, Meltzoff, & Olson, 2017). Hence, rather than neglecting or ignoring the issues of cultural diversity at the elementary level, it is crucial that the teachers acknowledge and address such issues through providing their students exposure to out-group positive exemplars to help reduce implicit racial biases and form positive first impressions in their early stages of development (Gonzalez, Steele, & Baron, 2017; Xiao et al., 2015).

Acknowledgment of science and mathematics as acultural and abstract subjects by the teachers in this study indicates that these teachers experienced difficulties in mediating informed notions of socio-cultural influences on these subjects and may or may not have a clear and holistic understanding of the NOS (Kurup, 2014). The NOS typically refers to the epistemology of science or understanding science as a way of knowing as reflected in the values and beliefs inherent to the development of scientific knowledge (Abd-El-Khalick & Lederman, 2000; Lederman, 1992).

Prior research in science education indicates seven aspects of the NOS that are relevant to K-12 education. These aspects underscore that scientific knowledge is: 1) tentative (subject to change), 2) empirically based (based on and/or derived from observations of the natural world),
3) subjective (theory laden), 4) involves human inference, imagination, and creativity, 5) involves a combination of observations and inferences, 6) the function of, and relationships between, scientific theories and laws, 7) socially and culturally embedded (Abd-El-Khalick, Bell, & Lederman, 1998; Lederman, 1992; 1999). Interestingly, however, there is “no one agreed-on philosophical position underpinning the existing NOS in science education” (Alters, 1997, p. 48), and there is much disagreement about which version of the NOS should be taught (Cobern, 2000; Stanley & Brickhouse, 2001).

Having no agreement regarding the NOS could have great implications for Science education because the preparation of scientifically and mathematically literate students is a perennial goal of education in Canada, and “an adequate understanding of NOS is a central component of scientific [and mathematical] literacy” (Abd-El-Khalick & Lederman, 2000, p. 665). Unfortunately, considering the ongoing debate about the NOS, it is the Universalist conception of science that is often taught with its proclaimed superiority of WMS over Indigenous cultural knowledges (Carter, 2008; Harding, 1998; Stanley & Brickhouse, 2001). Various studies have reported that often teachers consider that cultural knowledges are not relevant to their pedagogy and present Science as culturally devoid, objective, universal knowledge (Aikenhead, 1996; Anderson et al., 2015; Blades, 1997; Blades et al., June, 2001; Gay, 2010b; Nielsen & Nashon, 2007; Snively & Corsiglia, 2001; Snively & Williams, 2016).

The existence of a subculture of science teachers who perpetuate the “myth of school science” by presenting science as a universal, positivist, impersonal and socially sterile view of seeing the world (Cobern, 2000, p. 233), may distort the NOS. Even though all science teachers may not hold such limited views, as Stanley and Brickhouse (2001) mentioned, it is irresponsible of any teacher to teach only Universalist conceptions of science as if they are uncontroversial.
and/or teach indigenous knowledges as Other(ed) knowledges that are different (and thus inferior) and/or are filling in the gaps where WMS is lacking. Thus, teachers’ adroit understanding of the NOS is crucial so that they can become cognizant of their own perceptions of Science and acknowledge the limitations of Eurocentric WMS to legitimately integrate Other(ed) cultural knowledges in their teaching (Barcelos, 2013; Blades, 2002; Cobern, 2000; Ferner, 2013; M. Ryan, 2012).

Research suggests that the relationship between teachers’ conception of the NOS and their classroom practice is complex, and improving teachers’ understandings of the NOS may not directly translate into students’ gains (Abd-El-Khalick & Lederman, 2000; Lederman, 1999). However, having critical understanding of the NOS by the teachers is crucial because teachers’ views of the NOS are not only reflected in their classroom instructions but also influence their perceptions about how scientists construct knowledge, which in turn may inform their beliefs about how students should learn science (Barcelos, 2013; Brickhouse, 1990).

For most of the teachers in this study, the cultural aspects of teaching Science were limited to “outdoor learning” and “celebrating” diversity through holidays and festivals which Kirova (2008) has called “folklorization” (p. 107). Overwhelmed with the challenges of diversity that the students of various cultural backgrounds bring with them, some of these teachers even wished for an “all Canadian” classroom (please see 4.1.5.5 for details). One may simply wonder and question: What does it mean to have an “all Canadian” classroom in a multicultural country like Canada? Indeed, as Henry (2017) mentioned—“the Canadian understandings of race and culture are not as inclusive for all Canadians as we are led to believe” (p. 3). Implicated within the boundaries of official policies of multiculturalism and the Official Language Act, the realities
of multicultural education in Canada complicate the possibilities of culturally responsive pedagogies that could meet the needs of culturally diverse students.

Rather than promoting the development of communal learning environments which could support academic and social inclusion of culturally diverse students (Averill et al., 2009), strict adherence to a “Canadian style” of teaching may hinder academic and personal growth of many culturally diverse students who may find themselves alienated in these Canadian classrooms. In a review of twenty-five years of multicultural Science Education, Krugly-Smolska (2013) has drawn attention towards the economic focus of the multicultural educational policy which perceives Science education merely as a means to compete in the global economy. The review further states that there has been a “documented difficulty” in getting teachers to see that a multicultural approach to teaching Science is essential for achieving the goal of “Science education for all” (p. 27). The review echoes the concern that a lack of explicit teacher support has resulted in hypothetical discourses of multicultural Science education that do not prepare teachers to deal with the complexity of diversity in everyday classroom situations.

Thus, even though teachers in this study claimed to value students’ cultural diversity, their attempts to integrate cultural knowledges in their science and mathematics classrooms seem controversial. Teachers’ own perceptions of science and mathematics as acultural, universal subjects, their contradictory understandings of culture, cultural diversity and Canadian culture, as well as the ongoing debate about the “co-existence” of WMS and Indigenous or Native science further complicate the issue of indigenizing or multiculturalizing the Canadian Science curriculum.

In these situations, one may envisage that a border-crossing approach to Science education could serve as an appropriate model for meeting the needs of all students in cultural
diversity-rich Canadian classrooms. However, as Carter (2004) mentioned, appearing to be just and equitable, such normative approaches to multicultural education actually reassert the control of Western culture more than acknowledging the Other(ed) cultural knowledges and inadvertently “work[s] against the very attitudes they seek to promote” (p. 821).

5.2.2 Diverse understandings and manifestations of culturally responsive teaching

As mentioned in the findings in Chapter Four’s section 4.1.6, none of the participating teachers of this study mentioned their familiarity with culturally responsive education or explicitly acknowledged the use of CRT strategies in their science and mathematics classrooms. However, glimpses of cultural responsiveness were evident in their thoughts and actions in diverse forms. For example, teachers differentiated their instructions, modified their teaching strategies, allowed the use of native languages, emphasized “strength-focused” assessments and even wished for a “grade-less education” to encourage the participation of their diverse students in their classrooms (please see 4.1.6). Teachers’ such practices reflect their understandings of the fact that culturally diverse students may bring different cultural lenses, which may influence their understandings of specific vocabulary and concepts in their science and mathematics classrooms (Krugly-Smolska, 2013; Leonard, 2008; Leonard, Napp, & Adeleke, 2009).

Teachers in this study were also aware of certain nonverbal cultural manifestations in their culturally diverse students’ behaviours. In their interviews, these teachers indicated their cognizance regarding particular student behaviours such as a student’s avoidance of making an “eye contact” with the audience while talking, which is usually considered a “valid” expectation to indicate engagement in Canadian classrooms. The teachers shared that they were aware that certain behaviours might be cultural expressions of respect for authority or an indication of students’ learning disabilities (please see Theme 6 subheading 4.1.6.5). However, the efforts of
these participating teachers were limited to lower levels of multicultural education where they tried to merely tolerate, accept or at their best respect the differences of culturally diverse students into their science and mathematics classrooms (Nieto, 2000a).

Categorizing and identifying “not making eye contact” merely as a cultural manifestation is problematic (Mckinley, 2001). Teachers’ attempts to associate such behaviour either with the students’ culture or with the exceptionalities indicate deficit-based perspectives (Gay, 2010a; 2010b). Often teachers perceive the sense-making practices of their culturally diverse students as hindrances in the learning of science (Seiler, 2013). Teachers’ attempts in such situations often focus on correcting or justifying the behaviours of diverse students who they often perceive as “other people’s children” (Delpit, 2006; Ladson-Billings, 2001).

However, just because a teacher is non-White and/or had similar racialized experiences, it does not mean that they will be able to provide a better educational environment for culturally diverse students. Still, the need for diversifying the teaching force in Canadian schools is imperative. Research suggests that teachers of colour have served as inspiring role models and are well positioned as insiders to establish relational rapports with culturally diverse students and employ culturally responsive pedagogies to help them better prepare for a world that marginalizes them (Ladson-Billings, 2001; J. Ryan et al., 2009; Villegas & Davis, 2007).

Teachers’ expectations can be influenced and biased by stereotypes and can be disadvantageous for students of negatively stereotyped social groups (Holder & Kessels, 2017; Hughes et al., 2005). High teacher expectations may enhance performance and achievement among members of dominant positively stereotyped groups, which are often white, male, middle-class students in most North American classrooms. Studies indicate that teachers have differing cultural and gendered perceptions of students’ behaviours as well as their achievements
(Riley, 2014; Timmermans et al., 2016), and teachers’ perceptions of students’ mathematics proficiency may exacerbate early gender gaps in achievement (Robinson-Cimpian, Lubienski, Ganley, & Copur-Gencturk, 2014).

In contrast, positive expectations are often less beneficial for the members of stigmatized groups, which include girls and students from diverse cultural and low socio-economic backgrounds. Many of these students may distrust and discount positive feedback given by the teacher, as they may perceive it as arising from sympathy for their stigmatized social identity, rather than because of their academic ability and merit (Crocker & Major, 1989; Holder & Kessels, 2017). A teacher’s own gender further complicates the issue as a teacher’s gender has been reported to influence students’ self-efficacy and interest in mathematics and science, especially in high school settings (Sansone, 2017).

Teachers’ perspectives in this study also indicated their conscious efforts to reflect on their cultural and experiential biases. For example, one of the participating teachers, James, acknowledged that through his upbringing and education in Canadian system of schooling, he may have “accumulated probably lots of Eurocentric bias”. Similarly, indicating her awareness regarding her own “white” background, Louise shared her conscious efforts of removing “white and masculine” perspectives from her teaching through including diverse cultural names of children while teaching (please see 4.1.6.9 for details). Louise’s effort of utilizing diverse cultural names in everyday instruction reflects cultural responsiveness as using students’ cultural names is one way to honour their culture and cultural identities (Gunn et al., 2014).

Cultural responsiveness requires one to critically reflect on the moral, politically and ethical moments of teaching (Gay, 2003; Nieto, 2000a). Teachers’ self-reflections about their own cultural biases are crucial to enable them for “teaching to and through cultural diversity”
and to improve the achievement of their diverse students (Gay, 2013, p. 53). These reflections will allow teachers to “critically reflect on their own racial and cultural identities” and recognize how these identities may intersect with the cultural identities and experiences of their culturally diverse students (Howard, 2003, p. 196). As Ayers (2001) mentioned, effective teaching, “requires a serious encounter with autobiography… because teachers, whatever else they teach, teach themselves” (p. 122). Hamachek (1999) suggested teachers’ personalities are embedded within the subject matter and the content they teach because “teachers teach not only a curriculum of study, they also become part of it” (p. 208).

In summary, teachers’ understandings of CRT and their perspectives on the viability of CRT in their science and mathematics classrooms were diverse and full of contradictions. While most of the participating teachers appreciated students’ cultural diversity, many of them acknowledged that they did not take this cultural diversity into account while teaching science and mathematics because they considered these as culturally neutral, abstract, universal subjects. A few recognized cultural aspects of Science but for them also the “culture of science” was limited to outdoor teaching and at the most “celebration” of cultural differences and the occasional mention of some features of local Indigenous cultures. Thus, the teachers in this study often perceived culture as disconnected from academic learning (Sleeter, 2012).

On one hand, the participating teachers emphasized that they are aware of the cultural diversity of their students but on the other hand, they justified their treatment of all students in a “similar” manner and seeing them as a collective and not as individuals because they wanted to be “fair” to all. Many of the elementary teachers emphasized that even though their student populations are diverse, they do not see cultural diversity as an issue at the elementary level as the children at this young age do not “see” their peers based on their diversity. However, as
evident in the findings and discussion in Chapters 4 and 5, these same teachers reported certain incidences where they found their elementary students forming “clubs”. In these clubs, the elementary students formed members based on hair colour indicating their association with certain peers while discriminating others.

Moreover, overwhelmed with the diversity that students with various cultural backgrounds bring into their science and mathematics classrooms, these teachers wished for an “all Canadian classroom”. However, at the same time, glimpses of cultural responsiveness were also evident in these teachers’ teaching. The teachers accommodated their students’ use of native languages in the classrooms and tried their best to adapt their teaching strategies and contextualize learning of science and mathematics to make these subjects relevant and accessible to their culturally diverse students. It is important to acknowledge that given the training and support these teachers received to teach for cultural diversity, their efforts are commendable.

5.3 Conclusion

Guided by a synthesized (trans-multi)culturally responsive education framework based on the critical and transformational multicultural education (Keating, 2007; Nieto, 2000a) and notions of CRT (Gay, 2010b), the analysis and discussion of the six overarching themes juxtaposed with the study’s research questions reveal that:

- Teachers’ understandings of students’ cultural diversity and CRT are full of contradictions, which implicate teachers’ perceptions of Canadian multiculturalism.
- Cultural diversity was considered as a characteristic feature of the teachers’ schools, which associates the geographic location and transient nature of surrounding populations with students’ cultural diversity.
• Teachers’ described students’ cultural diversity as a mosaic, a strength and a challenge for teaching science and mathematics in diversity-rich classrooms.

• Teachers shared their experiences of confronting gendered cultural practices, religious and cultural resistance, and identified differing parental expectations as the greatest challenges in creating diverse learning environments in their science and mathematics classrooms.

• Teachers expressed concerns about certain systemic challenges in supporting the learning of culturally diverse students and indicated that varied levels of students’ English language competency add to the challenges of cultural diversity.

• Teachers shared that increasing class sizes along with increasing numbers of students with exceptionalities make it harder for them to respond to students’ cultural diversity.

• Eurocentric or culturally neutral curriculum, Eurocentric textbooks, the lack of appropriate culturally relevant resources, and the lack of adequate teacher training and professional development were identified by the teachers as the key factors hindering the appropriate integration of Indigenous knowledges and cultural ways of knowing in their science and mathematics classrooms.

• Teachers’ understandings of Canadian culture cohered around national symbolism as they wished for an “all Canadian classroom”.

• Teachers considered science and mathematics universal, fact-based subjects which are culturally neutral and emphasized treating all of their students in a “similar” manner or as a “collective” while teaching these subjects.
• Often teachers employed CRT strategies in their science and mathematics classrooms without calling them as such. However, their teaching strategies were limited to content integration and incidental acknowledgement of cultural ways of knowing.

• Teachers were aware of their own experiential and cultural biases and tried to be reflective about these while teaching science and mathematics to culturally diverse student populations.

• Teachers wished for a “grade-less education” where they could shift the focus of learning science and mathematics from getting entry into higher education to learning these subjects to promote healthy citizenship among their culturally diverse students and their parents.

Thus, participating teachers’ willingness and conscientiousness to meet the needs of their culturally diverse students and acquire cultural responsiveness in their teaching were evident in their efforts to accommodate their teaching practices as well as in their attempts to integrate cultural knowledges. However, these teachers’ perspectives also revealed many complexities that hinder their teaching for diversity in their science and mathematics classrooms. For example, the teachers in this study experienced gendered cultural practices and religious confrontations, and constantly felt challenged by the varied English language competency levels of their culturally diverse students as well as the increasing number of students with exceptionalities. Findings also reinstate the need for special education practices to be responsive to meet the needs of culturally diverse students with exceptionalities (Chu & Garcia, 2014; Gay, 2002a; Levin, 2004; 2009; Lupart & McKeough, 2009).
Hence, the findings of this study are in part overwhelming because they highlight the complexities that occlude teachers’ understandings of students’ cultural diversity and impede the utilization of CRT as a viable strategy in their diversity-rich science and mathematics classrooms. At the same time however, the findings are in part underwhelming because this study has several limitations. First, it is a small-scale study involving ten volunteering participating teachers from two schools that are in geographical proximity to each other and are bordering a prominent research university in a large urban city in Western Canada. Second, it is bounded by temporal constraints as the data for this study were collected within a short time period of four months during the school year 2014-2015. However, while the findings of this study may not be transferred directly, the insights gained might inform teachers’ understandings as well as Science education research and practice. In the following section, I discuss the implications of this study.

5.4 Implications

While the implications of this study have been subtly described throughout this dissertation, in this section, I provide a more targeted discussion of how this research may inform theory, practice, and future research in multicultural Science education.

5.4.1 Implications for theory

The growing frequency of studies in Science education exploring the issue of cultural diversity indicate that there are “no more pressing sets of problems in educational theory today than those that fall under the broad issue of cultural difference” (Carter, 2004, p. 821). Teachers’ perspectives in this study indicated their contradictory perspectives on students’ cultural diversity in their science and mathematics teaching as well on the viability of CRT in their diversity-rich classrooms. This study builds on past and current theories in Science education on
how metaphors related with cultural diversity and multiculturalism may have influenced teachers’ science and mathematics teaching in diversity-rich classrooms. Considering the centrality of the concept of culture in Science education, this study calls attention towards how teachers’ perspectives may play a crucial role in shaping their “Science classrooms as cultural spaces” (Seiler, 2013, p. 117).

The complexity of issues which teachers encountered while teaching science and mathematics in their cultural diversity-rich classrooms also provide insight into various factors that could lead to the marginalization of students of non-dominant groups. The study reiterates the need for shifting the focus from mere “resistance and recovery” to a “more nuanced understandings of the reciprocal relationships between domination, resistance, and difference” in Science education (Carter, 2004, p. 824). Science educators are challenged to examine how Eurocentrism inherent in metaphors of culture and multiculturalism could continue perpetuating the hegemony of some forms of knowledge and delegitimization of others within and beyond the contexts of classrooms. If Science has a culture of its own, how and in what ways can it be taught in a (trans-muliti)culturally responsive manner?

5.4.2 Implications for practice

Bearing in mind the demographic shift towards greater diversity in contemporary schools, cultivating deeper understandings of students’ cultural diversity as well as critical reflection on teaching practices and biases is essential for all teachers (Gay, 2003; 2010a; 2013; Nieto, 2000a). The findings add to the knowledge base of broadening in-service teachers’ understandings of cultural diversity as previous studies mostly have focused on pre-service teacher-candidates’ understandings (Baldwin, Buchanan, & Rudisill, 2007; Daniel, 2016; Ellerbrock et al., 2016; Kahn et al., 2014). This study reaffirms the fact that in contemporary multicultural societies such
as Canada, cultural diversity is a contextual phenomenon, which is embedded in all aspects of life including schooling because “everything in education relates to culture” (Erickson, 2010, p. 35). As reflected in the findings, teachers’ perspectives on cultural diversity also reflect their perspectives on the NOS. Considering that teachers’ perspectives greatly influence the way they teach (Gay, 2010a), the insights provided through this study will be useful in informing CRT.

In addition, the study calls attention towards inadequate teacher education, support, and resources that hinder teachers’ efforts to respond to students’ cultural diversity and employ CRT in science and mathematics classrooms. The issues raised in this study may inform teacher education programmes as well as in-service teacher professional development programmes to examine what could or should be done to support teachers in their journey to become (trans-muti)culturally responsive educators. The study reiterates the need for teacher education programmes to address the challenge of preparing a predominantly white, middle-class teaching force to effectively teach an increasingly diverse population of students (Galman, Pica-Smith, & Rosenberger, 2010; Ladson-Billings, 2001; Sleeter, 2008).

5.4.3  Implications for research

The insights generated through this study have implications for future research on cultural diversity, teacher education, and teachers’ professional development in Science education. This study calls attention to issues that need to be explored and addressed in order to develop critical and comprehensive understandings of cultural diversity and CRT in diversity-rich classrooms. The findings reveal, at least in the ten participants’ perspectives, that there are inherent biases as well as structural inequities. To ensure equity and social justice and to develop “affirmation, solidarity, and critique” and promote CRT in cultural diversity-rich science and
mathematics classrooms, critical and transformational understandings of multicultural education among teachers are important (Keating, 2007; Nieto, 2000a).

Researchers nonetheless have to investigate the contradictions and conundrums of multicultural Science education. Findings suggest that recent immigrant families’ value high achievement in science and mathematics, and as reflected in the perspectives of one participant, the BC curriculum was belittled as “baby math” or weak in content. Many culturally diverse students, especially Indigenous students, continue to struggle in STEM subjects. Ironically, culturally diverse “Asian” students, including students from East and South Asia, continue to establish themselves as high-achievers in STEM, which is to say in Eurocentric, Westernized, high-status knowledge. Among the top universities across Canada and the USA, these “Asian” students constitute nearly 50% of the undergraduate demographic enrolment and the percentage increases rapidly in STEM graduate studies (Findlay & Köhler, 2010; Mervis, 2014). How might multiculturalizing Science education influence the participation and success of all culturally diverse students in Science?

More research is needed to explore how teachers’ perspectives of students’ cultural diversity influence their expectations for student achievement and thereby, shape assessment practices in their science and mathematics classrooms. There is a need for documenting current assessment practices, the challenges associated with such practices, and how they could be utilized to equip teachers with the necessary knowledge and skills that will allow them to implement CRT driven assessments. Have teacher education programmes been redesigned with a greater focus on preparing teachers to teach for cultural diversity?

Finally, this study also draws attention towards the ongoing deliberation about appropriate recognition and integration of cultural knowledges in Science education. There is a
need for further research on how a focus on teaching the content and teachers’ perception of NOS limits their pedagogical responsiveness. Do teachers merely “talk the walk” of multicultural education without realizing the actual potential of students’ and communal funds of knowledges? How might teachers promote increased parental involvement and build stronger home-school-community relations to support the learning of their diverse students? Considering the absence of a Federal governance of multicultural education in Canada, these findings suggest a need for researching how multicultural education policies and practices are implemented in various provinces. What systemic issues serve as sources of structural inequities in schools? The teachers’ concerns about ESL placements, the lack of appropriate CRT resources, as well as peripheral inclusion of Aboriginal knowledges in textbooks demand critical examination of current schooling practices and the new BC curriculum, and reiterate the need for research that could develop culturally responsive science and mathematics for specific regions.
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Appendices

Appendix A  Informed Consent Form

Teachers’ Perspectives on Culturally Diverse Classrooms and Responsive Science and Mathematics Teaching

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Co-Investigator: Mrs. Latika Raisinghani, PhD Candidate, Department of Curriculum and Pedagogy, Faculty of Education, University of British Columbia, Vancouver, British Columbia, Canada. Telephone: 604.221.6205; Email: latikarai@hotmail.com

Purpose: Above referenced PhD research involves engaging with teachers who teach science and mathematics at elementary or secondary level in Vancouver. The goal of this research is to investigate teachers’ perspectives about the effect of cultural diversity on their science and mathematics teaching and their understandings of culturally responsive teaching as well as their perspectives on it as a viable strategy for teaching science and mathematics in their cultural diversity-rich classrooms.

Study Procedures: We invite you to participate in a PhD research to share your perspectives regarding effects of cultural diversity on your science and mathematics teaching, and your understandings of and perspectives on the viability of culturally responsive teaching as a strategy to teach science and mathematics in cultural diversity-rich classrooms of Vancouver. Your participation will involve two informal individual interviews and your consent for three-four informal visits of your science/mathematics classrooms by Mrs. Latika Raisinghani, the Co-
Investigator. The day and time for these informal visits will be arranged in consultation with the respective teacher(s). Each interview session will be approximately one hour and will be arranged outside of class time. The focus of these interviews and classroom visits is to learn through your experiences and practices of teaching science or mathematics to culturally diverse students. All individual interviews, with your permission, will be audio recorded. Total time of your participation in this study will be maximum three hours. The findings of this research study will only be utilized for writing PhD dissertation and for relevant academic publication(s) and conference presentation(s). A summary of findings will be shared with you through postal mail/email. You will also have access to the final report.

**Benefits and Risks:** Through your engagement in this research you will learn about the processes of participating in research. You will get the opportunity to reflect on your own understandings of cultural diversity and its effect on your teaching by recollecting, organizing and sharing your experienced challenges, successes and benefits of cultural diversity while teaching science or mathematics. By sharing your understandings of culturally responsive teaching and perspectives on its viability as a strategy for teaching science and mathematics to culturally diverse students, you will contribute in broadening understandings of cultural diversity and culturally responsive teaching in cultural diversity-rich urban Canadian context of Vancouver. Participation in this research poses no greater risk than that you might experience during planning for your teaching or while participating in professional development sessions. 

**Confidentiality:** Identities of all participating teachers and their respective schools will be kept confidential. Pseudonyms will be assigned to all participating teachers and schools engaged in the research for identifying data sources and reporting of the results. Only the Principal Investigator and Co-Investigators will have access to all data. All data acquired during this study
will be stored in password protected files or in a locked cabinet. Following the study, a copy of the data will be kept in Principal Investigator’s office at the University of British Columbia for a period of five years after which it will be destroyed. The results of this research study will only be used for writing PhD dissertation and for relevant academic publication(s) and conference presentation(s). An abstract of the final report will be submitted to the Vancouver School Board’s (VSB) research Committee.

**Significance:** Acknowledging Vancouver School District 39 as one of the most diverse school districts of Canada, VSB, supports creating inclusive and welcoming educational environments for linguistically and culturally diverse learners. Your involvement in this research as a VSB teacher could play a pivotal role in developing understandings towards cultural diversity and culturally responsive science and mathematics teaching in Vancouver. Developing such an understanding is crucial as student populations are increasingly becoming culturally diverse, and very few research studies inform cultural diversity and culturally responsive teaching in urban Canadian contexts. The insights developed by this study will inform further research in wider Canadian contexts and in other international societies that value multicultural understandings.

**Contact Information:** If you have any concerns or complaints about your rights as a research participant or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Services at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598 (Toll Free: 1-877-822-8598).

**Consent:** Your decision to participate in this PhD research is totally voluntary and you may refuse to participate or withdraw from this study any time without giving any reasons and with no consequences of your withdrawal. You are most welcome to ask any questions that you may have regarding processes of this study or your engagement with this study.
INFORMED CONSENT FORM: TEACHERS

Teachers’ Perspectives on Culturally Diverse Classrooms and Responsive Science and Mathematics Teaching

Please keep a signed copy of this form for your record and return the other signed copy to the Co-Investigator Mrs. Latika Raisinghani.

I understand that my participation in this PhD research is entirely voluntary and that I may decline to participate or withdraw from this study at any time without jeopardy to my status. I may restrict Co-Investigator’s visits to my science or mathematics classroom(s) at any time during the study. I may also refuse to answer any question(s) during individual interviews, and prior to or after informal classroom visits.

I have received a copy of this form for my own records.

I agree to participate in the PhD research entitled: Teachers’ Perspectives on Culturally Diverse Classrooms and Responsive Science and Mathematics Teaching

Signature: Date:

Full Name:

Designation:

School Name:

Email: 

Telephone:

Postal address:
Appendix B  Protocol for Interview Session 1

Reference: PhD research entitled “Teachers’ Perspectives on Culturally Diverse Classrooms and Responsive Science and Mathematics Teaching.”

Prior written consent from each participating teacher will be sought prior to their first interview. At the beginning of each interview session, verbal consent to proceed with the interview and to audio record the session will be taken from the participating teacher. During the entire interview session, the Co-Investigator will remain sensitive to the participant’s comfort and on occasions re-affirm that participant wishes to continue.

Participant’s Background

1) Could you please briefly share a bit about yourself?
   a. Educational background
   b. Professional background

Classroom context

2) Could you please describe your school and the classroom?
   a. Setting (socio-cultural contexts of school)
   b. Grade level
   c. Number of students in the class
   d. Demographic profile of the class (based on cultural backgrounds of students)

Teaching and Learning Experiences

1) What is it like teaching science or mathematics to this class (with students coming from diverse cultural backgrounds)?
   a. In what ways it is rewarding?
   b. How it is challenging?
   c. What could be the examples of above?
2) What resources do you utilize to teach science or mathematics to these students?
   a. What is your opinion about the current science or mathematics textbook(s) and curriculum?
   b. If you would get a chance to change something in present (science or mathematics) textbook(s) and curriculum, what would you change and why?
3) In what ways do you think the science or mathematics that you teach is relevant for your students?
4) How do you usually organize students for your science and/or mathematics lessons?
5) Is there any specific topic/lesson/concept of science or mathematics that you found was most challenging for you to teach to culturally diverse students?
6) Have there been joyous moments teaching such a class? Is there any memorable moment/particular story/example you would like to share (about the challenges/benefits/affordances of cultural diversity that you might have experienced)?
7) Have there been times when you felt least prepared to teach such a culturally diverse class?
8) Would you see yourself as having transformed through the experience of teaching such a diverse class?
9) What advice would give to a novice teacher in such a classroom?
10) Is there anything else that you would like to add that you feel I might have forgotten to ask you?
   a. Do you have any further comments, thoughts, and questions?

Questions designed to encourage participants to expand and/or clarify on their responses or provide in-depth description of particular aspect may also arise throughout the interview.
Appendix C  Classroom Observation Protocol

Reference: PhD research entitled “Teachers’ Perspectives on Culturally Diverse Classrooms and Responsive Science and Mathematics Teaching.”

Prior written consent from each participating teacher and respective school principal will be sought prior to first classroom visit.

At the beginning of each observation session, verbal consent to proceed with the observation and to audio and video record the session will be taken from the participating teacher. During the entire observation session, as a participant-observer, the Co-Investigator will remain sensitive to the participant’s comfort (and also of the students present in the classroom) and reaffirm on occasions that observation session could continue. The focus of these informal classroom observations is to learn about teachers’ experiences of teaching science or mathematics in cultural diversity-rich classrooms and gather insights regarding how cultural diversity of students is utilized as a resource for teaching, how do the teacher(s) address or respond to students’ diverse cultural backgrounds.

Guiding Criteria for Classroom Observations

1) Physical set-up of the classroom
   a. Teacher’s positionality and role
   b. Individual student work/ Pair-share/whole-group discussions
   c. Fixed/Flexible set-up
   d. Resources available

2) Verbal and Non-verbal Cues
   a. How the teacher introduces and continues a (new) science or mathematics concept?
      i. Language used by the teacher
      ii. Tone of voice and facial expressions
      iii. Body language with the students
      iv. Lecture/Interactive exchange
3) Is there any cultural connections/link with real-life contexts made?
   a. Who made that connection?
      i. How and when?
   b. Are students invited to share their prior experiences/thoughts?
      i. When are student(s) prior experiences/thoughts invited?
         a. At the beginning?
         b. During the development of the topic
         c. During follow-up activities
         d. During introducing next activity/topic
      ii. How are student(s) prior experiences/thoughts invited?
         a. Inviting students to share verbally
            i. When and how
         b. Bring a cultural artifact/Show and tell
            i. When and how
         c. Hands-on experience with particular cultural activity
            i. When and how

4) Are cultural connections or students’ responses (their lived experiences) utilized during teaching of science or mathematics concept?
   a. How?
   b. When?
   c. To what extent?

5) Are there any additional resources (other than the textbook) utilized to make specific activity culturally relevant and more interesting and meaningful for the students?
   i. Which ones?
   ii. How are they integrated?

6) How does the general atmosphere of the classroom feel?
   a. Is there anything specific in this teacher’s teaching/today’s activity/students’ involvement that is making it feel this way?

7) How does teacher connect with the students or keeps them engaged and motivated/redirects students’ attention?

8) Is there anything specific that I have noticed today?
   a. About the teacher
   b. This particular event
   c. This particular activity
   d. This particular student/ students’ group?

9) Any specific event/activity/response/action of the teacher that I would like to follow-up with…
10) Any specific event/activity/response(s) of the student(s) that I would like to follow-up with…?

11) Any other specific thing that happened today…
   a. In what ways it is specific?

12) Is there anything else that I might have forgotten to note?
   a. Any further comments, thoughts, and questions?

Questions designed to expand and/or clarify on particular observations or to provide in-depth description of particular aspect may also arise throughout the observation.
Appendix D  Protocol for Interview Session 2

Reference: PhD research entitled “Teachers’ Perspectives on Culturally Diverse Classrooms and Responsive Science and Mathematics Teaching.”

Prior written consent from each participating teacher will be sought prior to their first interview. At the beginning of each interview session, verbal consent to proceed with the interview and to audio record the session will be taken from the participating teacher. During the entire interview session, the Co-Investigator will remain sensitive to the participant’s comfort and on occasions re-affirm that participant wishes to continue.

1) Do you think that cultural backgrounds of your students (and also of your own) affect your teaching (how you introduce or teach science or mathematics to them)?
   a. How?
   b. Why?
   c. In what ways?
   d. Would you like to share any particular example(s)?

2) Is there any memorable moment/particular story/example you would like to share about the challenges/benefits/affordances of cultural diversity that you might have experienced (while teaching science or mathematics)?

3) Do you think these specific event(s)/experiences have reaffirmed/challenged/changed your opinion/belief about science or mathematics?
   a. Why/why not?
      i. How/In what ways?
   b. What would you like to take away from this/these experience(s)?

4) How do you see your teaching of science or mathematics in relation to the students’ cultural diversity in your classroom?
   a. In what ways do you think the science or mathematics that you teach is relevant for your students?
   b. How do you see the school policies, curriculum, and textbooks affecting your teaching science or mathematics (for diversity)?

5) How would you like to describe science, mathematics, culture and cultural diversity?

6) I wonder what comes to your mind when you hear of culturally responsive teaching. Of course, different people might understand it differently, but I am curious to know your own interpretation of this and if it has any relevance to your classroom?
7) How do you make science or mathematics relevant for your culturally diverse students or what strategies/activities/resources you utilize to make science or mathematics relevant for your students?
   a. Would you like to share any particular activity/story/memorable moment/example?

8) How do parents of your culturally diverse students or the students themselves see your teaching of science and mathematics?
   a. Would you like to share any particular activity/story/memorable moment/example?

9) Reflecting back now on your (these many years/months) experiences of engaging with your students how do you see cultural diversity and culturally responsive teaching?
   a. Has your experience reaffirmed/changed your opinion/belief about cultural diversity and teaching and learning of science and mathematics?
   b. Reflecting back now on your teaching (of science or mathematics) do you wish you could have done something different?
   c. Would you like to share any specific moment/event that made this shift in your understanding/reaffirmed your belief(s) about science, mathematics, culture and cultural diversity?

10) Would you see yourself as having transformed through the experience of teaching such a class?
    a. How and in what ways?

11) Would you like to suggest any thing for your fellow science or mathematics teachers?
    a. Any particular moment/example/thought that could help them in approaching their culturally diverse students
       i. Why did you choose this particular moment/example/thought?

12) Is there anything else that you would like to add that you feel I might have forgotten to ask you?
    a. Do you have any further comments, thoughts, and questions?

Questions designed to encourage participants to expand and/or clarify on their responses or provide in-depth description of particular aspect may also arise throughout the interview.