A Study of Strategies used by Ontario Secondary Science Teachers for English Language Learners (ELLs)

By

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Abstract

Multicultural classrooms are common in Ontario schools with a great diversity of race, mother tongue, and cultural background. As a result of the increase in immigrants, a lot of students who are brought into Canada are English language learners (ELLs). These students face different types of challenges at schools due to their language barrier and cultural dissonance. Therefore, it is crucial for teachers to be mindful and accommodating while planning their lessons and educating their students. My qualitative research study investigates strategies utilized by two Ontario secondary teachers to support English Language Learners (ELLs) in their science classes. The purpose of my study is to examine the challenges ELLs face in Ontario High School and most specifically within science classes, as well as the techniques and approaches the teachers of my study use to target students’ learning needs within the scopes of implementation of differentiated instruction and critical pedagogy. This study also provides examples of how these teachers advocate for ELLs in their science classes, and how they support these students beyond the classrooms.

Key Words: English Language Learners (ELLs), Differentiated Instruction, Critical Pedagogy, Science, Secondary Education
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Chapter One: Introduction

1.0 Background and Purpose of the Study

Multicultural classrooms are extremely common in Ontario schools, where there is often a great diversity in students’ race, mother tongue and cultural background. It is important for teachers to acknowledge and embrace this diversity, as well as to keep it in mind while planning and conducting their lessons. Since Canada is a country composed of immigrants, it is common to have students who speak a different language or have English as a second, or additional language. In order for students to effectively learn and get involved in class activities, it is especially important for teachers to pay attention to the students’ special needs, in order to offer them corresponding support. With consideration for the language barrier English Language Learners (ELLs) face, special measures and pedagogies for teaching sciences were established. Teachers often use these strategies in hopes of helping students better understand the course material and to keep them engaged in class.

In this study, I investigate teaching methodology related to ELLs that is used in secondary science classes in Ontario. I interview two secondary science teachers on their approaches in conducting and creating inclusive science lessons for ELLs. In this research project, I introduce and study some existing pedagogies and theories established. I further compare these theories and frameworks to the practices suggested by the two teachers of interest. The purpose of this study is to develop and reinforce pedagogies for assessing and improving learning in sciences for secondary students with limited English proficiency. It also raises awareness amongst teachers about the presence of differences in the learning ability of students with language and cultural barriers. This research paper explores the theories regarding the
significance and methods in creating an inclusive classroom, as well as techniques and skills that these science teachers practice.

1.1 Statement of the Research Problem

The main question of interest in this research is: **what are the strategies that two Ontario secondary science teachers use to teach ELLs?** I have established several sub-questions to address the foundation, significance, and effectiveness of these techniques in creating an inclusive science classroom for ELL students. These sub-questions are:

1. What are the instructional and assessment challenges faced while making accommodations for ELL students?
2. In what ways do these teaching strategies help to overcome the barriers ELLs have in a science class?
3. How do teachers advocate for ELLs in terms of promoting multiculturalism?

I use two theoretical frameworks as a lens for investigating these questions. I incorporate studies on differentiated instruction and critical pedagogy to explain different approaches that these teachers use in planning lessons.

Differentiated instruction requires that teachers plan curriculum and instruction according to the needs of their academically diverse learners (Tomlinson, 2008). This is done by maximizing student potential and meeting all their learning needs (Tomlinson, 2000; Tomlinson & Edison, 2003). Teachers who effectively integrate differentiated instruction in class help students in developing power and agency to become active intellectual learners (van Garderen & Whittaker, 2006).

Critical pedagogy, which is rooted in critical theory, is another way to foster the idea of liberal multiculturalism in a classroom setting (Alegria, 2014; Norton & Toohey, 2004). It
promotes a classroom environment where students are engaged by making the connection between the sociocultural and sociopolitical contexts in lessons to students’ background knowledge (Alegria, 2014).

In other words, a diverse type of pedagogies is studied in this research. I examine different ways teachers lesson-plan and utilize resources, based on the foundations of these two theoretical frameworks. This way, teachers are able to create a better learning environment for students – especially for those who have a language barrier.

1.2 Significance of the Study

The topic of interest is highly applicable in Ontario classrooms due to the cultural diversity of Canada, as well as how the curriculum is designed. Students in Grades Nine and Ten are required to take Science courses to fulfill the requirements of the Ontario High School Diploma. Aside from maintaining the professional and educational level of science class, it is important for teachers to make science classes enjoyable and engaging for all students. Promotion of learning and the development of interest in science subjects can be achieved through the use of class activities that allow all students to get involved and stay engaged. Often students lose interest when they cannot relate to the learning material, or when they cannot fully understand the material due to different learning challenges. This research serves as an example of how science teachers try to uphold a positive and engaging learning environment for high school ELL students.

Research shows that ELLs especially experience challenges in learning science because of the subject’s complexity and the heavy language component associated with the subject. Often, students are required to learn and memorize scientific terminology, concepts, principles, and fundamentals. Introduction and acquisition of such vocabulary is challenging enough for a
normal English-speaking student, let alone an ELL student. ELL students must worry about the linguistic component in addition to the subject matter, especially since the nature of science puts heavy emphasis on the ability of students to express their ideas and findings (Allen & Park, 2011). For instance, when learning about mitosis, ELL students may struggle to describe the stages chromosomal movement inside a cell using words. They may have difficulty incorporating words like ‘sister chromatids’ in their explanations since the word ‘sister’ has multiple meanings. ELLs may also encounter social barriers issues when learning about certain topics that they are not familiar with in their culture (Meyer & Crawford, 2011; Edmonds, 2009).

With emphasis on meeting the special needs of ELLs, the research results from this study provide teachers different perspectives in helping ELL students to overcome the language and cultural barriers in learning science. This helps ease the transition from ESL to mainstream classes, and to higher-level science classes for students who want to pursue a science-related career. This paper investigates effective ways to promote science education and to encourage the development of science-talented students with lower English proficiency. It addresses students who do not wish to pursue science in the future, speaking to ways that help them enjoy mandatory science classes.

This research project serves as a guide for science teachers when designing their classes. It is a reminder for teachers to recognize the diversity in their classroom and to make corresponding modifications in the way they teach and assess students. Teachers can apply the learning diversity, perspectives, and alternative teaching methodologies studied in this research in other classes aside from science. Educators are able to use these theories and approaches to stimulate students’ engagement in class for better learning in general.
1.3 Background of Researcher

I am an international student from Hong Kong. I graduated with a Bachelor of Science degree from the University of Waterloo, majoring in Biomedical Sciences and minoring in Biology. I am Asian, where my first language is Cantonese. I was raised in Hong Kong and I came to Toronto for high school at the age of sixteen. I took all science courses in grade 12 when I arrived in Canada, including Biology, Chemistry and Physics. I am a person who is passionate about learning sciences and aimed to pursue a science-related career after graduating high school. However, due to the language barrier and the cultural difference in the two countries, I personally found it challenging to adjust to the learning environment in Canada. Having experienced the difficulty in transitioning firsthand, I am extremely interested in studying ways to create an inclusive science classroom to improve learning for students with limited English proficiency.

As a science teacher with Biology and Mathematics as my basic qualifications, I am curious in gathering ideas from other experienced science teachers on their strategies in creating a successful science class. I think it is beneficial for me to observe and interview experienced teachers in the field to learn about their techniques and insights in teaching science subjects. This will also help me develop skillsets related to giving constructive instruction and equitable assessment.

1.4 Overview

Chapter Two contains a review of the literature regarding the definition of terminology, barriers ELLs face in science classes, and the theoretical frameworks used in this study – differentiated instruction and critical pedagogy. Chapter Three describes the methodology and procedures used in this study, including research and analysis approach, instruments of data
collection, participants’ biographies, and methodological limitations and strengths of the study. Chapter Four organizes the data collected from the research participants into two major themes: (1) differentiated instructional strategies in secondary science for ELLs, and (2) implementation of critical pedagogy in science for ELLs. Chapter Five includes significance of the findings, implications, recommendations for practice, and areas of further study. References and a list of appendices follow at the end.
Chapter Two: Literature Review

2.0 Introduction

Canada is known internationally as one of the most popular immigration destinations in the world. The demographic patterns show that Canada is becoming increasingly diverse, with a positive net migration into the country (Statistics Canada, 2011).

As a result of the increase in immigrants, students from around the world are brought into Canada (Statistics Canada, 2011). Depending on the origin of these students, they may speak languages other than English in their home country, or have no knowledge of the English language. According to the People for Education Annual Report (2012), English Language Learners (ELLs) make up around 60% of English-language elementary schools and 54% of secondary schools in Ontario. There are more than 100 languages and 230 ethnic groups in Ontario, which provide the great diversity in schools and communities (Statistics Canada, 2011).

It is undeniably important for teachers to recognize the diversity in their classrooms and to take it into account when they design their pedagogy (Gunderson, 1987). In this chapter, I review literature regarding English Language Learners and their success in Science classrooms. I also introduce and explain several theoretical and conceptual frameworks regarding this topic.

2.1 Definition of English Language Learners (ELLs)

The terms “English as a Second Language” (ESL) and “English Language Learner” (ELL) are often misused and misunderstood. *English as a Second Language (ESL)* refers to students who learn another language other than English first, and then they learn English as a second language (Gunderson, 2009). However, “ESL” is often incorrectly used to describe students who speak a language other than English at home, when English is their third, fourth, or additional language (Gunderson, 2008). “ESL” is also incorrectly used to label all students that
come from another country, regardless of their language ability (Gunderson, 2008). In fact, a more accurate way to describe those students is to refer them as *English Language Learners* (ELLs).

### 2.1.1 ELLs by the Ministry of Education in Ontario.

According to the Ministry of Education in Ontario, the term *English Language Learner* (ELL) is used to describe students whose “first language is a language other than English, or is a variety of English that is significantly different from the variety used for instruction in Ontario’s schools, and who may require focused educational supports to assist them in attaining proficiency in English” (Ministry of Education, 2007, p. 8). In other words, it includes students from diverse backgrounds and academic experiences who are deficient in English, regardless of their place of birth (Ministry of Education, 2007).

ELLs born in Canada are “raised in families or communities in which languages other than English are spoken”. For example (Ministry of Education, 2007, p. 8):

- Aboriginal students whose first language is a language other than English;
- Children who were born in communities that have maintained a distinct cultural and linguistic tradition, who have a first language that is not English, and who attend English language schools; or
- Children who were born in immigrant communities in which languages other than English are primarily spoken.

On the other hand, ELLs may be newcomers who came to Canada from another country. Their proficiency of English may vary depending on their date and age of arrival in Canada, country of origin, and experiences prior to arrival. Examples are (Ministry of Education, 2007, p. 9-10):
• Children who have arrived in Canada with their families as part of a voluntary, planned immigration process;
• Children who have arrived in Canada as a result of a war or other crisis in their home country, and who may have left their homeland under conditions of extreme urgency; or
• International or “visa” students who have paid fees to attend school in Ontario and often plan to attend a Canadian university.

In this study, the focus is on English Language Learners (ELLs) in Ontario, Canada. These ELLs are identified according to the Ministry of Education in Ontario, where they are not limited to immigrants or international students, but all students whose most proficient language is a language other than English.

2.1.2 Secondary ELLs.

Studies show that teachers have different expectations for ELL students in class depending on their academic level (Gunderson, 2009). For instance, elementary teachers focus on training students to critically read, comprehend, understand, and learn the material (Gunderson, 2009). Secondary teachers focus on teaching them the academic content instead of reading skills (Gunderson, 2009).

Gunderson (2009) classified secondary ELL students into two groups: “(1) those who need to learn to read, and (2) those who need to learn how to learn from reading”. Nonetheless, teachers should first recognize students’ first language background and their English ability. This is because the ability for ELL students to read and comprehend material in English has a huge correlation with their reading level in their first language (Avalos, Plasencia, Chavez, & Rascón, 2007). ELLs generally must be able to read and understand their textbooks in order to benefit from academic instructions (Gunderson, 2009).
The focus of this study is the pedagogies of teaching science to ELL students, and not the language acquisition of these students. Therefore, I target secondary ELL students who are able to read and comprehend from text, with the assistance of a teacher (Gunderson, 2009).

2.2 Challenges ELLs Face in Science Class

ELLs face a lot of challenges in science classes. The most common challenges that English Language Learners (ELLs) face at schools include their lack of engagement in class, and their difficulty understanding class material due to their language barrier (Gunderson, 2009).

2.2.1 Conversational versus Cognitive Academic Language.

ELLs can be fluent in conversational English, but not in cognitive academic English for science (Allen & Park, 2011). Carrier (2005) stated that ELLs might be confused because some terms have different meanings in academic compared to conversational English. Carrier (2005) also noted that an average person takes five to seven years to fully develop cognitive academic language proficiency. On the other hand, it has been proven that there is a two- to three-year gap in acquisition of conversational English versus cognitive academic language (Allen & Park, 2011). For example, a student who has been in Canada for eight years has only five- or six-year English proficiency (Allen & Park, 2011). This gap in proficiency makes it difficult for teachers to create written exams, because they need to ensure that students can comprehend the academic English that they use (Allen & Park, 2011). A reason why students fail to perform well in exams is the failure to translate the scientific terminology into the language they are familiar with (Allen & Park, 2011).

2.2.2 Development of Scientific Literacy.

Apart from the discrepancy in academic and conversational English skills, ELL students
have been shown to struggle even more in science classes, specifically in development of scientific literacy (Allen & Park, 2011). According to Burkhardt et al. (2003), students who are scientifically literate are able to demonstrate basic skills common to all literacy; ask about, describe, explain, and predict natural phenomena and everyday experiences. They are also able to read and understand scientific articles (Burkhardt et al., 2003). Science literacy skills enable students to effectively participate in science learning, which include skills to “read, write, and orally communicate about science concepts and principles” (Carrier, 2005, p. 6).

It is relatively straightforward and easy for students who are native speakers of English to develop their scientific literacy; since they are familiar with the English language, they only need to learn the scientific vocabulary (Carrier, 2005). On the other hand, ELLs are required to interpret, describe, answer, and make predictions about science, using a language that they are not proficient in, while they are still acquiring basic literacy skills in English (Carrier, 2005). In order to participate in science activities, students are required to master strategies in effective reading, writing, listening, and note taking (Carrier, 2005). This is why it takes ELLs longer and requires more effort to become science literate (Carrier, 2005). Therefore, science teachers need to consider this difference between native English speakers and ELLs, referred to the literacy gap by Au and Raphael (2000), when they plan and conduct their lessons.

2.2.3 Proficiency in First Language.

Avalos et al. (2007) stated that the ability for ELL students to read and comprehend material in English is highly correlated with their reading level in their first language. Cummins and Swain (1983) also supported the statement by proving that older students learn to read in a second language by transferring the skills they have learned in reading in their first language. They do so by using the concepts and knowledge gained by studying their first language
(Cummins and Swain, 1983). Children who are struggling readers in their primary language tend to have a more difficult time grasping a second language compared to those who are proficient readers in their first language (Avalos et al., 2007).

2.2.4 Home Life and Country of Origin.

Due to the lack of English use at home and with peers, new language acquisition of ELLs is often slow (Su, 2006). Depending on the country of origin, children who arrived in Canada with their families may have very different academic backgrounds. For example, school-age children who moved to Canada as part of a voluntary, planned immigration process probably received formal education in their home countries (Ministry of Education, 2007). Some students may have “limited or inconsistent access to schooling”, while others may have studied English as a foreign language (Ministry of Education, 2007, p. 9).

However, children who arrived in Canada as a result of a war or other crisis in their home country may have suffered traumatic experiences (Ministry of Education, 2007). These children may be separated from their parents and lack access to formal education, due to years of transition between countries (Ministry of Education, 2007).

On the other hand, international students who hold a student visa to attend schools in Canada, often come into the country by themselves without their families (Ministry of Education, 2007). Although some may have experience in learning English, they are often under great pressure to do well at school (Ministry of Education, 2007). They commonly try to rush the schooling progress to graduate as soon as possible in order to minimize the expenses involved in studying abroad (Ministry of Education, 2007). These factors may affect their ability to learn effectively in an English-instructed classroom.
2.2.5 Other Factors.

Personal pride, cultural difference, transition, and adjustment to a new learning environment can also be factors that impede learning of ELLs (O’Loughlin & Haynes, 2008). All of these factors contribute to the challenges ELLs face in effectively learning science in an Ontario classroom. Therefore, proper pedagogies, assessments, and special care from the teachers are necessary for the success of ELLs in science classes.

2.3 Frameworks for the Research

I use two existing theoretical frameworks, differentiated instruction and critical pedagogy, to guide this study. Critical pedagogy and differentiated instruction are established strategies that teachers use to create an inclusive classroom that is accommodating of students’ special needs. The following section explains and describes each of the stated techniques.

2.3.1 Critical Pedagogy.

Schools, like any other educational institutions, are considered as “liberal advocates for multiculturalism and diversity, striving to model for their colleagues and students” (Kubota, 2004, p. 30). Educators try to endorse *liberal multiculturalism* in the classroom, where open-mindedness and non-prejudiced attitudes towards race, ethnics, and linguistic backgrounds are upheld among teachers and students (Kubota, 2004). Differences in cultural values and customs are valued; all people are viewed equally with equal opportunities given in a society, regardless of their backgrounds (Kubota, 2004). In other words, liberal multiculturalism “promotes tolerance, acceptance, and respect toward different cultures and culturally diverse people while supporting equality among them” (Kubota, 2004, p. 30).
2.3.1.1 Definition.

Critical Pedagogy, which is rooted in critical theory, is one way to foster the idea of liberal multiculturalism in a classroom setting (Alegria, 2014; Norton & Toohey, 2004). This educational theory originated from Paulo Freire’s “liberation narrative” under the lens of the unbalanced power relations between academic, emotional, racial, gender, and social class issues (Alegria, 2014; Freire and Macedo, 1987). It promotes a classroom environment where students are engaged by making the connection between the sociocultural and sociopolitical contexts in lessons to students’ background knowledge (Alegria, 2014). This type of education demands the incorporation of daily instruction, critical inquiry, and materials into the curricula (Norton & Toohey, 2004).

The applications of Critical Pedagogy and multicultural education are not merely the inclusion of visual images, narratives of people of different racial background in the curriculum, or the celebration of culture awareness once a year. Instead, they “seek social justice and transformation” while “exposing issues of racism and critically examining discursive constructions of the knowledge on culture and language” (Kubota, 2004, p. 44). This challenges teachers to develop what it is called emancipatory literacy in the classroom, where students celebrates and learns about their identity and growth, which include personal history, experiences, and culture of their everyday environments (Alegria, 2014; Macedo, 1994). This is accomplished by creating a student-centered curriculum – students actively participate in an interactive social process that involves personal growth and creating multicultural democracy in class (Shor, 1992). A way to do so is to construct curricula such that it reckons the cultural and personal resources of students (Giroux, 1988). This allows students to connect their voices and languages to social and cultural practices at school (Giroux, 1998).
Apart from relating personal growth to public life, another main focus of Critical Pedagogy is to education students into critical thinkers, who actively take part in the learning process, critique, and transform their own education (Hooks, 1994; Shor & Freire, 1987). In other words, students become empowered democratic agents who reclaim power and identity in schools (Giroux, 1988; Shor, 1992). Through applying critical pedagogy in classroom, ELLs are provided “opportunities to understand and explore a multiplicity of expressions and interpretations”, where “new possibilities beyond their abilities in their native language and culture” are offered (Kubota, 2004, p. 48).

2.3.1.2 Teacher’s Role.

The first criterion for applying critical pedagogy in classroom is a literacy-rich social environment for students to critique and transform their learning experiences (Freire, 1970). In order to develop emancipatory literacy, teachers should discuss emancipatory questions to address and understand the effects of race, class, and gender in the curriculum and pedagogy (Chubbuck & Lorentz, 2005). Teachers should always be encouraging and instructive in assisting students to shape their own education as critical empowered agents (Shor, 1992). McLaren (2003) also suggested teachers to constantly reform and adjust their teaching by addressing ideological pedagogical questions. On the other hand, teachers should consider advocating for marginalized students (including ELLs), so mainstream students learn about the cultural and linguistic diversity in classroom (Kubota, 2004). This helps promoting equality and equity in classroom, as well as engaging marginalized and mainstream students to work together (Kubota, 2014).

2.3.2 Differentiated Instruction.

“To offer the same curriculum and instruction to all students is to deny that individual
differences exist or matter in the enterprise of learning” (VanTassel-Baska, 1997, p. 11). This is the reason why current educators encourage the use of differentiated instruction, which is a student-centered teaching method (Tomlinson, 1999). It encourages teachers to plan curriculum and instruction according to the needs of academically diverse students (Tomlinson, 1999; van Garderen & Whittaker, 2006). This is done by maximizing student potential and meeting all students’ learning needs (Tomlinson, 2000; Tomlinson & Edison, 2003).

Teachers can integrate differentiation in five classroom elements: content, process, product, affect, and learning environment (Tomlinson & Eidson, 2003; van Garderen & Whittaker, 2006). These five elements deal with the curriculum, the way it is taught, students’ understanding, relation to the material, and the classroom setting (van Garderen & Whittaker, 2006). It also uses three student-based criteria to further differentiate instruction in class – readiness, interest, and learning profile (Tomlinson & Eidson, 2003; van Garderen & Whittaker, 2006). Readiness is assessed by determining “a student’s current knowledge, understanding, and skill as it related to what is being studied”; interest is determined by observation upon “what a student enjoys learning about, thinking about, and doing”; learning profile refers to the learning model that students favor, influenced by factors such as “learning style, intelligence preference, gender, and culture” (van Garderen & Whittaker, 2006, p. 13). In regards to assessment, differentiated instruction is most effective when they address a wide range of abilities, where collegiality and communication between teachers and students are promoted (Aldridge, 2007).

In other words, differentiated instruction requires teachers to make connections with students, ensure that they are engaged and understanding in class, and constantly monitor student proximity to content goals (Tomlinson, 2008). Teachers are then able to use the knowledge about their students and the assessment information to adapt the methods of their teaching regarding
students’ readiness, interest, and preferred modes of learning (Tomlinson, 2008). This helps teachers in “planning content dimensions, process dimensions, and product dimensions” (Dixon, Yssel, McConnell, & Hardin, 2014).

### 2.3.2.1 Four Goals of Differentiated Instruction.

Tomlinson further elaborated the way teachers should incorporate differentiated instruction into their classrooms by proposing four elements – building trust, ensuring fit, strengthening voice, and developing awareness (Tomlinson, 2008).

*Trust* is essential in creating a partnership for success. Teachers can build trust through responding to students with respect, giving positive feedback and actively supporting them in learning (Tomlinson, 2008). Once students believe that their teachers trust them as persons of worth and ability, they are willing to work in their best interest (Tomlinson, 2008).

*Fit*, on the other hand, ensures that the work assigned to students is what they are ready to do and are able to learn from (Tomlinson, 2008). Teachers should make the material relevant to students and present them in ways that facilitate their success (Tomlinson, 2008). They should also be flexible with time and teaching methods and adjust their teaching according to ongoing assessment of their students (Tomlinson, 2008).

*Voice* refers to students’ power as active learners over their own education (Tomlinson, 2008). Teachers can honor students voice by “inviting, encouraging, affirming, supporting, mentoring, and responding with honesty” (Tomlinson, 2008, p. 29). Examples include allowing student discussions, providing guided choice for tasks, and using dialogue journals where students are able to speak up and own their learning (Tomlinson, 2008). As supported by Palmer, education only happens when people are able to speak their minds (Palmer, 1998).

Last but not least, *awareness* refers to students’ recognition of how learning works based
on criteria for success (Tomlinson, 2008). This type of awareness is important for building academic success (Tomlinson, 2008). Students develop skills to capitalize on their learning strengths and to compensate for their weaknesses (Tomlinson, 2008). It also involves self-evaluating the effectiveness of their learning and planning (Tomlinson, 2008).

2.3.2.2 Barriers in Differentiated Instruction.

Differentiated instruction requires teachers to be flexible and to modify their curriculum and presentation of information according to their students’ needs (Hall, Strangman & Meyer, 2009). Teachers who effectively integrate differentiated instruction in their classes help students in developing power and agency, and becoming active intellectual learners (van Garderen & Whittaker, 2006). These elements provide a platform for students to take charge of their own learning (Tomlinson, 1999). However, teachers who do not recognize ways to differentiate or instruct diverse groups in class may find it challenging (Dixon et al., 2014). Also, determination readiness levels and student engagement may not be direct, thus making the corresponding modifications difficult (Dixon et al, 2014).
Chapter Three: Research Methodology

3.0 Introduction

This chapter describes my research methodology. To begin, I explain the general research approach, research procedures, and instruments of data collection. Then, I go into the details of sampling criteria, procedures, and recruitment. I next provide detailed profiles of the participants in my study. I then outline the procedures of data analysis and ethical review. I also identify several limitations and strengths in my research methodology. I conclude the chapter with a brief summary of the key methodology decisions and rationale.

3.1 Research Approach & Procedures

This study uses a qualitative research approach. It includes a literature review and two semi-structured face-to-face interviews with teachers. The literature review covered topics of interest, including the definition of English Language Learners (ELLs), the obstacles ELLs encounter in class, as well as existing research on differentiated instruction and critical pedagogy, which are the theoretical frameworks I use in the research. These insights and information could be used as context knowledge to understand any differences in my findings from those in the literature (Flick, 2009).

Qualitative research is descriptive and involves in-depth study of the topic (Löfstedt, 1990). It is often relevant to experience as it is “lived”, “felt”, or “undergone” (Löfstedt, 1990). I was interested in investigating strategies Ontario secondary science teachers use to support ELLs, thus I thought qualitative research was the most suitable approach for this study. Through face-to-face interviews, I expected to hear about lived stories from teachers who have experiences integrating different practices to promote engagement and performance of ELLs in science classes (Creswell, 2013). Since the same set of data collected in qualitative research
could be interpreted in many different ways, it also opens up room for me as a researcher to analyze the data regarding my research questions using the chosen theoretical frameworks (Creswell, 2013).

3.2 Instruments of Data Collection

The instrument of data collection I used in this research was the semi-structured face-to-face interview. The goal of these interviews was to “reveal existing knowledge in a way that can be expressed in the form of answers and so become accessible to interpretation” (Flick, 2009, p. 160). Conducting semi-structured interviews allowed me to ask interviewees open-ended questions, and allowed them to answer on the basis of the knowledge that they had immediately at hand (Flick, 2009). It also enabled me to purposively formulate questions based on specific theories to collect desirable data, such as personal experiences relating to my research questions (Creswell, 2013; Flick 2009). For instance, I was able to ask for interviewees’ lived experiences and opinions as science teachers using differentiated instruction and critical pedagogy to teach ELLs. I planned my interview questions based on participant’s background information, teacher practices, and beliefs. I also examined influencing factors and future applications. The data I collected in semi-structured interviews represented different approaches on the topic that could be further developed and interpreted for analysis (Flick, 2009).

3.3 Participants

In this section, I explain the sampling criteria, procedures and recruitment. I also provide profiles of the participants.

3.3.1 Sampling Criteria.

I recruited my participants using the sampling criteria as follows:
1. Teachers have a minimum of 3 years teaching experience in science subject(s) at an Ontario high school;

2. Teachers have a minimum of 1 year teaching English Language Learners (ELLs) experience; and

3. Teachers have demonstrated expertise in differentiated instruction and critical pedagogy.

The focus of this study is on the strategies used by teachers teaching the Intermediate/Senior Ontario Science Curriculum. Therefore, participants should be secondary Science teachers who are familiar with the Ontario curriculum, and have experience in teaching science subject(s) in a middle or high school in Ontario. It is also important that the participants teach in a normal school setting because the class dynamics and environment will be relatively different from those at a night school or summer intensive class.

It was also essential that the participants have had interactions and experience in teaching ELLs in class prior to the interviews. This was to ensure that they have a certain level of understanding in the differences between teaching ELLs and native English-speaking students. It was ideal that the participants have made accommodations for ELLs with regards to the obstacles these students encounter and the language/cultural barriers they face. I was especially interested in knowing how they change their pedagogies and approaches in the planning and delivery of lessons.

Differentiated instruction and critical pedagogy are the theoretical frameworks I used in the research. I sought to find participants who are familiar in integrating these theories in their classrooms, since I wished to hear their personal experiences with these approaches, their opinions on them, as well as how effective they are in real-life classrooms.
3.3.2 Sampling Procedures & Recruitment.

I mostly relied on purposeful sampling for my study. Purposeful sampling indicates that individuals are carefully chosen “based on a specific purpose rather than randomly” (Tashakkori & Teddlie, 2003, p. 713). I chose my participants according to my sampling criteria I set upon my research purpose and questions. This way, I ensured that each participant would provide valued information in regards to my topics of interest (Teddlie & Yu, 2007). I recruited by asking teachers and instructors at Ontario Institute for Studies in Education to share my research proposal and my contact information to individuals who met the said criteria.

I also recruited by convenience sampling, where I recruited participants who were more readily accessible to me and were willing to participate in a study (Teddlie & Yu, 2007). This could have included the teachers and educators I interacted with previously in educational conferences, teaching practicum, volunteering experiences and so on. This included (but was not limited to) teachers I met last year at Science Teacher Association of Ontario (STAO). Once I identified individuals who were relevant to my study with my existing networks, I used snowball sampling to locate more applicable prospects (Teddlie & Yu, 2007). Although the variation in the sample was limited, it provided a convenient way to find desired participants given the parameters and small-scaled nature of my study (Teddlie & Yu, 2007).

3.3.3 Participant Bios.

In this section, I provide detailed profiles of the participants in my study. My first participant was Megan, and my second participant was Tania.

3.3.3.1 Megan.

Megan is currently a science and math teacher at a public high school in Toronto, Ontario. She has over ten years of experience teaching ELLs. Although her parents are
immigrants, English is her first language. Besides English, she also speaks Taiwanese. She teaches grades nine and ten ESL-designated science classes. She does not have an Additional Qualification to teach English as a second language, nor has ever received any formal training for teaching ELL students. However, she expressed great interest in working with ELLs and showed genuine care for these students in her classroom.

3.3.3.2 Tania.

Tania is currently a science teacher at a public high school in Toronto, Ontario. She has six years of experience teaching science subjects in the Toronto District School Board. She teaches a grade nine science ESL class, a grade nine mainstream science class, and a grade ten science ESL class. She speaks English and Vietnamese, and English is not her first language. She started learning English when she came to Canada. She does not have an Additional Qualification in teaching English as a second language. She has never received formal training teaching ELLs, yet she has attended meetings with the school ESL department to discuss strategies and issues teaching ELL students. She has preference teaching mainstream classes as opposed to ESL designated classes.

3.4 Data Analysis

I transcribed the two semi-structured interviews, and interpreted the transcripts by coding for data analysis. I first read each transcript several times to obtain an overall understanding and feeling of the content (Creswell, 2013). Then, I coded these transcripts individually to look for common themes and categories that were relevant to my research questions (Creswell, 2013). I used a word or phrase to summarize and condense the ideas in the interview in my initial coding process (Saldana, 2008). I wrote down my “first impression phrases” by “circling, highlighting, bolding, underlining [...] significant participant quotes or passages” (Saldana, 2008, p. 16). I used
several coding methods such as descriptive codes, in vivo codes, process codes, value codes and inferential codes (Saldana, 2008). For instance, I used descriptive codes to identify specific statements or phrases that were relevant to challenges ELLs face; I used in vivo codes to highlight any tools or materials that my participants used to teach ELLs; I also used value codes and inferential codes to make notes of my participants’ beliefs and philosophies; I used process codes to label actions and pedagogies used by the participant that were based on theory of differentiated instruction and critical pedagogy.

I used several big ideas from previous studies as my codes in this study, such as the five differentiated instruction elements suggested by van Garderen & Whittaker (2006) – Content, Process, Product, Affect, and Learning Environment. I also used the three students-based criteria identified by Tomlinson & Eidson (2003) – Readiness, Interest, and Learning Profile, as well as the four goals of differentiated instruction suggested by Tomlinson (2008) – Trust, Fit, Voice, and Awareness as my codes. On the other hand, I made amendments and developed my own set of codes.

Through development of these qualitative codes, I quickly established clusters of themes using colour coding. I synthesized common ideas in both transcripts, resulting in emergence of themes shared with both participants (Creswell, 2013). I integrated the data collected into more “in-depth, exhaustive description of the phenomenon” that was further analyzed and understood with the help of existing research (Creswell, 2013).

3.5 Ethical Review Procedures

I assigned a pseudonym to participants, related students, and schools. I also excluded any identifying markers to ensure the confidentiality of my participants. There were no known risks to participate in this study. However, to minimize any possible risks of participation, participants
had the right to withdraw from the study at any stage of the research study. They had the right to refrain from answering any questions if they felt uncomfortable doing so. I audio-recorded and transcribed all their responses in the transcripts. Before the start of interviews, I asked participants to sign a consent letter (Appendix A) giving their consent to be interviewed and audio recorded. I saved such data on my password-protected laptop and phone, which I will delete after 5 years. I wrote clearly in the consent letter about the overview of the research, ethical implications, and specific expectations of participation. I reassured participants with their confidentiality and rights to withdraw from the study before signing the consent letter and conducting the interview.

3.6 Methodological Limitations and Strengths

3.6.1 Limitations.

Due to accessibility and time constraints, I only interviewed two individuals for this research. Apart from the small sample size, this study also lacks students’ point of view on the discussed teaching strategies. Due to my place of residence and schooling, I interviewed teachers only from the Greater Toronto Area in Ontario. Having only two participants in the study, it was difficult to make generalization of the effectiveness of the participants’ pedagogies. On the other hand, readers should take into consideration of other factors that might influence the findings in this study, such as the dynamics and types of students in these classrooms. Since I was not able to conduct a field observation in my participants’ classes, I could only draw conclusions from the interviews.
3.6.2 Strengths.

I was able to plan my interview questions ahead of time regarding my research topics due to the nature of semi-structured interviews. I was able to collect first-hand data from teachers regarding their own field experiences with ELL students. I was also able to quote concrete examples from my participants’ practices to compare and contrast strategies and theories from literature in teaching ELLs. With my sampling criteria, I was able to recruit participants who had rich experience teaching ELLs in science classes, which provided this study with valuable findings to contribute to existing research. Semi-structured interviews also allowed more flexibility and room for teachers to share stories that were relevant to the topic of interest. I believe all information shared during these interviews was helpful in providing readers insights on teaching ELLs.

3.7 Conclusion

This research paper uses a qualitative research approach, which includes a literature review and two semi-structured, face-to-face interviews with teachers. This approach allowed me to collect descriptive data of my participants’ lived experiences, and use it to compare to existing research.

I interviewed two secondary Science teachers, who have experience teaching ELLs in Ontario high schools, and are familiar with using differentiated instruction and critical pedagogy in their classrooms. I recruited these two participants by purposeful sampling, convenience sampling, and snowball sampling.

I transcribed the findings collected in the interviews and analyzed them by coding. My participants signed a consent letter, which gave me consent to interview and audio-record them in this study. I explained to the participants about the overview of the research, ethical
implications, and specific expectations of participation to minimize risks to the participants. I ensured their confidentiality and rights. I will report detailed research findings in Chapter Four.
4.0 Introduction

This chapter presents the findings from two semi-structured interviews on strategies two Ontario secondary teachers use to support English Language Learners (ELLs) in science. I have given the two interviewees the pseudonyms Megan and Tania, respectively. I gather and emerge the findings into two main themes: (1) differentiated instructional strategies in secondary science for English Language Learners (ELLs), and (2) implementation of critical pedagogy in science for ELLs. I further categorize findings under each theme into sub-themes to compare teacher practices to existing literature. I conclude my chapter with a summary of findings.

4.1 Differentiated Instructional Strategies in Secondary Science for ELLs

In this section, I describe general differentiated instructional strategies that the two participants use in their secondary science classroom for English language learners (ELLs). These will be discussed in terms of content delivery, learning process, learning product, and classroom dynamics. This section is particularly important as it provides concrete examples of how these two teachers apply theories of differentiation in all elements of their live classrooms.

4.1.1 Content Delivery.

In terms of content delivery, one of the main challenges that teachers reported is the ability to ensure the level of contextual support and cognitive demand of material they use and create are appropriate for ELLs’ English reading proficiency. According to Tomlinson and Eidson (2003), teachers should adjust their teaching materials and methods to ensure they are a fit for students. Additionally, the authors posited that it is important for teachers to acknowledge the needs of ELLs and to adjust their reading material accordingly (Tomlinson & Eidson, 2003).
In order to ensure a proper fit for ELL students, both participants described making accommodations including, varied levels of reading materials, bolding, underlining, and translating keywords. Chin (2015) stated that development of vocabulary is one of the most important indicators of student achievement. Corresponding to Chin (2015), Tania, the second participant, also focuses on teaching her ELLs vocabulary in science and math explicitly. She usually highlights keywords in the reading materials and slides, and implements what she calls “What’s Your Word Day” with her ELL students. In this activity, each student picks one word that they do not understand, and then the whole class looks into it. However, Tania found that this was too time-consuming, so she also asked her students to look up the translations of the words on their own, and to create a vocabulary list. Occasionally, Tania gives her students a quick one- or two-paragraph-long passage containing those vocabulary words, and students answered multiple-choice questions similar to what is required in the literacy test. Tania finds that this method effectively promotes students’ success, as it provides ELL students more opportunities to practice for the Ontario Secondary School Literacy Test. This point of view also resonates with Chin’s (2015) argument that teachers should improve students’ understanding of vocabulary through usage in different contexts and scenarios.

Apart from varying reading levels and creating vocabulary lists, Megan, the first participant, reported carefully designing the layout of reading materials and choice of vocabulary. Cummins (2000) stated that the difficulty of an academic task is based on the relationship between its cognitive demand and the amount of available contextual support. Similar to Cummins (2000), Megan believes that students benefit the most when the work is cognitively demanding with context embedded. This includes the use of audio and visual representations. At the same time, Beal, Adams, & Cohen (2010) suggested that ELLs have less
available capacity for problem solving, as they must devote substantial cognitive resources to English comprehension. Megan agreed and explained that ELLs spend a lot of effort in decoding. In her own words:

If they see too many words all at once, all they see is an overwhelming of decoding that they have to go through. Too much decoding all at once is too tiring for them and they get stressed and nervous.

Therefore, she suggested that teachers minimize the number of words in a question, and include a lot of space and pictures between lines to make it easier for ELL students to read and understand. Megan also is very careful with her choice of vocabulary. She explained that there are many synonyms in science and math, and students sometimes get confused when teachers use multiple words that have the same meaning. At the same time, there are many common words that are used to describe completely different things, such as finding a “solution” to a math problem versus finding a “solution” that is made up of dissolved solutes in solvents. Therefore, Megan always explicitly teaches her ELL students synonyms and homonyms in her science class to avoid confusion.

Despite the fact that numerous studies showed that the use of interactive technologies in the classroom effectively engage students and promote their cognitive development, teachers experience a lot of difficulty integrating technology into existing curriculum (Brown, 2006; Brown & Warschauer, 2006; Kim, Mims, & Holmes, 2006). Interestingly, Megan and Tania reported being proficient in integrating technology in their everyday classroom as part of their instructional pedagogy. Both teachers frequently use translators, computers, and smart boards in the delivery of content materials. They also often use the Internet and online resources to complement their lessons.
Specifically, Megan introduced her ELL students to an interactive online response system called Kahoot for a more engaged learning environment. Kahoot is an application in which students complete quizzes online simultaneously in a competitive or noncompetitive manner using electronic devices. Students respond using cellphones, tablets, or computers, and receive instant feedback after they respond. Megan uses the test results as formative assessments to monitor students’ learning progress, and as a ‘minds on’ activity to promote student engagement. Since teachers can choose to use pre-existing quizzes created by teachers around the world or to create their own, it is a convenient tool for teachers to adjust the questions and format according to specific groups of students. In order to accommodate for the learning needs of her ELL students, Megan frequently embeds pictures and video clips whenever appropriate, and printed out hard copies of the quizzes for her ELL students to work on.

Both participants described having expertise in implementing differentiated instruction in the delivery of science content to ELLs. Strategies reported included varied reading level, emphasis on vocabulary, and promotion of scientific literacy. Contrary to the literature (Brown, 2006; Brown & Warschauer, 2006; Kim et al., 2006), Megan and Tania reported exceptional capability in integrating learning technology into the existing curriculum.

4.1.2 Learning Process.

As described in the literature, collaborative learning is beneficial to students as it allows students with different strengths and learning styles to complement one another (Broach et al., 2012; Dillenbourg, 1999). Tania and Megan also recognize the benefits of collaborative learning, and promote collaboration amongst students in their science classes to foster a supportive learning community for ELL students. They implement strategies like special grouping arrangements for activities and group revision sessions. They encourage students to question
each other using cue cards. Details of the grouping strategies will be further explained in a subsequent section.

Another important collaborative learning experience in science classes is labs. Both participants expressed their worry and concern leading lab sessions with ELLs. They recommended teachers be extremely mindful with their instructions and explanation of, for example, safety precautions. Allen and Park (2011) suggested that ELLs tend to claim they understand the task or the material completely even when they do not. They have a tendency to hide their confusion to avoid looking ignorant (Allen & Park, 2011). Megan described the same situation with her ELL students. She stated how it is a teacher’s responsibility to ensure students are actually clear about the success criteria and expectations. Megan stated:

I always make sure they completely understand because the thing with ELLs is, they’ll say ‘yes’ many times when they don’t understand. Sometimes when I talk about labs, they’ll pretend they understand and say yes they know what to do.

Similarly, Tania noticed the same problem with her ELL students. She also stated:

They tell me ‘Yeah, yeah we get it!’ and then they come to do their work, and they do something completely different. […] Some of the kids you think they're listening, but they're not really listening. Well they tell you they listen but they don't.

However, in order to tackle this problem, Megan and Tania take two different approaches to make accommodations for their ELLs. Although Megan used the same labs for her regular class and ESL class, she emphasizes the prep-lab work for ELLs. She developed a step-by-step protocol to ensure students’ preparedness prior to the actual lab. She also used white boards and write-up pre-labs to evaluate students’ understanding in the use of equipment, lab procedures, hypothesis, and the purposes of labs. Megan concluded:
They write out the procedures. I give them whiteboards, and they can explain to me step by step what they would do ahead of time. I show them the equipment. They have to know the names of the equipment. They have to able to tell me what equipment does before they actually do the lab. We usually do a half-an-hour prep time. They have to do the write-up. They also have to do the reading of the lab beforehand, and answer a couple questions like the hypothesis and so forth before doing the actual lab. I need to make sure they're a hundred per cent sure of what they do.

Tania has a different approach for her ELL students. For her, the success of her pedagogy depends on students’ readiness and level of English proficiency. She expressed her concern dealing with labs that involved hazardous chemicals or higher-level scientific skills in chemistry with ELLs. She encourages her ELL students to do simple tasks in labs such as weighing and making observations, but prohibits them from doing certain tasks that require more precautions, like mixing of chemicals. Due to the language barrier, she chooses to do demonstrations instead:

I don't let them do the mixing themselves because the instructions are more… you know, it's already a problem with me explaining to them what to do and stuff like that, so I mostly do demo. But like simple activities like weighing and measuring, they can do on their own.

When I questioned Tania about how she prepared her students to develop lab mastery in higher-level science without training for such skills, she clarified that she only does this with her Grade 9 students in ESL A and B for safety reasons. She emphasized the language barrier in giving instructions, and believes that when students got to Grade 10, they would succeed as long as she reads the lab instructions with them, and makes sure they have a full understanding. Tania stated:
In my Grade 10 academic science of course they do their own mixing. But if you're talking about kids in ESL A and B right now, they barely can say or understand anything you say to them, so no, no. […] That's why I said it all depends on the class. Yes, my grade 10 do their own mixing but I have to read instructions with them, making sure they understanding everything that's said on that procedure.

In regards to general instructional strategies, Tania allows extra time for her ELL students for processing and going over materials slower than in her other regular classes, and teaches the same concepts using multiple perspectives to facilitate ELL students’ learning process. She went on to describe how she uses a repetitive “three-time process” – teach, practice, quiz – to ensure student success while providing them sufficient time and opportunities to practice. She also integrates scaffolding in her instruction, making sure she breaks the big ideas into smaller concepts.

One example of scaffolding she did with her ELLs was on the astronomy unit. She explained the concepts in the beginning, and then she broke down her remaining lesson into different activities. Students first had to look at pictures of a galaxy, made all observations they could, and then classified based on different properties like colours and shapes, and finally made comparisons. She made it fairly easy for her students to follow her instructions step-by-step to understand classification of the galaxy.

Both participants frequently implement collaborative learning to enhance students’ learning. Other strategies include repetition, extra time, and scaffolding. In respect to labs, Megan takes a more time-consuming approach that focuses on pre-lab preparations and scientific skills acquisition. Alternatively, Tania prioritizes students’ safety and chooses to perform teacher-directed demos in place of student labs for beginning English learners.
4.1.3 Learning Product.

Tania and Megan thought that ELL students are generally disadvantaged in terms of their lower ability to express their understanding using English. Cummins (1979) proposed that Cognitive Academic Language Proficiency (CALP) takes five to seven years to develop, and there is a two to three year gap in the acquisition of academic English versus spoken English. In order to accommodate for the delay, one strategy that Tania uses was to evaluate her ELL students using concepts and scenarios that had been discussed or they had been exposed to before. Both participants also suggested numerous alternative assessment tools to evaluate students. Megan described how stressful it is for students to be placed in a testing situation, so she tries to evaluate students’ problem-solving skills using white boards, where students “felt more at ease and could change their answers anytime”. Apart from using paper tests, Megan also allows ELLs multiple opportunities to demonstrate their learning in order to determine their performance. She evaluates products like posters, class participation, group projects, presentations, brochures, and hands-on activities.

Megan is particularly impressed with the level of creativity of her ELLs and their effort in hands-on projects, thus she often chooses hands-on projects as assessment tools when appropriate. For example, she has asked her ELL students to create cell models. Without suggesting materials to use, her ELL students built their three-dimensional cell models using food items and play-doh, whereas her regular students only drew on cardboard using markers. She thought that ELL students were able to perform better when evaluations were not test-based:

Actually I didn’t even say the word "food". But I have someone who used grains of rice to stick that on for pieces. So they're really creative. They go home, and they
actually make things interesting [...] So I’m most amazed at what they do when it's something that doesn't require any words or whatsoever.

For presentations, Megan provides options for her ELL students and uses a specific strategy that will be described in the following section. Instead of evaluating students’ English proficiency like an English teacher would, Megan evaluates “their confidence, their volume, their tone”, and quality of information they present.

Both participants recognized the delay in development of cognitive academic language. Consequently, they design alternative assessments to provide multiple opportunities for ELLs to show their understanding. They evaluate different learning products of summative and formative assessments, such as tests, presentations, class participations, and hands-on projects. Megan described that her ELL students in particular were more creative and performed better with assessments that were not language demanding.

4.1.4 Classroom Dynamics.

Tomlinson & Edison (2003) stated that teachers can integrate differentiation in five classroom elements: content, process, product, affect, and learning environment. In respect to affect and learning environment, Megan believes that the key to success of ELL students is the ability to create a welcoming classroom and a safe environment. When students feel trust and comfort with the teacher, she is able to work closely and cooperatively with the students to achieve their goals. Megan often uses modeling and shares her personal experiences as an ELL with her students. By doing so, she becomes relatable to her students. ELL students then realize that their teacher genuinely cares about them, and understands the struggles they are experiencing. Instead of a teacher-directed learning environment, Megan creates opportunities
for students to take on roles as educators by designing a student-centered curriculum. This will be further elaborated upon in a subsequent section.

As mentioned earlier in the section *Content Delivery*, Megan frequently integrates the online response system Kahoot in her class as a ‘minds on’ activity. The leadership board is a feature on the application, and shows the person in the lead, but it does not show who answers correctly or incorrectly. Students can only check their answers on their devices, so it engages ELL students who are usually too shy to participate. Also, students can enter the game using anonymous IDs, so students are not embarrassed if they get the questions wrong. It creates a safe environment for students to participate. The competitive element may also motivate students to try harder for the sense of accomplishment. One advantage of Kahoot is that the teacher has full control of the game pool. Teachers can work toward a positive learning environment by removing students who use an inappropriate word or nickname.

Van Garderer and Whittaker (2006) suggested teachers should ensure consistent equitable participation of students. Similarly, Megan always signs out additional laptops for students who do not own a personal device. When asked if it creates a socioeconomic discrepancy, Megan stated that she had never noticed any evidence of embarrassment or shame shown by students who need the extra laptops. However, after some thought, Megan expressed her concerns for certain students because she understood that “in the real world people get teased for not having cellphones”.

Tania agreed with Megan that ELL teachers have to be particularly patient, understanding, and creative to build inclusive learning environments. Another strategy that Tania suggested was to make good use of classroom decorations and arrangements to change the classroom dynamics. Tania often displays students’ work in the classroom, and uses a lot of
pictures and visual representations. For example she used an orange balloon to represent the sun and different coloured balloons and balls as other planets. She believes that students should be able to visualize the content that they are learning.

Both participants recognized that the key to students’ success was to create a safe and inclusive learning environment. Their beliefs align with Tomlinson and Eidson (2003), which called for teachers to modify their pedagogies with differentiated instruction according to unique student needs. Megan promotes equitable student participation and student engagement by ensuring availability of supplies and modeling respect, while Tania decorates her classroom using visual representations and effective furniture arrangements.

4.2 Implementation of Critical Pedagogy in Science for ELLs

In this section, I describe cultural and linguistic challenges ELLs face in secondary science classes, then illustrate the ways both participants implement students’ cultural background and identity in their classrooms. Critical pedagogy, which is rooted in critical theory, fosters the idea of liberal multiculturalism and engages students by making the connection between the sociocultural and sociopolitical contexts in lessons to students’ background knowledge in a classroom setting (Alegria, 2014; Norton & Toohey, 2004). I use five categories: the use of students’ mother tongue, development of emancipatory literacy, support for multiculturalism, growth as critical empowered agents, and advocacy for marginalized students. This section is particularly important in regards to ELL student’s construction of self-identity, development of critical thinking skills, and creation of an inclusive learning environment.

4.2.1 Cultural and Linguistic Challenges ELLs Have in Science Classes.

It is undeniably important for teachers to recognize the diversity in their classrooms and to create an inclusive environment for their students where different cultural behaviors and
customs are valued (Gay, 2002). Both participants recognized the difference between Canadian-born and newly immigrated students in respect to their attitudes and values towards education. Megan and Tania believe that ELL students generally value education more than Canadian born students. Tania thought that her ELL students show a higher level of interest in class than the native English speakers. Tania stated: “the ELL students are much more engaged in learning, they care much more than the native English-speaking students here”.

When asked about the reason, Tania explained it as a difference in culture. She thought that one of the main reasons is the influence of parents and home life in their countries. This resonates with the findings of Su (2006), who argued ELLs’ language acquisition and level of engagement at school are often influenced by home conditions and values. Based on personal experiences and conversations with students, Tania noticed her ELL students generally wish to succeed at school in hopes of pursing a better future. She believes that succeeding academically would be the very first step to a better future:

I think the ELL students that came from countries where education could be one of those that… your parents instilled in you, that you have to go and get an education. But here, I don't know if we instil that much value in the kids here anymore. So maybe that's the reason. And they want a better life when they come to Canada so they think that education is a way… Which I agree too because same idea when I first came, I didn't speak a word of English and this is what education brought me.

The Ontario Ministry of Education (2007) suggested that international students often try to rush the schooling progress to graduate to minimize the expenses. Contrary to that, Tania noticed her visa students are in fact unmotivated and disengaged. She thought that those students avoid
trying because they are not confident they could succeed given the language barrier. Some students also think their wealthy background would help them bypass the hard work. Tania stated:

A few that have this mentally because they don't speak English […] They are not just disengaged. The learning altogether… they don't see the value of it. One of them is a visa student, and I think she's come from a very wealthy family. I don't know but she seems like that. She's older so she has this idea that ‘Oh I don't know, I'm not going to try’.

Similarly, Megan also agreed with the linguistic obstacles ELL students face in her science classes due to the lower English proficiency. She understood that her ELL students have “an overwhelming of decoding that they had to go through” in science classes. She believes that teachers should be sensitive about the learning curves and processes to make accommodations accordingly. Megan stated:

You can imagine a whole day you’re decoding a different language and that alone takes energy and efforts. So, on top of decoding they have to understand the science and do their science work, but you know, the first process is decoding, which a lot of native speakers don’t have to do because it’s completely native to them. So they’re doing an extra task on top of everything. So it is a lot of work for them. So that’s something else that teachers have to be sensitive about.

Due to cultural and linguistic challenges, Megan described how she discourages students who have relatively high grades in Grades 9 and 10 from taking higher-level science courses. She explained that science, especially in biology, is an extremely language-based subject that requires a lot of “text-based learning, memorization, and use of complex terminologies”. She was
worried that failure in those courses would “shatter students’ self-confidence”. She wishes the curriculum would be more lab-based so as to engage ELL students more easily.

Apart from cultural dissonance and language barrier, Tania believes that lack of friends was another big factor that affects student’s engagement in class. She noticed that students tend to avoid classes and get depressed when they are unable to make connections with peers. Evidence of disengagement includes constantly being late to class and refusing to participate in group activities. Tania used one of her student as an example:

She's constantly late to class because she'll go to the library. I guess she doesn't have any friends; she goes to the library and puts her headphones on. She won't hear the bell so she comes to class late […] but I think she used it as an excuse to come to the class late. […] Um... most of them for the culture part is not having friends. So, if they have friends, they seem to be okay.

Both participants addressed several cultural and linguistic challenges ELLs face in a high school science class. In the following sections, I described what Megan and Tania shared with me regarding strategies they use in their classes to overcome these barriers and to engage their ELL students.

4.2.2 Use of Students’ Mother Tongue.

Existing studies have explored the positive and negative consequences of students’ use of their mother tongue in the classroom. Anton and DiCamilla (1998) stated that students’ mother tongue serves social and cognitive functions, and Lin (2000) stated that it promotes recognition of learner identity. Megan and Tania agreed that the use of students’ mother tongue indeed promotes communication between students with similar backgrounds. They also agreed that use of students’ mother tongue might effectively increase students’ understanding in class if it is
used appropriately. Both participants highly encourage their ELL students to look up and translate unfamiliar vocabulary using their mother languages. They promote the use of translators, phones, and computers in their classrooms.

Megan believes that the use of mother tongue was essential for newcomers, and the presence of peers who speak the same languages eased their anxiety drastically. She noticed the tendency for ELLs who speak the same language to stick together and explain to one another in their mother tongue in class. Although she believes such practice is unavoidable, she tries to discourage it. Similar to what Skehan (1998) and Carless (2002) suggest, she thought that too much reliance on the students’ mother tongue might in fact hinder students’ acquisition of language. She always tries to foster an environment where students will talk and explain to one another in English. She tells students to speak in English in her classes. She worries that her ELL students will not be able to catch up by Grade 11 otherwise, when they no longer have the benefit of an ESL program. Megan stated:

It is true that because they are held back, so I always encourage them that it will take them more time, and they will have to push themselves harder… force themselves to read the textbooks… that they can catch up by the time they get to Grade 11, because in their Grade 11 we no longer have the ESL program.

When asked if she encourages the use of students’ mother tongue in class activities and writing draft assignments, Megan again stated that she is not supportive of using other languages. She explained that she is unable give feedback to students if they write in languages that she cannot understand. This resonates to Bruton (2005), who argued many teachers feel uncomfortable when students do not use their target language. Another worry she had is the level of integrity in student’s work. Megan described how advanced technology allows students to easily translate
their work into any language simply by typing the paragraphs into their computers. She also stressed the concern of word-to-word translations that could lead to undesired outcomes, such as over-reliance on translators, and delays in English language learning. Megan stated:

They're taking from word to word, trying to translate a word in their language to a word in English and sometimes it's just there's no cohesion between that. So it can be more difficult.

Megan understands the challenges of writing English for ELLs, and by prohibiting them to write in their mother languages, she creates different success criteria for them depending on student’s English proficiency. She encourages students to first think and write about what they could in English. She evaluates individually and she focuses on students’ progress. However, when I asked how exactly she set her standards for evaluations, she became hesitant and was not able to elaborate further on her answer. Megan explained:

But I evaluate from, in terms of, you know, what their level of English is, so… some may have lower level but I can see that they try harder… you know… so… Uh… I don't know how to explain it. It's… basically coming from where they're at. I look at their level of English then I mark accordingly.

On the other hand, Tania integrates the use of students’ mother tongue outside of the classroom for academic purposes. Apart from challenges communicating with ELL students, she also experiences challenges communicating with her students’ parents. She described a situation where a parent, who did not speak English, wished to talk to her about his son’s academic performances. She expressed her frustration throughout the meeting despite of the presence of a translator:
He doesn't speak English either. So we had a translator but it's like a whole conversation, like, lost in translation.

When dealing with this parent who spoke another language, Tania communicated with him by writing the family a letter. She offered suggestions to help the parent support his son academically, such as focusing on understanding of concepts, instead of memorizing materials. Specifically, she encouraged parent-children conversations in their mother tongue. She suggested the student explain to the parent in his own language. Tania believes that such practice required the student to first get a full understanding of the concepts, and then illustrate it using his own words. She implements the use of students’ mother tongue to promote students’ thinking and problem-solving skills. By doing so, she prevents students from merely memorizing textbooks word for word.

To sum up, the benefits of using students’ mother tongue included increased collaborative dialogues among peers and parents, as well as increased students’ understanding of learning materials. Concerns included over-dependence and delay in target language acquisition. Both participants show adequate ability to implement students’ mother tongue in class despite the aforementioned drawbacks. However, they still experience difficulty in evaluating and balancing equity issues while creating success criteria.

**4.2.3 Development of Emancipatory Literacy.**

To become culturally responsive, it is essential for teachers to promote the development of emancipatory literacy. As described in chapter two, emancipatory literacy includes knowledge on culture, identity, language, and growth (Alegria, 2014; Macedo, 1994). Megan shared with me an example of how she created a student-centered curriculum that allowed her students to bring in their personal history, experiences, and culture into the classroom.
Megan recognizes that in science, most teachers create their curriculum based on familiarity of Canadian surroundings. She pinpoints the downfall of such curriculum for ELL students – cultural dissonance. Often students are unable to understand or relate to the content materials presented in textbooks or tests, examples included cultural food items and wildlife animals. Megan stated:

They will use examples like ketchup, mayo, things that we would think is common knowledge, but to them, they don't know what ketchup and mayo are. Again, it's a cultural thing. And then, when we get into the ecosystems, for example, the animals that we're exposed to are completely different from the animals they're exposed to.

So they don't have that background knowledge.

Megan shared with me a project she designed for her ELL students in the ecosystem unit to promote cultural democracy to combat this situation. As one of projects in the unit of endangered species, students had the option to research an endangered species that interested them from their home countries. Megan used that as an opportunity to start conversations with her ELL students, so as to get a better understanding of their cultural background and build rapport with them.

Megan observed the passion and excitement her ELL students had when they talked about their personal experiences and knowledge of their culture. When I asked about the reason, Megan explained it as a change in roles and power in the classroom. Instead of creating a traditional, teacher-directed classroom where teachers gave all instructions, her ELL students take on an active role as educators who were in charge of their own learning. Students begin to teach the teacher and their peers, and by doing so, they start to build self-efficacy. Megan stated:

I think because they start to teach me. So a lot of time, they'll say "Miss, Miss, come over, do you know this animal?" I'm like, "I have no idea, looks like a dog..."
They start laughing because I don't know, but it's good because that makes them feel proud. They can teach me, "No, this is a chinchilla!" or whatever it is.

Megan successfully allows students to connect their voices, languages, and culture in the class. What Megan created was similar to what Shor (1992) and Giroux (1998) described as a student-centered curriculum, which involves recognition of cultural and personal resources of students to create a multicultural democracy in class. Megan believes that ELL students felt disadvantaged compared to students who were born in Canada. By designing a student-centered curriculum that promotes multicultural democracy, she supported marginalized students. She was then able to engage her ELL students, who now felt confident to share their knowledge on their culture and identity. Megan elaborated:

I think when they're here, they feel umm… Disadvantaged. They feel like they have less knowledge than the person next to them who's born in Canada. But when I bring them topics about their own country, they feel more confident so they like to share that knowledge that they have.

Tania also agreed with Megan that ELL students lack exposure to Canadian culture. She shared experiences in which she had difficulties assessing students using examples and concepts they had not been explicitly taught about. She recommended teachers teach the same concept using examples from multiple cultures to ensure fit. The repetitive explanation of the same concepts exposes ELLs to different ways to interpret them, and can help them better relate the concepts to not only themselves, but also people around them. Repetition also serves the purpose of ensuring ELL students understanding.

On the other hand, Tania described one of the conversations she had with an ELL student, Amy. Tania caught Amy crying at school one day and decided to have a one-on-one
conversation with her after school. Amy was struggling with school and the new living environment. She spoke about her mother’s favouritism towards her brother, who seemed to be adapting really well to the English-learning environment while she was not. She thought she was not good enough and thus, unable to adapt to the new culture, and got treated differently by her mother. She felt weak and disadvantaged compared to her brother and the native English-speaking classmates. However, when Tania asked her if she wanted to go back to her country to avoid such unbalanced power dynamics and cultural dissonance, Tania was surprised that Amy still chose Canada over her home country. Tania stated:

She told me, ‘No, I don’t want to go back. I want to be here. I like it here’.

Tania assisted in Amy’s transition to the new learning environment by explaining different learning styles and cultural values. Through closely monitoring Amy’s progress by having one-on-one conferences with her regularly, Tania facilitated Amy’s development of emancipatory literacy. She allowed Amy to understand and embrace her growth as a learner, and guided her exploration of her cultural identity.

In fact, Megan believes that the everyday cultural environments where students live would make a big impact on their personal growth. Megan recommended that teachers pay close attention to the situation of students’ home-care in terms of the support, love, and food they receive. She expressed her heart-break at moments when she learned about students’ home situations where “they had zero communication with the ones taking care of them due to the language barrier”, where “food was generic bare minimum”, or where “their new home was just a shelter for them”. Through learning about students’ situations at home, Megan also changed her view on some students with behavioral problems. Megan stated:
For me as a teacher, you know, before I'd get very disappointed. But now, I relate to where they're coming from. If they come to school and they're tired, I sometimes wonder if it's because they have not been fed, or they have not been able to sleep at night. Sometimes they're so scared. Some of these kids have told me stories where they're scared at night times because they don't know what's going on around them.

Therefore, Megan believes that it is very important for teachers not to jump to conclusions without trying to relate to what was going on at an ELL students’ home. They should understand that sometimes the home situations can be very difficult. Megan makes herself available to her students, and offers suggestions of people who students can talk and relate to. Megan also invites students to spend more time at school after class where they can be surrounded by teachers and peers with whom they feel safe. If teachers did end up discovering problems arising from home, Megan suggested that they follow-up by getting guidance or school counselors involved as well.

Both participants demonstrated their ability as culturally responsive teachers. They were able to develop emancipatory literacy among students, in which students were able to speak about their cultures, identities, and personal experiences in class.

4.2.4 Support for Multiculturalism.

Studies indicate that it is important for teachers to embrace and teach multiculturalism in class to promote an inclusive environment for students (Gay, 2002). Megan and Tania recognized the need to support such diversity as well. Megan compared her students to those in classes where teachers fail to differentiate and accommodate for students of diverse
backgrounds. Megan found that students in those classes generally show less engagement and lower performance (in grades). From her observation, they tend to shut down, stop completing their homework, and are reluctant to ask for help. Those students end up failing those courses; although they might be the brightest children in her class. She thought that the main reason for such a difference is lack of bond. When students fail to relate to the materials or the teachers, students become cold and stop asking questions when they do not understand. They become disengaged, which eventually leads to failure in class.

Therefore, in order to create a welcoming and safe environment, Megan believes that teachers should promote multiculturalism in classrooms. She repeatedly emphasized the importance of bonding between teachers and their students. Megan understood that ELLs are in a relatively new environment, where most of the time “they were removed from their family, their friends”. She thought that ELLs need nurturing from teachers to “latch on some kind of bond”. When ELLs’ cultures are recognized and valued in the class, they feel welcomed and comfortable about opening up. Megan also believes that it is important for teachers to embrace ELLs in a warm environment, while at the same time maintaining a positive student teacher dynamic in the classroom by watching their limits. Megan stated:

So the most important I think for ELL students, ESL students, is the feeling of a welcome classroom, a safe environment. They need to feel trusted by the teacher; they need to feel comfortable with the teacher. I am very close with all my ESL students because they have bonded with me. They love to open up. As soon as I have that bond, they are respectful. I have known ELL students to completely shut down with teachers that do not open up and do not embrace them in a warm environment.
Similarly, Tania found that one of the factors of disengagement in class is the lack of peer connection. As a frequent practice, Tania often creates opportunities for her ELL students to meet new friends. Tania recognizes the diversity in her classroom, and tries to promote the idea of multiculturalism by actively endorsing her student’s cultural identity and explicitly teaching cultural differences.

She encourages her students to get involved in school activities and shows her support by fostering a close community in class. When one of her ELL students was performing at a Winter Concert, she signed up the whole class to support the student. Instead of emphasizing only academic success, she motivates her ELL students to get involved in different school communities to create a multicultural environment.

In everyday class, she creates opportunities for her ELL students to get to know and work with peers with different cultural backgrounds. She designs group activities and builds a cooperative learning environment by special arrangement of the tables. She strategically puts her ELL students into groups of 2 to 4 to ensure fit for the activities.

Strategic group arrangements not only allow students to initiate conversations with one another, but also create chances for students with different learning styles to make use of their strengths in a cooperative manner (Dillenbourg, 1999). Tania commented that grouping academically stronger students with the relatively weaker ones is beneficial because they tend to extend themselves to explain to each other pretty well. She believes the best way to learn is to explain something to someone else. And by doing so, the academically weaker students receive extra help as well.

One strategy that Tania uses was the rotation of group arrangements. Tania rotates the groups so her ELL students are also able to jump out of their comfort zone to find new work
partners, and find peers who they can relate to at the same time. The increased interactions between students then facilitate building of relationships between ELL students. Tania stated:

[…] And rotate the groups so they get to know… to work with different kids in the school […] they get to meet different people, not just the same person they work with all the time […] they are always able to find somebody that have something common and they become friends, hopefully.

Tania sometimes gives her students options to choose their own group mates. In one instance, in which students requested to form their own groups, she turned the lesson into a valuable teaching moment on multiculturalism. She asked her students to situate themselves in a work setting, and questioned them how they would be capable to work well with colleagues and clients with diverse cultural backgrounds. By creating opportunities to work with different groups of peers, Tania prepares her ELL students to become more accepting to differences progressively and learn from one another through cultural inclusion. She also explicitly reminds her ELL students that intercultural competence would be one of the most important skills they can acquire. In other words, she also implements multiculturalism in her science lesson whenever she finds an appropriate time. During her conversation with students who requested for a change in group members, Tania commented:

How you would interact, or how you would work with people who are different than you, and not your friends? So it is an extra skill that you can learn, not just about science, but the skills that you bring with you everywhere you go. So let's do that. And they will be okay with that.

All in all, Megan and Tania show evidence of supporting multiculturalism in their science classroom. They successfully use ELL students’ “cultural socialization and experiences in
teaching improves the quality of their educational opportunities and outcomes” (Gay, 2002, p. 618).

4.2.5 Growth as Critical Empowered Agents.

Critical Pedagogy describes approaches that seek social justice and transformation (Kubota, 2004). Megan and Tania integrate critical pedagogy to educate students into critical thinkers and global citizens who take part in transformation of their own education. Both participants frequently incorporate Science, Technology, Society, and Environment (STSE) studies and real-life applications in their classes. As noticed by both participants, ELL students demonstrate engagement and participation by frequently asking questions. Megan described this practice as one of her favorite things about ELL students. She thought that it is very important for students to think, reflect, and question the materials that are presented to them. It is even more important for students to think critically about things around them and decisions that they made.

As described earlier, Megan asked her students to research on an endangered species from their home country. In order to facilitate the development of critical empowered agents in class, she used open questions to prompt critical thinking. She asked students to reflect on: “What happened to the species? Reasons why they are dying? What has changed in the environment that causes the reduction in species?” By doing so, she raised awareness in students about the consequences of their everyday decisions, as well as other factors such as urban development and climate change.

Similarly, Tania spends time teaching STSE to her ELL students. From her experiences assessing, she noticed that ELLs are relatively weaker in the thinking and application categories, when compared to her native English-speaking students. Based on her assumptions, she believes
that it was partly due to the difference in education models between Canada and their home countries. She thought that some of her ELL students grew up in countries that used the ‘banking model’, where they “sit down and the teacher tells [them] exactly what to do”. She thought that these students are accustomed to memorizing and answering questions from the textbook. On the contrary, the education system in Ontario promotes critical thinking and application of concepts. Tania thought that some ELL students struggle because they are not adapted to the changes in education models. Therefore, apart from teaching the science curriculum, Tania focuses on developing critical thinking skills in students by engaging them in debates.

Critical thinkers actively take part in the learning progress, where they learn to explore and critique (Giroux, 1988). By facilitating critical thinking skills, Tania believes that students are also able to better define their identities and learning goals. Tania shared with me a conversation between her and her ELL student Melissa. Melissa used her Mathematics teacher as an example to question the purpose of attending school. Melissa stated:

Miss, what’s the point? What’s the point we go to school? It’s so tiring and then you get jobs that you don’t even like. My Math teacher said he didn’t like his job.

Similar to how she dealt with students who asked for a change of group arrangements, Tania responded to Melissa by questioning and leading a class discussion. She discussed students’ aspirations, and explored multiple routes to achieve their goals. She explained to students that none of the jobs in the world would be perfect, and what really matter would be to find a job that they enjoy doing. In the norms of our society, education is the way to students’ success in the future, in terms of getting them equipped with skills and knowledge, and keeping their future job options open. Tania helps her ELL students through their rough times towards their goals.
At the same time, Tania thought that it is important for ELL students to realize the consequences of the choices they made. Tania facilitates discussions about strategies and rationales behind decision-making. Tania believes that education leads to “better opportunities, higher pay, and better living conditions”. Therefore, she endorses the same values to her students:

After you get education you have better opportunity, so you have better living conditions. You can travel more, you have more money, and you have more opportunities! But if you choose not to go to school, then maybe you have... maybe you're lucky you make money some other ways, but this is the way right now. So just give yourself a chance. Go get your education and we'll see what happens.

This resonates with Tania’s personal background as an immigrant - she wanted a “better life” by receiving an education in Canada. She believes that education had brought her to where she was, and hopes that her ELL students can achieve their goals by valuing education as well. Most importantly, Tania strives to motivate students to take initiative to transform their learning. She thinks that teachers can guide students by setting up the right environment for them; yet not hold students’ hands too much. She keeps her classes challenging in order to “force students to think outside of the box”. Tania stated:

I don't want to hold hands too much, I want a little bit of guiding, but at the same time, they have to take initiative on their own learning. I will set up the environment for them, but ultimately it's for them to learn.

Megan agreed with Tania on the push for students to grow into empowered learners. She thought that a lot of ELL students “initially came to the [ESL] class thinking it would be easier”. In order to maintain a high standard, Megan often tells her ELL students that she will push them even
harder than a regular class because she expects the same curriculum while they must learn the language as well.

Both participants implement social studies and cross-disciplinary studies to facilitate critical thinking in students. They turn students into critical empowered agents that actively reflect and critique their education. They also motivate their students by maintaining high expectations.

4.2.6 Advocate for Marginalized Students.

I described how the two participants discussed the issue of ELLs and their self-perception of being “disadvantaged” in the previous sections. In respect to this problem, Tania thought that she could increase ELLs’ confidence by complimenting their work and effort publicly and by displaying their work in the classroom. Megan noticed that certain groups of ELL students tend to have weaker performance, lower self-efficacy, or are treated inequitably. Based on Megan’s observations, she thought students from the Philippines and other Asian countries were very “reserved” and “quiet”, which becomes a big factor influencing their performance in giving presentations. These students are extremely nervous, and they try to rush through their presentations. When asked how she combatted this situation, Megan giggled and stated that she gave students demonstrations of the worst possible presentations to lead a discussion in a safe and laid-back environment. Megan stated:

This is what I'm looking for… This is what I don't want to see! Sometimes it's hard.

It works with certain groups, and certain other groups take longer. It's just something that they need to grow into.

Due to her personal cultural background, Megan is able to easily relate to her ELL students. She understands the presence of unbalanced power relations at school and in society. Megan uses her
parents, who are immigrants, as an example to illustrate why it is essential for "minorities" to speak up:

I tell them my parents were immigrants, and a lot of minorities, unfortunately in reality of our society, if they're quiet and shy while at work, they can be abused in terms of... They get all the work but they don't make the pay... They don't make their levels up because they're too quiet. So I tell them leaders need be able to speak loudly and clearly.

As an accommodation, Megan provides her ELL students with assessment options. For the first oral presentation, her ELL students can choose to record a video in place of giving an oral presentation in the front of the class. Despite the fact that the whole class will still see the video, students are able to work on their speeches at their own pace under a relaxed environment. In other words, ELL students get to experience showcasing their work in front of their peers in a safe environment first, which allows them to then slowly build up their confidence to speak up in front of a crowd.

Megan shared with me her experience with a Chinese student, Sally. Sally was an extremely shy student who was petrified to speak in front of the class. As described, Megan allowed Sally to video-record her first presentation as a practice. At first, Sally was not going to try at all. Megan helped Sally in brainstorming ideas and closely monitored her work progress. With Megan’s support, feedback, and reassurance, Sally finally completed her video and felt comfortable and safe to present her final product to her peers. Megan stated:

She became more confident from the praise I gave her, and even the feedback from the other students. She started to make more connections, she felt less shy. She is still shy but she's very comfortable. She's now more comfortable and she's happier.
She really is. And I think I kept saying that to her that it was such a great presentation. Even when I spoke to her the next time if I could show the other classes, she said yes it was okay, whereas, before when I asked if I could show it to her own class, she was hesitant.

Megan stressed the need for teachers to provide extra support and encouragement to ELL students. Positive feedback and constructive comments are critical to ELLs’ improvement and growth. Progressively, through her encouragement and feedback, her ELL students become more comfortable and confident about their work. Megan facilitates her ELL students to build connections with peers, and fosters student-teacher relationships. Megan also believes that teachers must be cautious so as to not to hurt student’s self-esteem when they fail to perform as well as expected. Asking reflective questions and providing reinforcement are ways she helps students recognize their weaknesses and discover ways to improve. Megan elaborated:

For even the ones who don't do a good presentation, I try to say it in a way that's not... you know I ask them questions like “Were you nervous?” “Did you not prepare for this?” “You could have done so much better, you're a very smart student. I want everyone else to know that you know this.” “You shouldn't be scared, these are your friends.”… I try to make sure that they understand that for the next presentation, they will do better.

She also recommended that teachers give feedback orally, as ELL students are more attentive to in-person interactions and comments. She realized that they are more inclined to ignore written comments. Megan stated:

This is what I like about your presentation… This is what I think you can improve on… I can see you going into this in the future... They need to hear it, whereas if I
were to write out all these comments, they won't even bother to read them sometimes. I think oral feedback is much better for them.

One of the biggest challenges ELLs have in a science class is vocabulary. Both participants agreed that higher-level science, especially Biology, is extremely language based. Megan notices that ELLs sometimes have the fear of being laughed at for mispronunciation. Megan uses modeling to explicitly teach vocabulary as a class. She teaches the meaning and pronunciation of words, and asks students to repeat them to learn the proper pronunciation. She thought that this is an advantage for her ESL class, since students have a “mutual understanding that everybody is learning the word and saying it for the first time”. Tania also stated:

The fact that they’re all grouped together, and they know that each person in that class is a newcomer, they relate to each other, and they help each other.

Although Megan and Tania’s ELL students come from different countries and speak different languages; they feel safe and comfortable in class. Megan and Tania demonstrate support for marginalized students by providing them options, giving effective feedback and reinforcement, as well as creating supportive learning communities.

**4.3 Conclusion**

**4.3.1 Differentiated Instructional Strategies.**

The findings of this study generally agree with the literature regarding differentiated instructional strategies used by secondary science teachers. Specifically targeting learning needs of English language learners (ELLs), both participants implement differentiated strategies to enhance delivery of content materials, promote students’ learning process, evaluate alternative learning products, and create positive classroom dynamics. Participants identified the barriers ELLs face in Canadian high schools, and modified their lessons accordingly.
There was a general consensus regarding the differentiated instructional strategies used by the participants in terms of facilitating content delivery and maintaining positive classroom dynamics. Common strategies used to promote ELL students’ understanding include varied reading level, emphasis on vocabularies, and integration of learning technologies. Both participants believe that the key to students’ success is the creation of a safe and inclusive learning environment. Strategies include modeling, promoting consistent equitable participation, and using effective classroom decorations.

Despite the similarities, the two participants take different approaches in enhancing ELL students’ learning processes in lab mastery. Both participants expressed their concerns regarding lab safety, while one spends extra time on briefing pre-lab preparations and equipping ELL students with scientific skills in an earlier age, the other prioritizes students’ readiness in terms of their language proficiency and chooses to perform demonstrations instead.

Recognizing the strengths and weaknesses of ELLs, both participants use multiple alternative assessment tools to evaluate students’ understanding and ability. These assessments include oral presentations, hands-on projects, class participations, and group activities. In respect to written assessments, both participants suggested teachers to simplify word questions by only using learned vocabularies.

In conclusion, the findings of this research act as a complementary addition to existing literature on differentiated instructional strategies in science classes, with a focus on making accommodations for ELLs.

4.3.2 Implementation of Critical Pedagogy.

Based on the participants’ responses, I described cultural and linguistic challenges English language learners face in secondary science classes, then I illustrated the ways both
participants implement students’ cultural background and identity in their classrooms. I also illustrated ways Ontario science teachers implement critical pedagogy in their lessons to meet special needs of ELLs. These strategies include the use of students’ mother tongue, facilitation of emancipatory literacy, support for multiculturalism, development of critical empowered agents, and advocacy for marginalized students. Overall, this section focused on integration of ELL students’ cultural identity and development as critical thinkers.

In agreement with existing literature on the use of students’ mother tongue in the classroom, both participants agreed that it is generally beneficial to ELLs’ learning. Common uses of mother language include translation purposes and promotion of communication with peers and parents. Despite these benefits, there were concerns regarding students’ overreliance on their mother tongue leading to a delay in acquisition of English. Both participants showed evidence of adequate use of students’ mother tongue in enhancing students’ learning, yet they still felt uncomfortable to use it for evaluations.

In order to develop Emancipatory Literacy, the participants suggested teachers design student-centered curriculum for students to share knowledge on personal experiences and cultural identities. They also suggested that teachers create inclusive communities that promote multicultural democracy. This includes exposure to multiple cultures and creation of opportunities to work and socialize with people with diverse backgrounds.

With respect to development of critical thinking skills in students, both participants frequently integrate STSE studies and real-life applications in their lessons. They promote reflective practice and foster ELL student’s decision-making skills. Participants also stressed teachers’ responsibility to advocate for marginalized students. They show their support for ELL
students by providing them with options, and giving effective feedback and reinforcement for improvement.

This study illustrates numerous examples of how the two Ontario science teachers integrate multiculturalism in their classrooms to develop critical thinkers and empower learners. This is particularly important in regards to ELL students’ construction of self-identity, development of critical thinking skills, and perception of an inclusive learning environment.

In Chapter Five, I will describe the implications of this study and make recommendations for future research in this area.
Chapter Five: Implications

5.0 Introduction

This chapter presents the implications of my study. I begin by providing a summary of the key findings, including the implementation of differentiated instruction and the use of critical pedagogy in secondary science class for English Language Learners (ELLs). I then describe the implications of the findings for the educational community and myself as an educator. Next, I list a few recommendations for science teachers and other readers in regards to teaching ELLs, and suggest areas for further research based on my findings. I conclude my chapter with some final thoughts about this research.

5.1 Overview of Key Findings

In this study, I interviewed two Ontario secondary science teachers for strategies they used to teach English Language Learners (ELLs). I emerged the findings into two main themes for analysis: (1) differentiated instructional strategies in secondary science for ELLs, and (2) implementation of critical pedagogy in science for ELLs. Both participants shared valuable strategies and examples they used to target ELLs’ learning needs and overcome challenges these students might have in secondary science classes.

Firstly, both participants successfully modified their lessons and assessments based on their students’ level of English proficiency, in terms of the four categories suggested by Tomlinson and Eidson (2003): content, process, products, and environment. Both participants enhanced the delivery of content materials by focusing on students’ development of vocabulary, varying reading levels of materials, and integrating learning technology in classrooms. Examples included creation of vocabulary lists, use of vocabulary in different contexts and scenarios, and use of interactive online response system to promote development of scientific literacy and
ensure proper fit for ELLs. In terms of promotion of ELLs’ learning process, both participants frequently implemented collaborative learning to foster a supportive learning community, where students with different strengths and learning styles complement one another. They also used strategies including repetition, extra time, and scaffolding. In respect to labs, one participant prioritized student-centered pedagogy, and spent more time with students on pre-lab preparation. The other participant preferred teacher-directed pedagogy, where she promoted ELLs’ scientific skills acquisition mostly by modeling and doing demonstrations. In order to accommodate for the delay in development of cognitive academic language proficiency, both participants suggested alternative summative and formative assessment tools to evaluate ELL students. They used tests, presentations, class participations, and hands-on projects to provide ELLs multiple opportunities to show their understanding of the materials. They also gave students evaluation options to reduce their anxiety. Additionally, both participants believed the key to students’ success was the creation of an inclusive learning environment. They built a positive environment and facilitated student engagement by modeling respect, ensuring availability of supplies, promoting consistent equitable participation, and using effective classroom decorations. By recognizing ELLs’ learning needs and challenges in secondary science classes, both participants modified their pedagogies and evaluating strategies to differentiate for these students in content, process, products, and learning environment. As an addition to existing literature on theories of differentiated instruction, findings of this study provided more practical examples of ways teachers can differentiate for ELLs, specifically for their strengths and needs, in science classes.

Secondly, both participants recognized the cultural and linguistic challenges ELLs faced in secondary science classes, and described ways to implement critical pedagogy in their lessons to promote critical thinking and integrate students’ cultural identity. I broke down these
SUPPORT ENGLISH LANGUAGE LEARNERS IN SCIENCE

strategies into five categories: the use of students’ mother tongue, facilitation of emancipatory literacy, support for multiculturalism, development of critical empowered agents, and advocacy for marginalized students. In spite of having concerns of over-dependence and delay in acquisition of the target language, both participants generally agreed with the benefits of using students’ mother tongue, which included increased understanding of learning materials and constructive dialogues among peers and parents. While they showed evidence of adequate use of students’ mother tongue to enhance ELLs’ learning, both participants experienced difficulty in ensuring equity in evaluating students and creating success criteria. On the other hand, both participants demonstrated their ability as culturally responsive teachers to promote multiculturalism and development of emancipatory literacy among students.

They created a multicultural democratic community for ELLs to share knowledge on personal experiences and cultural identities. Strategies included using a student-centered curriculum, exposure to multiple cultures, and strategic group arrangements to increase interaction between students with diverse backgrounds. Instead of merely focusing on the science curriculum, both participants frequently implemented social studies and cross-disciplinary studies to facilitate ELLs’ critical thinking and decision-making skills. They promoted students’ growth as critical empowered agents by frequently integrating Science, Technology, Society, and Environment (STSE) studies and real-life applications in their lessons. Additionally, both participants were strong advocates for marginalized students. They provided options, effective feedback and reinforcement, and created supportive learning communities for ELLs. These findings illustrate how two Ontario science teachers integrated critical pedagogy in their classroom to help ELLs with construction of self-identity and development of critical thinking skills.
5.2 Implications

This section describes the implications of the study on two levels. The first level is the broad level – the educational research community, and the second level is the narrow level – my personal professional identity and practice.

5.2.1 Broad: The Educational Research Community.

With a positive net migration into the country, Canadian schools and communities are becoming increasingly diverse. As reported by Statistics Canada (2011), there are more than 100 languages and 230 ethnic groups in Ontario. As a result, there has been an increase in the population of people who speak languages other than English in their home country or have no knowledge of the English language. According to the People for Education Annual Report on Ontario’s Publicly Funded Schools (2012), ELLs make up around 54% of Ontario’s publicly funded secondary schools. It is undeniably important for teachers in Ontario to recognize the great diversity and huge population of English Language Learners (ELLs) at schools, and make accommodations and modifications in their lessons and assessments for these students. In particular, it is compulsory for all students to complete the grade 9 and grade 10 science credits in order to obtain the Ontario Secondary School Diploma (OSSD) when they graduate. Therefore, it is in society’s great interest to study the challenges ELLs face in science classes, and explore ways secondary teachers target ELLs’ learning needs in their classrooms.

Throughout pre-service and in-service teacher trainings, educators are repeatedly introduced to differentiated instruction and critical pedagogy. Findings of this study provide educators in the community insights for the practicality of these theoretical frameworks in lived classrooms.
The findings are also useful towards multicultural education, as they show how these two teachers promoted students’ growth as critical-powered agents by embracing multiculturalism and constructing self-identity. This study provides educators with ideas to support multicultural democracy and advocate for marginalized students, including ELLs, in the classroom.

In this study, the participants experienced difficulty in ensuring equity and creating success criteria between their non-ELL and ELL students. Regardless of their personal preferences and qualifications, these participants were assigned to teach ESL designated science classes by their schools. Participants also showed evidence of making generalizations and stereotypes about ELLs despite rich experiences working with them. Therefore, this study raises the question of the necessity and availability of trainings and resources for teachers teaching ELLs in Ontario. Through understanding the teaching practices and teaching philosophies of these two teachers, readers may also further reflect upon what the existing teaching training programs lack for adequately equipping ESL teachers.

5.2.2 Narrow: My Professional Identity and Practice.

Being an English Language Learner (ELL), I am especially interested in this research topic. When I was in high school, I found myself being at a disadvantage compared to my English-speaking classmates. I was curious what teachers could do to help students like me to adjust to the Ontario high school environment. As a researcher in this study, I was able to better understand the struggles ELLs had in secondary science classes, and as a new teacher, I was able to learn from the teaching practices of my participants.

First, through the findings of this study, I recognized the challenges that other ELLs might also face in science classes. As I believe the first step of becoming an educator is to know the students well, so the results of this study are very useful for me as a teacher. Through the
study I have gained a better understanding of the cultural and linguistic barriers ELLs face in intermediate/senior science classes. I have also learned from the ways my participants targeted and tackled these barriers. I have realized how fortunate these students were to have teachers like my participants who cared about both their academics and mental well-being. This has given me insights regarding the importance of establishing my role as an educator not only to teach, but also to show genuine care for all students.

As a teacher, I have also recognized how I could make a big impact on students’ perception of schooling and learning by putting in an extra effort in lesson planning. For instance, there was a drastic increase in student engagement and performance when students worked on culturally relevant tasks in an inclusive learning environment, as well as when my participants designed a student-centered curriculum.

5.3 Recommendations and Areas for Further Research

When teachers have English Language Learners (ELLs) in their classes, I recommend teachers first spend time understanding the learning needs of their students before they go ahead to design and plan their classes. In particular, based on the findings of this study, I recommend teachers pay special attention to following three areas: acquisition of cognitive academic language proficiency (CALP), students’ home situation, and cultural dissonance.

Due to the language barrier, there is a delay in acquisition of cognitive academic language proficiency (CALP). Teachers should first focus on promoting ELLs’ development of vocabulary, and then progressively facilitate ELLs’ development of scientific literacy. These can be done by exposing students to the different uses of scientific vocabularies in multiple contexts, and by spending more time on pre-lab, debrief, and modeling of scientific skills.
Apart from helping students academically, teachers also should show genuine care to their ELL students about their home life. Some ELLs may live in homestays where they lack family support, or may even have arrived in Canada as a result of a war or other crisis in their home country. Teachers should pay more attention to ELL students’ struggles outside of the classroom and refer students to other school professionals such as the school counselor if needed.

It is also important for teachers to recognize the presence of cultural dissonance for ELLs. Teachers should support multiculturalism in the classroom by building an inclusive environment. Teachers should design a student-centred curriculum, which could provide opportunities for students to share their personal experiences and cultural knowledge in tasks. This helps ELLs in construction of self-identity and development of a sense of belonging.

On the other hand, there are areas for further research that are relevant to this study. Five key questions arose in this study as follows:

1. It is recommended that teachers differentiate for students according to their special needs.

   In this study, both participants frequently modified their pedagogies and assessments to accommodate for students’ lower English proficiency and cultural dissonance. In particular, both participants had different success criteria for their regular and ESL classes respectively. However, when I asked them under what standards or ground rules they created these rubrics, both participants became very hesitant and failed to explain themselves. Without proper teacher trainings or guidelines, how do teachers ensure equity in assessments amongst ELLs and students who are fluent in English?

2. In this study, both participants showed adequate use of students’ mother tongue to enhance student learning. These included the use of translation and communication
purposes. Despite the benefits, to what extent should teachers allow students to use their mother tongue in participation? In assignment? In assessment?

3. Teachers without an additional qualification in teaching English as Second Language (ESL) are sometimes assigned to teach ESL subject classes. Are these teachers equipped with specific skills to teach ELLs? If not, why is it acceptable for schools to assign those teachers ESL classes? Are there sufficient professional development trainings or resources available for these teachers?

4. Numerous studies have shown benefits of differentiated grouping arrangements as they promote collaborative learning among peers with similar needs. Grade 9 and Grade 10 ESL science classes are currently provided in only several Ontario high schools. What are the benefits and drawbacks of putting ELLs into ESL science classes, as opposed to sending them to mainstream science classes? Should more schools offer ESL subject classes?

5. Similarly, Ontario only offers ESL subject classes up to grade 10. Should the Ministry of Education in Ontario offer ESL biology/chemistry/physics classes in grade 11 and grade 12 as well to provide ELLs more future study options and attract them to go into the science field?

5.4 Concluding Comments

In this research, I studied how two Ontario science teachers used differentiated instruction and critical pedagogy to accommodate for English Language Learners (ELLs) in their classes. Both participants developed their own strategies over years of experience teaching and understanding challenges ELLs faced inside and outside of the classroom. Corresponding to existing literature, the two participants reported differentiating their lessons and assessments
based on the main categories in differentiated instruction: content, process, products, and learning environment (Tomlinson & Eidson, 2003). Both participants also showed proficiency in integrating technology such as the Internet, simulations, and online response systems in their classrooms. Furthermore, as strong advocates for marginalized students, both participants increased student engagement and performance by supporting multiculturalism and facilitating development of emancipatory literacy. They showed evidence of being culturally responsive teachers by frequently implementing students’ cultural identity and personal experiences into their lessons. To conclude, despite the fact that ELLs are not considered part of the special education program, it is important for teachers to recognize the specific learning needs of ELLs and to modify their lessons and make accommodations for them accordingly.
Appendix A: Letter of Consent

Date:__________________

Dear ___________________,

My Name is Wing Hei Grace Chan and I am a student in the Master of Teaching program at the Ontario Institute for Studies in Education at the University of Toronto (OISE/UT). A component of this degree program involves conducting a small-scale qualitative research study. My research will focus on the strategies used by secondary Science teachers use to teach English Language Learners (ELL). I am interested in interviewing teachers who are familiar with differentiated instructions and have experience teaching ELL students any science subject(s) in an Ontario high school. I think that your knowledge and experience will provide insights into this topic.

Your participation in this research will involve one 45-60 minute interview, which will be transcribed and audio-recorded. I would be grateful if you would allow me to interview you at a place and time convenient for you, outside of school time. The contents of this interview will be used for my research project, which will include a final paper, as well as informal presentations to my classmates and/or potentially at a research conference or publication. You will be assigned a pseudonym to maintain your anonymity and I will not use your name or any other content that might identify you in my written work, oral presentations, or publications. This information will remain confidential. This data will be stored on my password-protected computer and the only people who will have access to the research data will be my instructor Dr. Arlo Kempf. You are free to change your mind about your participation at any time, and to withdraw even after you have consented to participate. You may also choose to decline to answer any specific question. I will destroy the audio recording after the paper has been presented and/or published, which may take up to a maximum of five years after the data has been collected. There are no known risks or benefits to participation.

Please sign this consent form, if you agree to be interviewed. The second copy is for your records. I am very grateful for your participation.

Sincerely,

Wing Hei Grace Chan
(226) 972 8623
whg.chan@mail.utoronto.ca

Instructor’s Name: Dr. Arlo Kempf
Contact Info: arlo.kempf@utoronto.ca
Consent Form
I acknowledge that the topic of this interview has been explained to me and that any questions that I have asked have been answered to my satisfaction. I understand that I can withdraw from this research study at any time without penalty.

I have read the letter provided to me by Wing Hei Grace Chan and agree to participate in an interview for the purposes described. I agree to have the interview audio-recorded.

Signature: ________________________________________

Name: (printed) _______________________________________________

Date: ______________________________________
Appendix B: Interview Questions

Section 1: Background Information

1. a) What is your name?
   b) What subject(s) do you teach? What grade(s)?
   c) Where do you teach?
   d) Is English your first language? What other language(s) do you speak?
   e) How many years have you worked with English Language Learners in class?

2. a) Do you have an Additional Qualification to teach English as a Second Language?
   b) If not, have you received any kind of training for teaching ELL students? Please explain.

3. In your class, what is the ratio of ELLs to non-ELLS?

4. a) From your experience working as a teacher, have you noticed a difference in the level of interest in class between native English speakers and ELLs?
   b) Why do you think there is a difference?

5. From your experience working as a teacher, have you noticed a difference in the level of performance in class between native English speakers and ELLs?

6. What do you think are the challenges and barriers for ELLs in your class?

Section 2: Teacher Practices (What/How?)

7. a) To what extent do you incorporate Differentiated Instructions in your lessons for ELL?
   b) Can you explain how you use DI in your class in terms of teaching content?
   c) Can you explain how you use DI in your class in terms of fostering scientific skills development?
d) Can you explain how you use DI in your class in terms of promoting engagement and participation?

e) Can you explain how you use DI in your class in terms of constructing students’ learning environment?

8. a) What benefits do you see in using differentiated instructions in your class? How so?

b) What drawbacks do you see?

9. a) Can you give me some specific examples from your practice that you feel have been successful, in terms of using critical pedagogy in classroom, that have promoted ELL’s engagement in science?

b) What is the evidence of improvement in engagement?

c) Why do you think students respond positively to such practices?

d) Does this strategy work with most ELL students or just a specific individual or group of students?

10. a) What types of assessments and evaluations do you use for your ELL Science students?

b) How considerations do you have when you create your assessments?

c) What other abilities are being evaluated and addressed?

d) How do you ensure these assessments are fair?

e) How do native English speakers in your classroom respond to your accommodations made?

11. a) Do you have experience where a certain strategy works perfectly for one group of ELL students, while works poorly with another?

b) What do you think the reason is?

12. a) What other strategies have you used to teach science to ELL?
b) What benefits do you see?

c) What drawbacks do you see?

Section 3: Beliefs/Values (Why?)

13. What do you think are the most important considerations teachers should take while teaching Science to ELL students?

14. a) In what ways do you think using critical pedagogy in the class affect your relationship with the ELL students?

b) In what ways does this relationship affect students’ behaviors in class?

c) In what ways does this affect students’ performance in class?

15. In what ways do you think using differentiated instruction affect ELL student’s confidence to succeed in class?

16. a) Do you have a preference working with native English speakers or ELL students? Why?

b) Have your preference changed over time? Why?

17. Do you believe that English language learners benefit more when they are scattered in a regular science class, or are grouped and isolated as an “ELL” Science class?

Section 4: Influencing Factors

18. Have you faced any obstacles or challenges when using differentiated instructions in your teaching?

19. a) Do you think you are provided with enough resources or trainings to teach ELL students?

b) What resources do you use?

c) If not, what kind of support or resources are you hoping to get?
20. a) What kind of feedback have you had from i) students ii) people outside the classroom regarding your practice of using differentiated instructions in the classroom?

b) Did it influence your practice? If so, how?

Section 5: Next steps (What next?)

21. a) To what extent, if any, do you think students avoid choosing Sciences in their senior years due to their English proficiency?

b) What are your suggestions for schools to promote students’ interest in Sciences despite of the challenge in language?

22. What advice would you give to a beginning teacher teaching ELLs in a Science class?
References


