EXAMINING THE PERSPECTIVES AND PRACTICES OF HIGH SCHOOL SCIENCE TEACHERS ON INCLUSIVE PEDAGOGY

by

© Simon Adu-Boateng

A thesis submitted to the School of Graduate Studies

in partial fulfillment of the requirements for the degree of

Master of Education

Faculty of Education

Memorial University of Newfoundland

May 2019

St. John's Newfoundland and Labrador

Abstract

This study examined the perspectives and practices of high school science teachers on inclusive pedagogy. The study also sought to elicit teachers' views on the challenges they encounter in the classroom. Previous studies on inclusion have focused on pre-service teachers, elementary, and middle school teachers' attitudes and perceptions toward inclusion, leaving a gap on the perspectives of high school science teachers on inclusion and how they adopt inclusionary practices to make the science curriculum accessible to students. This study attempted to fill this gap by addressing three essential research questions: (a) what are high school science teachers' conceptions of inclusive pedagogy? (b) how do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diversity in their classrooms? and (c) what specific inclusive pedagogical strategies do high school science teachers use to respond to the diverse learning needs of students?

This study was carried out in the Avalon region of the English School District of Newfoundland and Labrador using a qualitative case study methodology. Data were gathered from four experienced high school science teachers who were sampled purposefully from three different high schools during the fall 2017 and winter 2018 semesters. To gain a more in-depth insight into participants' perspectives of inclusion and their instructional practices, data were gathered using semi-structured interviews, classroom observations, and document analysis. The data were then coded and analyzed qualitatively using MAXQDA software.

Six overarching themes emerged from the study: (1) science teachers hold multiple conceptions about inclusion, (2) science teachers' perspectives and practices of inclusion are influenced by classroom experiences, (3) collaboration is essential when planning instructions for learners in inclusive settings, (4) several factors influence the science teachers' selection of

instructional strategies, (5) science teachers implement multiple instructional strategies to represent information, engage students, and enable students to express their knowledge and what they have learned, and (6) science teachers encounter several barriers in creating inclusive classrooms.

The recommendations in the final chapter of this qualitative case study may be a valuable source of information for addressing many of the concerns identified by the participants and provide avenues for future studies to enhance teacher education and teaching science to diverse learners in inclusive environments.

Acknowledgement

With a sincere appreciation, I would like to express my profound gratitude to all those who helped and supported me in the preparation of this thesis. First, to Dr. Karen Goodnough, my thesis supervisor, for her incredible patience, guidance, and support. Without her help and positive feedback this thesis would not have been possible. Her sincere advice and guidance helped me to learn the process of doing research and to overcome many of the challenges I encountered in the course of undertaking this project. Dr. Goodnough, thank you for providing me with such a strong foundation in academic research. I would also want to thank Dr. Azam Saiqa for her genuine advice, encouragement, and the opportunity to work with her on several research projects as a graduate and research assistant. Dr. Azam, I am grateful to you.

My humble thanks to my sponsors, Rotary District 7820, for believing in me and providing me with a means of achieving my goal when all hope was lost. Your support for me is invaluable. I would also like to extend a special thank you to Mr. Greg Coldwell, Jillian, Mike, and all Rotarians of Rotary Club of St. John's Northwest. I am indebted to you all. Moreover, to my friend Greg and wife Ellen, thank you for your kindness, love, and support. Greg, I am forever grateful to you for being there as a friend and providing me with a listening ear. You made life more comfortable and made me feel at home.

I also would like to extend special gratitude to the English School District, principals of the high schools in this study, and the teacher respondents for their cooperation and valuable time.

Special thanks to my family and in-laws for their prayers, support, and encouragement.

Finally, I would like to dedicate this thesis to my beloved wife, Sylvia, for her patience, support, and prayers. She has made countless sacrifices and has been a pillar behind me in achieving this goal.

Table of Contents

LIST OF TABLES

Chapter 1

Introduction to the Study

1.1 Background

Research evidence suggests that more children in Canada with special education needs are being taught by teachers in the same classroom with their peers without disabilities (Andrews & Lupart, 1999; Beaudoin & Mendes, 1996; Specht, 2016). Educating children together in an inclusive environment has been shown to benefit students with disabilities and non-disabled students (Katz, 2012; Katz & Sugden, 2013; McGhie-Richmond, 2010). Although inclusive education was previously conceptualized within the framework of placement of children with disabilities in mainstream classrooms (Ballard, 2000), the philosophy of inclusion has been taken a step higher in recent literature beyond the mere placement of children with disabilities in inclusive schools. The United Nations Educational, Scientific and Cultural Organization (UNESCO), for instance, provides a more comprehensive definition of inclusive education as reforming educational systems and providing equal opportunities to enable all children "including boys and girls, students from ethnic and linguistic minorities, rural populations, those affected by HIV and AIDS, and those with disabilities and difficulties in learning" to learn and socialize together in the same classroom (UNESCO, 2009, p. 4). Thus, the principle of inclusion revolves around the creation of an educational system where there is equity in the provision of services and instructions to enable all children, with and without disabilities, to gain equal access and treatment to quality education in an environment where diversity is respected and valued.

Reports indicate that diversity in Canadian communities is increasingly growing (Katz, 2012; Porter, 2004, 2008). For instance, available data from Statistics Canada (2005) shows that "one out of every five people in Canada, or between 19% and 23%" of the Canadian population

was estimated to be members of visible minorities as of 2017 (Statistics Canada., 2005, n.p). Although these developments reflect the unique identity of Canada as a nation that respects and celebrates diversity (Porter, 2008), it places enormous responsibilities on general education teachers to equip themselves with the necessary skills and knowledge to respond to the diverse learning needs of students in public schools.

It is accepted that the increasing growth in diversity necessitates an educational system that embraces and promotes the philosophy of inclusivity (Porter, 2004). Fuelled by the United Nation's declaration for *Education for All*, the 1994 Salamanca Statement in Spain (Inter-Agency Commission, 1990; UNESCO, 1994), and the *Science for All* movement across America (Rutherford & Ahlgren, 1991), various governments and departments of education globally have reformed their educational systems to reflect the ideals of inclusion in order to account for the multiplicity of needs in the K-12 classroom (Beaudoin, 2013; Gayle, 2013; Gilroy, 2005).

Since then, researchers have written extensively about inclusive education, highlighting its benefits and challenges. For example, studies have shown that inclusive education promotes the academic success of every student regardless of the student's abilities or background experiences (Katz, 2012; Stefanich, 2001a). Compared to some special education system which may confine children with special needs in separate classrooms, inclusive education allows such children to be educated in the same classrooms with their peers without disabilities, an opportunity that positively impacts their learning and social development (Baurhoo & Asghar, 2014; Katz, 2012; Salend & Duhaney, 1999). In fact, literature indicates that children with special needs in inclusive classrooms certainly have an advantage over their peers in specialized institutions in terms of literacy and numeracy skills, achievement on standardized tests, college entrance rates,

and participation of various domains of learning and other social activities (Katz & Sugden, 2013; Jordan, Glenn, & McGhie-Richmond, 2010).

Notwithstanding research attesting to the many benefits of inclusion, several studies have highlighted genuine concerns and challenges in education in recent times in the areas of implementation and workability of the inclusive education model (Sokal & Katz, 2015; Sposaro & Lensink, 1998; Tan, 2015). Central to the challenges are concerns raised by teachers, parents, and students that the policy of inclusion as currently configured in many schools is not working (Katz, 2013; Sheppard & Anderson, 2016). More importantly, many general education teachers feel that they lack the expertise, skills, knowledge, and the ability to teach children with special needs in inclusive environments (Katz & Sugden, 2013; Spech et al., 2016). Thus, the teachers' role and their preparedness in the classroom become critical if inclusion is to be successful and the curriculum made accessible to all children in inclusive schools.

When considering science education, the research findings above are more troubling. Studies indicate that a lack of pedagogical efficacy among science teachers affects the majority of underrepresented groups including children with exceptionalities and other minority groups from enrolling in Science, Technology, Engineering, and Mathematics (STEM) related programs (Cunha, 2011; Moon, Todd, Morton, & Ivey, 2012).

Consistent with the primary goal of science education in North America, the National Science Education Standards emphasize that science should be accessible to all students regardless of their background or abilities (National Research Council, 1996). Similar calls have been reported by Baurhoo and Asghar (2014) that science teachers across North America are expected to equip students with the literacy skills that enable them to become lifelong science learners. In light of this, Canadian science teachers are encouraged to adopt inclusive teaching practices that

create learning opportunities for all students to succeed (Goodnough, 2010; Newfoundland and Labrador Department of Education and Early Childhood Development, 2017; Roth & Lee, 2004).

Underpinning the above calls is the report that students with special needs record low achievement in science across North America (Baurhoo & Asghar, 2014). Studies have attributed low achievement and participation in science to teachers' lack of necessary experiences, skills, and the training to make the science curriculum accessible to diverse students in inclusive environments (Kavale, 2004; Mumba, Banda, & Chabalengula, 2015; Stefanic, 2001, 2001b). With provincial and territorial governments' quests to improve education by making it inclusive and accessible to all, it is imperative for educational research to focus on exploring teachers' perspectives and practices of teaching science to diverse learners in inclusive classrooms.

1.2 Statement of Purpose and Research Question

Following the World Declaration on Education for All (Inter-Agency Commission, 1990) and the subsequent adoption of the Salamanca Statement and Framework for Action on Special Education in 1994 (UNESCO, 1994), many countries have enacted legislation and policy frameworks that promote equity in the provision of quality education for all children. For example, in the United States, there are several legislations passed by Congress which enjoin each state to educate children with disabilities in a regular classroom together with their non-disabled peers except on condition that the severity of their disabilities requires additional services that are unavailable in the regular classroom. These legislations include the Education for All Handicapped Children Act (Public Law 94-142) passed by Congress in 1975 and later amended to the Individuals with Disabilities Act in 1997, the No Child Left Behind Act in 2002, and most recently, the Every Student Succeeds Act signed by President Obama in 2015 (Lipsky, D. K., & Gartner,

A, 1997; Smith, Polloway, Patton, & Dowdy, 2009; Lipsky & Gartner, 1997; U. S. Department of Education, 2002, 2008, 2017).

Similarly, in England, the *Green Paper on Special Educational Needs and Disability*, which aims at removing the biases toward inclusive education, seeks to improve the range and diversity of schools from which parents and families of children with special education needs can make a choice. Part of the *Green Paper* provides parents with the autonomy to decide where to educate their children with special needs, either in a mainstream or special school (Department of Education, 2011). Moreover, the Children and Family Act passed by the British parliament in 2014 makes provision for a child or a young person with a special need to be educated or trained in mainstream schools in England or places in England where appropriate early years education is provided (Department of Education, 2015).

In the Canadian context, such provisions are enshrined in the 1985 *Charter of Rights and Freedoms*. The *Charter* guarantees that all persons in Canada must be treated equally, regardless of race, national or ethnic origin, colour, religion, gender, mental or physical disability (Beaudoin & Mendes, 1996). To this end, all educational policies at provincial and territorial jurisdictions in Canada are constitutionally mandated to abide by the provision in the *Charter* (Smith et al., 2009). Accordingly, "proponents of inclusive education [in Canada] believe that students with exceptionalities, regardless of severity, should be included in the regular classroom" (Smith et al., 2009, p. 3). It is therefore not surprising that out of the estimated 9% to 15% of students in Canada identified with special education needs (Specht et al., 2016), over 80% of them "spend at least 50% of their day in regular classrooms" (Specht, 2016, p. 2). The implication is that more children with exceptionalities such as learning disabilities, visual and hearing impairment, and autism, who

hitherto received their education in special education classrooms, are now learning science from general education teachers together with their peers without special needs in the same classroom.

While the inclusion of children with exceptionalities in the general education science classroom aligns with the recommendation by the National Science Education Standards of making science accessible to all students, it creates a challenge and extra work on teachers by increasing the demands and expectations on them to adopt and implement teaching practices that meet their new roles and responsibilities. Steele (2007) asserted that science requires complex cognitive skills such as problem-solving, critical thinking, evaluating, analyzing, interpreting data, and high-level thinking. Teaching it to diverse students requires a multifaceted teaching approach. Similarly, Brigham, Scruggs, and Mastropieri (2011) maintained that it is particularly challenging for science teachers in inclusive classrooms to meet the learning expectations of students with learning disabilities as a result of characteristics such as deficit in memory and recall of information, low-level reading and writing skills, language difficulties, and organizational problems associated with learning disabilities. This situation may affect the performance of such students in the classroom.

Consistent with these findings, Grumbine and Alden (2006) noted that the scores of K-12 students with special education needs on science achievement tests are almost one standard deviation lower compared to their peers without disabilities. Research indicates that such students require extra support from teachers in order to overcome the complex vocabularies and the theoretical nature of scientific concepts and processes (Marino, 2010). At the high school level, the majority of students with special needs underachieve in science if the needed help and support are not provided (Kirch, Bargerhuff, Turner, & Wheatly, 2005).

Despite the findings above, extensive research shows that all children can develop

scientific literacy (Grumbine & Alden, 2006; Haskell, 2000; Mujawamariya, Hujaleh, & Lima-Kerckhoff, 2014; Stefanich, 2001b). Moreover, evidence shows that "students with disabilities in inclusive settings learn as well as or better than they do in segregated settings while enjoying opportunities for social interactions that they do not have in segregated settings" (Smith, Polloway, Patton, & Dowdy, 2004, p. 34). Consequently, the National Research Council (1996) recommends that "science in our schools must be for all students: all students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain high levels of scientific literacy" (p. 19). This recommendation aligns with the Science Council Canada's (1984) position that

> for Canada to cope with social changes rooted in highly specialized technologies, its citizens need the best general education possible: - an education comprising not only the traditional basics of language and mathematics, but also the *new* basics of our contemporary culture: science and technology. (Science Council of Canada, 1984, p. 9)

The push for science for all, therefore, requires that K-12 science teachers should have the expertise to plan and differentiate their instructions to fit the differing abilities, interests, background experiences, skills, and knowledge of students they teach.

Unfortunately, reports in recent times indicate that teachers in inclusive science classrooms lack training, knowledge, and the pedagogical skills to teach science to students with special needs (Baurhoo & Asghar, 2014; Cunha, 2011; Mastropieri et al., 2006; Norman, Caseau, & Stefanich, 1998). A review of the literature showed that "both practicing science teachers and science teachers-in-training … believe that they are inadequately prepared to make appropriate instructional adjustments for students with disabilities" (Brigham, Scruggs, & Mastropieri, 2011, p. 224). Similar reports have been made by international studies that suggested that science

teachers in inclusive classrooms feel that they lack the pedagogical efficacy to confidently work with students with special needs (Horne & Timmons, 2009; McGinnis & Stefanich, 2007; Peterson, 2011; Specht et al., 2016). It is therefore not surprising that many science teachers still rely on the traditional teaching approaches which are known to be ineffective to address the diverse learning needs of students in inclusive environments (Stefanich, 2001; Tomlinson & Imbeau, 2010).

Meanwhile, a recent study by Collins and colleagues (2017), which reviewed the status of the K-12 education system in Newfoundland and Labrador (NL) highlighted several challenges within the inclusion model. As reported in the study, parents and teachers felt that "all students [in the province], not just those with exceptionalities, are being under-served with the current model of inclusive education" (p. 11). Similarly, Shepherd and Anderson (2016) reported that the most significant concern of teachers in NL is their inability to meet the learning needs of diverse students in inclusive classrooms. Despite the provincial government's support and interventions toward inclusion, teachers in the province perceive the current status of inclusion to be unworkable. This finding supports similar reports that Canadian teachers in inclusive classrooms face many challenges and struggle to address the learning needs of diverse learners (Baurhoo & Asghar, 2014; Campbell et al., 2016).

It is one thing to include all students in an inclusive classroom, but it remains another thing to respond to their learning needs equitably. Their ability to succeed depends on teachers' instructional practices and strategies (King-Sears, 1997; Peterson, 2011; Sharma & Sokal, 2015; Steele, 2007; Wade, 2000). In an effort to address the challenges faced by teachers in inclusive classrooms, there have been extensive studies that document successful research-based instructional approaches effective for addressing the diverse needs of students in the classroom

(Katz, 2012, 2013; Katz & Sugden, 2013; Smith et al., 2009; Stefanich, 2001; Tomlinson & Imbeau, 2010; Steele, 2007). Indeed, although there have been extensive studies about research-based instructional approaches that facilitate diverse student learning, a gap still exists between what research says and what teachers practice or implement in their classrooms (Fyssa, Vlachou, & Avramidis, 2014; Mitchell, 2014). Moreover, studies about how high school science teachers use inclusionary practices to meet the needs of all learners in an inclusive environment remain scant. As observed by Papadouris, Hadjigeorgiou, and Constantinou (2015), very few studies exist with regards to teaching science to students with special needs in inclusive settings. The current study seeks to respond to this gap by exploring high school science teachers' perspectives of inclusive pedagogy and how they adopt inclusive practices to design their lessons to make the science curriculum accessible to all students.

1.3 Research Questions

The purpose of this study is to examine the perspectives of high school science teachers about inclusive pedagogy and provide insights into both the successes and tensions teachers encounter when adopting inclusive pedagogy to meet the needs of all students in inclusive classrooms. The following research questions guided the study:

1. What are high school science teachers' conceptions of inclusive pedagogy?
2. How do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diversity in their classrooms?
3. What specific inclusive pedagogical strategies do high school science teachers use to respond to the diverse learning needs of students?

Chapter 2

Literature Review

Introduction

This chapter examines prominent literature on inclusive education. The purpose is to ground the study within the framework of existing literature on the perspectives and practices of inclusive education. The first section of the chapter reviews the history of inclusive education in the Canadian context. The next section focuses on exploring the varied conceptualizations of inclusive education within academic research and provincial and territorial ministries of education in Canada. The chapter also examines the conceptions of inclusion in the context of other international jurisdictions such as the US and New Zealand's departments of education. The general understanding of teachers regarding inclusive education, the concept of inclusive pedagogy, and the theoretical framework underpinning the current study are also discussed.

2.1 Evolution of Inclusive Education in the Canadian Context

The adoption of the World Declaration of Education for All (EFA) movement by the United Nations in Jomtien, Thailand, marked the beginning of a global movement towards equity and quality education for all children (UNESCO, 2000, 2009). The overall vision of this initiative aimed at "universalizing access to education for all children, youth and adults, and promoting equity" (UNESCO, 2009, p. 8). Thus, under the framework of Education for All, all students should belong, interact, and learn together as a community in their neighbourhood schools without experiencing any form of discrimination or segregation (Erten & Savage, 2012).

In the past, public education was exclusively reserved for the elites including children considered to be superior in terms of abilities or qualities and those who could learn without difficulty. As such, until the 19th century, many children in Canada were denied access to public

education (Andrews & Lupart, 2000; Millet, 2004). Unlike the present-day Canadian society, where diversity and differences are celebrated as positive features (and a source for learning opportunities in the classroom), the past educational system excluded children with developmental disabilities such as physical disabilities, behavioural disorders, visual and/or hearing impairments, and mental disabilities from accessing public education (Porter, 2008). As reported by Porter and Richler (1991), such children were considered socially unfit to be integrated into the regular education classroom. Any available education or training for them was typically provided in separate institutions alongside other marginalized children such as the poor, orphaned, or vagrant (Lupart & Webber, 2012).

Since the pre-Confederation period, this practice of allowing persons with disabilities to live and learn separately away from their families and peers was considered an acceptable norm within Canadian society. Despite the apparent discrimination and alienation associated with the practice, little was done until the end of World War I, when society began to question the rationale behind this system. Advocacy groups and human rights movements pushed for a new educational system that would prepare children with disabilities to be well integrated into Canadian society (Friend, Hutchinson, & Bursuck, 1998). According to Lupart and Webber (2012), these activists raised concerns about the widespread exclusion of persons with disabilities while criticizing the curriculum as appropriate for only the brightest students.

Therefore, by the mid-1920s, the special classes or schools previously run by advocacy groups and churches within the communities were eventually incorporated into the Canadian public education system amidst its associated challenges. Several other residential schools were established to expand the provision of specialized services for children with disabilities such as the hearing and visually impaired (Andrews & Lupart, 2000; Friend, Hutchinson, & Bursuck,

1998). The training of teachers commenced providing professional services, support, and assistance to these schools. Previously, teaching and management of special schools were primarily done by volunteers or non-professional teachers due to the lack of special education teachers and provincial government funding (Philpott, 2007: Philpott & Dibbon, 2008; Porter & Richler, 1991).

Meanwhile, following the adoption of special schools in the public education system, children with disabilities or special needs continued to receive services under isolated and segregated conditions. Although the assertion was that they would be better served in the separate special classes because of the reduced teacher-pupil ratio, those classes often became a dumping ground rather than providing these students with the special attention and care they needed (Andrews & Lupart, 2000). As such, progressive reformers continued to lobby actively for the full integration of children with disabilities in regular classrooms (Millet, 2004; Porter & Richler, 1991). For instance, in the 1950s and 1960s, parents and educators' organizations such as the Canadian Association for the Mentally Retarded and the Canadian Association for Children with Learning Disabilities were formed. These movements pushed for improvements in services for students with disabilities, which led to the implementation of the testing and identification of exceptional learners by provincial departments of education (Friend, Bursuck & Hutchinson, 1998).

Further, Philpott and Dibbon (2008) emphasized that the landmark case of *Brown vs. Board of Education* in the United States in 1954 made a significant impact on the provision of education for persons with disabilities across North America. This case established that segregating children with disabilities from their non-disabled peers in the general education classroom was discriminatory. This eventually led to the desegregation of schools and a push for the right to

education for other minority groups in the United States and Canada. This era marked a paradigm shift of disability services from a deficit-based medical model toward a more positive perspective that valued diversity.

According to Lupart and Webber (2012), the launch of the first artificial satellite into orbit by the Soviet Union in 1957 also popularized science, mathematics, and special education in the 1960s across North America. As pointed out by Lupart and Webber (2012), there was "a new appreciation for the educational nurturing of gifted students …[which] gave impetus to the development and expansion of separate and specialized programs from the 1960s on" (p. 14). During this period, society cultivated a new sense of hope and support for public education because they recognized education as the most effective means of addressing societal problems. Consequently, new educational reforms that defined students by categories of exceptionality and assessment criteria were developed by provincial education departments and school boards. At the same time, initiatives by some of the provinces and territories assumed responsibility for providing funding for the education of children with exceptional needs. These initiatives, according to Andrews and Lupart (2000), resulted in a five-step special education approach: referral, testing, labelling, placement, and programming for responding to students' needs. However, educational reforms, as argued by Lupart and Webber (2012), will remain an incomplete, ongoing process as societies and people continue to evolve. It is therefore not surprising that the use of testing to label students with exceptional needs also received similar opposition as the earlier interventions and reforms (Andrews & Lupart, 2000).

Consequently, as Canadian society began to recognize the deficits and debilitating effects associated with the categorization of students, the *One Million Children* commission was set up by the Commission of Educational and Learning Disorders in Children in 1966 to address these

challenges. The *One Million Children* report called for the elimination of labels and categorizations (Andrews & Lupart, 2000; Philpott, 2007; Philpott & Dibbon, 2008; Smith et al., 2009). As Towle (2015) emphasized, the authors of the report argued that "a child with a disability should be treated as a whole person, not fragmented by labels and diagnoses" (p. 7). Thus, rather than providing services for children based on labels and categorizations, the report called for the use of integration and instruction based on individual learning characteristics.

Ultimately, Canada adopted the normalization principle in the 1970s with a focus on integration and mainstreaming. This principle was influenced by a combination of factors including the recommendations from the *One Million Children* report and Wolfensberger's work at the National Institute of Mental Retardation in Toronto (Andrews & Lupart, 2000; Friend, Hutchinson, & Bursuck, 1998; Smith et al., 2009). Also, the enactment of the U.S. federal law on special education that mandated that children with disabilities must be educated in the Least Restrictive Environment (LRE) further gave impetus to the principle of normalization across North America (Friend, Bursuck & Hutchison, 1998). As highlighted by Lipsky and Gartner (1997), the United States' Congress embraced the Least Restrictive Environment principle because they acknowledged that education remains the most effective socializing institution for all children. Integrating children with disabilities in regular classrooms was therefore seen as the best alternative for fostering social interactions among students with disabilities and their non-disabled peers.

Three central educational concepts contained in the *One Million Children* report remain essential to the future discourse of the service delivery model (Philpott & Dibbon, 2008):

1. Every child has the right to the education required to realize his or her full potential;

2. The financing of education for all students is the responsibility of the educational authorities;
3. Students with exceptional learning needs should remain integrated with other students as long as possible (Andrews & Lupart, 2000. p.35).

According to Smith et al. (2009), the adoption of the principle of normalization significantly changed the face of education for persons with disabilities in Canada. This was a period in which many students with disabilities who had hitherto been institutionalized away from their family returned to their communities.

However, despite the implementation of the normalization principle, most school boards and provincial and territorial governments across Canada continued with the categorization system for students with exceptional learning needs. This resulted in a dual system of public education: regular and special education. As such, there was continuous pressure on educational authorities to ensure the full integration of all children into the regular classroom (Andrews & Lupart, 2000).

Accordingly, new reforms were instituted because the normalization principle could not provide the tools needed for removing the barriers to inclusion in the mainstream (Porter & Richler, 1991). Canada eventually adopted the inclusive education concept in the 1980s with an emphasis on educating students with disabilities in the same classroom with their non-disabled peers (Smith et al., 2009).

Of great significance was the *Constitution Act* of 1982, which provided the right to an education to all children with disabilities in the *Canadian Charter of Rights and Freedoms*, which came into effect in 1985. This *Charter* was a significant stimulus toward Canada's commitment to providing equity for all citizens devoid of any facet of discrimination (Andrews & Lupart, 2000; Friend, Hutchinson, & Bursuck, 1998; Smith et al., 2009; Smith & Foster, 1996; Sokal & Katz,

2015; Towle, 2015). Specifically, section 15. (1) of the *Charter of Rights and Freedoms* states that: "every individual is equal before and under the law and has the right to equal protection of the laws without discrimination based on race, national or ethnic origin, colour, religion, sex, age, or mental or physical disability" (Smith & Foster, 1996, p. 3).

Unlike Canada, other countries such as the United States (see Lipsky & Gartner, 1997) and the United Kingdom (see Beaton & Black-Hawkins, 2014; Runswick-Cole, 2011) have legislative instruments that exclusively make such provisions for students with disabilities. This has given Canada a reputation as a nation that accepts and celebrates diversity as a positive feature (Porter, 2004).

In addition to the *Canadian Charter of Rights and Freedoms*, several pieces of international legislation and policies served as guides toward the adoption of inclusive education in Canadian public schools (Katz, 2012; Loreman, 2014; Rieser, 2012; Towle, 2015). For example, the 1994 Salamanca World Conference on Special Needs Education held in Spain gave the impetus to move toward inclusive education. The Conference, of which Canada was a signatory, declared that:

> Regular schools with [an] inclusive orientation are the most effective means of combating discriminatory attitudes, creating welcoming communities, building an inclusive society and achieving education for all; moreover, they provide an effective education to the majority of children and improve the efficiency and ultimately the cost-effectiveness of the entire education system. (UNESCO, 1994, p. ix)

Also, Article 24 of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), of which Canada is a member, enjoins State Parties (i.e. countries which have adhered to the *World Heritage Convention*) to provide an education system that ensures life-long learning aimed at the full development of human potential, sense of dignity, fundamental freedoms, and

human diversity (Rieser, 2012). Furthermore, Canada accepted Article 26 of the Universal Declaration of Human Rights. Article 26, among other things, guarantees children the right to free education, at least during the elementary and fundamental stages (MacKay, 1984). Through this declaration, education unambiguously becomes a right which must be extended to every individual, including persons with or without disabilities or special learning needs (Porter, 2008).

It should be noted that the adoption of full inclusion in Canada has been somewhat slow because the Canadian educational system is under the provincial or territorial jurisdiction (Katz, 2015; Smith et al., 2009) by virtue of the *Constitutional Act of 1867* (Poirier, Goguen, & Leslie, 1988). This implies that a child's right to education is under the protection of the province or territory where s/he resides. As such, reforms and policies toward the provision of full inclusion are contingent on the readiness and availability of resources within each provincial and territorial department of education (Towle, 2015).

New Brunswick, Alberta, British Columbia, and Nova Scotia were among the first provinces to have completed reforms and policy manuals toward the implementation of inclusion. For instance, in 1986, the legislative assembly of the New Brunswick adopted Bill 85. This Bill established the legal backing of inclusive education in the province (Office of the Premier-Education, 2006). In Manitoba, the review of special education began in 1996, while Quebec updated their special education program in 1992 (Friend, Hutchinson, & Bursuck, 1998). In 2009, the Department of Education and Early Childhood Development in Newfoundland and Labrador began a phase-in approach to incorporate the Inclusive Education Initiative. Thirty schools across the various school districts in the province were enrolled in Phase I, with new schools joining each year until June 2017 when all public schools across the various school districts became fully inclusive (Newfoundland and Labrador Department of Education and Early Childhood

Development, 2017). In November 2016, a four-member team was charged by the Premier of Newfoundland and Labrador, the Honourable Dwight Ball, to review the inclusive education model. Snapshots of the key recommendations contained in the report by the Premier Task Force include:

1. The Department of Education and Early Childhood Development should review the curriculum at all levels to align with the principle of Universal Design for Learning;
2. The Department of Education and Early Childhood Development should create opportunities that reinforce self-regulation and social/emotional learning outcomes in the curriculum across content areas;
3. The Department of Education and Early Childhood Development should develop a model and a plan that introduce a second level of student assistants as 'instructional assistants' with levels of post-secondary education appropriate to the role; and
4. The Faculty of Education at Memorial University should include two courses on exceptionalities and modules with the focus on responding to student behaviour in initial teacher education programs. (Collins, Philpott, Fushell, & Wakeham, 2017, pp. 125-127)

Overall, the essence of the review is to address the concerns of parents, teachers, students, and the general public and eventually to improve educational outcomes in public schools across the province.

2.2 Conceptualization of Inclusive Education

Since its adoption in the late 20th century, the philosophy of inclusive education has had different conceptualizations among research communities (Ballard, 2000; Barton, 1997; Runswick-Cole, 2011). Earlier proponents of the inclusion concept aimed at eliminating barriers

to social integration. As such, they conceptualized inclusive education based on the placement or integration of persons with disabilities into the general education classroom to foster social integration among their peers without disabilities.

As pointed out by Ballard (2000), earlier definitions of inclusive education emphasized the involvement of students with disabilities in the regular classroom because the majority of researchers at the time had a background in special education. For example, some scholars described inclusive education "as an ongoing development of special education" (Ballard, 1999, p. 1), while others conceived it as a merger of regular and special education with an emphasis on the provision of services (Wade, 2000). Andrews and Lupart (2000) share the notion that inclusive education is a merger of special and regular education. However, they emphasized that, as a unified educational system, inclusion should focus on student diversity. It should be anchored in the integration of knowledge from special education into general education practices based on teaching practices, collaborative consultation, and organizational restructuring.

Meanwhile, Ballard (1999) argued that the idea of describing inclusive education as an amalgamation of special and regular education is problematic because such a description may perpetuate certain special education practices such as the medical and curative model, which excluded children with special needs from regular classrooms. Instead, he contended that the concept of inclusion should be defined based on "increasing participation not just for disabled students but for all those experiencing disadvantages, whether this results from poverty, sexuality, minority ethnic status, or other characteristics assigned significance by the dominant culture in their society" (Ballard, 1999, p. 2). The central theme of the philosophy of inclusive education is therefore anchored in respect for diversity and the celebration of differences in a dignified way. Inclusion forms part of an individual's rights to both social and academic integration. Therefore,

being inclusive means eliminating all obstructions toward the celebration of diversity in schools and communities. As Barton (1997) tellingly points out:

> Inclusive education is not about 'special' teachers meeting the needs of 'special' children in ordinary schools...It is not merely about placing disabled pupils in classrooms with their non-disabled peers; it is not about 'dumping' pupils into an unchanged system of provision and practice. Rather, it is about how, where and why, and with what consequences, we educate all pupils. (p. 234)

Runswick-Cole (2011) also maintained that, notwithstanding the conceptual difficulties or disparities about inclusive education, defining the inclusion concept must be an ongoing process which should be considered as "a 'journey' and not a 'destination' because the aim of achieving equity is always ongoing rather than realised" (p. 113).

According to Katz (2012), the adoption of the *Canadian Charter of Rights and Freedoms* guarantees every student a constitutional right to equity and quality education. Hutchinson (2013), also reminds us that inclusive education in Canada:

> Is an issue within the context of Canadian society, not just within the context of Canadian schools… Inclusive schools are…closely related to [an] equitable treatment of students regardless of gender, race, and so on. [Therefore,] if we choose to teach, we are choosing to teach in inclusive settings. (Hutchinson, 2013, p. xxi)

Further, the Ministries of Education in Alberta and Newfoundland and Labrador assert that inclusive education goes beyond providing support to students with special needs. According to Alberta Education (2018), inclusion is "an attitude and approach that embraces diversity and learner differences and promotes equal opportunities for all learners" (n. p). Similarly, the Department of Education and Early Childhood Development in Newfoundland and Labrador

(2018) noted that being inclusive is not limited to the mere inclusion of students with special needs in the classroom environment. "The goal of inclusive education is that students are included in all aspects of the learning environment regardless of any facet of diversity" (n. p.). Students who may have any form of special needs, "whether for medical, academic, social or emotional reasons, need individualized or small group instruction periodically, in order for their needs to be met" (Newfoundland and Labrador Department of Education and Early Childhood Development, 2018, n. p). This description aligns with the explanation by the British Columbia Ministry of Education (2016) that the concept of inclusion is "not necessarily synonymous with integration and goes beyond placement to include meaningful participation and promotion of interaction with others" (p. v). It guarantees equitable access to learning, while achievement and the pursuit of excellence remain the hallmarks of each student's education (British Columbia Ministry of Education, 2016).

Additionally, the Yukon Department of Education (2015) considers integration as just one of the strategies that should be used to achieve the goal of inclusion. According to the department, inclusion "refers not merely to [the] setting but specific instruction and support for students with special needs in classrooms" (p.4). Likewise, the Ontario Ministry of Education (2014) conceptualizes inclusive education as an "education that is based on the principles of acceptance and inclusion of all students. Students see themselves reflected in their curriculum, their physical surroundings, and the broader environment, in which diversity is honoured and all individuals are respected" (p. 87).

Meanwhile, the Advisory Board on Education (2006) in Quebec has outlined three essential components of inclusion: access, engagement, and success, which have been addressed frequently in the principles of inclusion across provincial and territorial policies and guidelines. The British Columbia Ministry of Education (2016), for instance, addressed the elements of access and success

by pointing out that "inclusion describes the principle that all students are entitled to equitable access to learning, achievement and the pursuit of excellence in all aspects of their education" (p. v). Also, the New Brunswick Department of Education and Early Childhood Development (2013) emphasized that inclusive education is "based on a system of values and beliefs centred on the best interest of the student, which promotes social cohesion, belonging, active participation in learning, a complete school experience, and positive interactions with peers and others in the school community" (p. 2). This also depicts inclusion as an element of engagement.

Moreover, in addition to the different conceptualizations within provincial and territorial ministries of education across Canada, other countries and international bodies have also highlighted similar conceptions of inclusive education. For example, UNESCO (2009) conceptualizes inclusive education as…

> a process of addressing and responding to the diversity of needs of all children, youth and adults through increasing participation in learning, cultures and communities, and reducing and eliminating exclusion within and from education. It involves changes and modifications in content, approaches, structures and strategies, with a shared vision that covers all children of the appropriate age range and a conviction that it is the responsibility of the regular system to educate all children. (pp. 8-9)

By this definition, it is essential for educational systems to employ inclusionary practices that revolve around individual differences to allow all students to have access to the curriculum while building a climate of diversity around students for the creation of a just and non-discriminatory society. Also, according to the United States Department of Education (2008), inclusive education refers to "a commitment to educate each child, to the maximum extent appropriate, in the school and classroom he or she would otherwise attend. It involves bringing support services to the child,

rather than moving the child to the support services" (p. 2). Further, within the viewpoint of the New Zealand Ministry of Education (2017), "inclusive education is where all children and young people are engaged and achieve through being present, participating, learning and belonging" (n. p). Such a system welcomes all students, encouraging their full and active participation in all aspects of school life while diversity is respected and upheld.

Inclusive education has also received wide-ranging conceptualizations from academic researchers since its introduction several decades ago. For example, Canadian researchers Katz (2012) and Sokal and Katz (2011) emphasized that in addition to the notion of inclusive education as philosophy for educating all children in a common setting, the inclusion model may be conceptualized from social and academic viewpoints. Katz (2012) defined social inclusion as "recognizing and valuing diversity, engendering feelings of belonging that lead to social equality through the participation of diverse populations, including the disadvantaged" (p. 5). In social inclusion, every child in the classroom is fully recognized and respected as a member of the classroom community. Similarly, academic inclusion in education is defined as "all students having full participation in the academic experiences of the classroom, including learning experiences with peers that are not separate or parallel to those of their classmates and that are not based solely on interactions with adults" (Sokal & Katz, 2011, p. 43). Katz's (2012) views on inclusive education are generally consistent with those of the U.S. Department of Education (2008), which stipulates that, in inclusive education, the provision of services to the student must be delivered in the classroom and the home schools of the students. However, notwithstanding the relevance of social inclusion, Katz (2012) asserted that many of the provincial and territorial legislation and policy guidelines on inclusive education are focused on fulfilling the rights to academic inclusion with less emphasis on social inclusion. As noted by Erten (2014), "students

with special needs experience difficulties in social skills and have lower self-concepts compared to their typically developing peers" (p. 42); as such, an inclusive learning environment must respond to both the academic and social needs of all students irrespective of diversity. Furthermore, according to Specht (2016), inclusive education in the Canadian context "means that students who are diverse learners attend their neighbourhood school with their same age peers where they are accepted, valued and made to feel they belong in regular classrooms and schools" (p. 894).

Meanwhile, Mitchell (2015) asserted that the scope of inclusion "goes far beyond learners with disabilities and has now been extended to cover all learners with special education needs, whatever their origin" (p. 9). As a multi-faceted concept, Mitchell (2015) proposed ten different elements of inclusion: vision, placement, adapted curriculum, adapted assessment, adapted teaching, acceptance, access, support, resources, and leadership. Also, similar to the description of Runswick-Cole (2011), who stated that inclusion is a 'journey' or an unending 'process', Opertti, Brady, and Duncombe (2009) conceptualized inclusion as "a dynamic and evolving process of understanding, addressing and responding to the diversity of all learners by providing personalized education and support, and by using their diverse cultural and social profiles as contexts and opportunity for learning enhancement" (p. 212). Additionally, MacKay and Burt-Gerrans (2004) underscored that a fully inclusive school system must strive continuously to provide access to students and enable them to participate in and be part of the operations of the school community.

Overall, regardless of the varied conceptualizations of inclusion, the central theme of inclusion is primarily rooted in meeting the educational needs of all students instead of particular groups of students in a natural environment where every student feels respected, safe, and a sense of belonging. Shore et al. (2011) identified belongingness and uniqueness as two critical

components of inclusion. They argue that the success of inclusivity depends on whether individuals are treated as insiders and allowed to retain their unique identity within a working group. Farrell (2016) also emphasized this by pointing out that how inclusive the school system depends on the extent to which students are welcomed and accepted by other students and staff, whether they are able to actively participate in school activities, and their ability to successfully acquire academic and social skills.

It would seem quite reasonable, therefore, to posit that a shift toward inclusive education challenges society to embrace student diversity. This reflects a societal transformation aimed at preparing children to live in inclusive communities with all other marginalized groups as emphasized by Andrews and Lupart (2000) and Philpott (2007). Whatever the rationale may be, the adoption of inclusive education calls for a global shift in thinking toward the use of effective teaching pedagogies to respond to the needs of diverse learners. As Katz (2012) emphasized, it represents an opportunity for stakeholders in education to explore useful instructional frameworks that involve "teaching to the heart as well as to the mind, exploring the deeper meaning of what we learn, connecting with the community we learn and live with, and coming to know ourselves" (p. 4).

2.3 Teachers' Understanding of Inclusive Education

The teacher's role is a crucial factor in the implementation of educational reforms and policies. Their understanding, interpretation, and general assessment of educational concepts and policies, to a large extent, influence the success and/or failure of a curriculum (Fyssa, Vlachou & Avramidis, 2014). For example, how they conceptualize the principle of *Science for All* may influence how they integrate inclusive science practices in their classrooms (Southerland, Gallard, & Callihan, 2011).

According to Engelbrecht, Nel, Nel, and Tlale (2015), systemic contextual factors such as the ethos in a school and the nature of the educational system directly influence the implementation of inclusive educational practices in the classroom. Furthermore, the teachers' understanding and interpretation of inclusion will have a direct and substantial effect on the implementation process.

As Hodkinson (2006) emphasized, "if inclusion was to be established as a core principle of educational policy its future success might rest with the next generation of teachers" (p. 45). This standpoint is consistent with Vaughn's (1994) argument that "teachers will be the primary service deliverers of whatever inclusion practices are adopted. Thus, their perspectives are essential if we are to anticipate possible difficulties and prepare for successful inclusive practices" (p. 6). It is therefore imperative for educational researchers to explore the understanding, attitude, and beliefs of both regular and special education teachers about the inclusive education concept.

Studies on general education teachers' conceptions about inclusive education show that teachers hold diverse views about what constitutes inclusive education. For example, in two separate studies that compared teachers' conceptions and misconceptions of inclusive education, Hodkinson (2006) reported that 100% of pre-service teachers initially conceptualized inclusive education as education that includes all pupils, 21% described it as education that treats all pupils equally, while 18% responded that inclusion ensures responding to every need of students to help them reach their full potential. However, one year later after becoming qualified as fully-trained teachers, the findings from a follow-up study conducted on the same participants showed a change in their conceptions about inclusive education. Compared to the initial 100% who defined inclusion as education that includes all pupils, only 40% of teachers conceptualized inclusive education as involving all pupils after one year of teaching experience in an inclusive setting. Similarly, there was a 20% reduction in teachers' conception of inclusive education as meeting all

the learning needs of individual students. However, of significant interest in the second study was a new perspective in which teachers conceptualized inclusion as "respecting and valuing the individual child" (p. 47) while emphasizing the need to increase support services for individual students in need.

In Canada, Woodcock and Hardy (2016) explored elementary and secondary teachers' understandings and engagement of inclusion in the southern part of Ontario. The authors found that teachers' conceptions of inclusion are generally focused on the recognition and representation of all students as active learners. Of the 120 participants sampled for the study, 64% conceptualized inclusion in the context of recognition, while 69% defined inclusive education with reference to representation-related issues. The findings also revealed that 92% of participants held positive views about inclusion. They felt that "inclusive classrooms were effective environments for all students to learn" (p. 674). Although teachers' responses generally demonstrated a positive attitude toward inclusive education, 15% of participants negatively conceptualized inclusive education "as predominantly associated with disabilities" (p. 674), while 8.3% defined inclusion with reference to issues pertaining to resourcing. This observation is consistent with Hodkinson and Devarakonda's (2009) claim that many teachers and education officials conceptualize inclusive education with reference to issues solely related to the provision of education for children with disabilities. Of significant interest in Hodkinson and Devarakonda's (2009) study was a conceptual confusion among participants. The authors reported that "a detailed analysis of the interview data reveal that for the participants of the study inclusion is not a well-known concept" (p. 92). While some of the participants involved in their study inquired about what inclusion means, others conceptualized inclusion as "integrating children" (p.92).

In a similar study to elicit teachers' understanding and perceptions of inclusion in five metropolitan school districts in the Southeastern United States, Vaughn (1994) reported that most of the responses from teachers involved in the study reflected a lack of understanding of inclusive education. For example, one teacher remarked: "It is very depressing because I feel like I should know about this [inclusive education] before my neighbour asks me, 'Oh, you're a teacher. What do you think about inclusion,' I mean, don't you feel so uninformed?" (p. 17). Other findings reported in the study include teachers' expression of concern about the lack of consensus on what inclusion really means. They called on policymakers to come up with a common definition that would be universally accepted. For example, another teacher argued that having a common understanding about inclusive education is essential because it will help them as teachers to "fight it out or go along with it, but without a definition, there's nothing" (p. 18). Vaughn (1994) claimed that many of the teachers involved in the study described inclusive education as just another term for mainstreaming, while others referred to it as a type of education that ensures the removal of labels and stigmatization against children with disabilities.

Meanwhile, Daniel (2011) argued that mainstreaming is not the same as inclusion. Mainstreaming involves bringing students into the general education classroom when they are no longer in need of specialized instruction or materials. This implies that a student with any form of disability does not necessarily have to be placed in the general education classroom except on the condition that s/he is able to work with his peers without disabilities. These debates indicate that despite the universal acceptance of the philosophy of inclusive education across the globe, the lack of a standard definition or understanding of inclusion remains a challenge that is yet to be unravelled within academic circles and provincial and territorial jurisdictions. According to

Runswick-Cole (2011), the lack of a standard definition of inclusive education makes it difficult to talk or write about the inclusion concept.

Further, Daniel (2011) also attributed the inconsistencies surrounding the true meaning of inclusive education in Canada to the lack of understanding and agreement on the concept of inclusive education across provincial and territorial jurisdictions. In his study on identifying the gaps towards an inclusive educational system within Quebec, he argued that the inclusion concept has been modified in many ways, creating more controversies about what constitutes full inclusion in Canadian schools. For instance, he pointed out that in the province of Quebec, education policies use the term "integration" instead of "inclusion." Yet, many teachers in the province conceptualize integration as inclusion. In the views of teachers, integration is synonymous with inclusion, and as such, they use the two terms interchangeably. Meanwhile, other teachers see integration and inclusion as entirely different concepts. According to Smith et al. (2009), integration or mainstreaming, which started in the 1970s, can be used interchangeably to denote the involvement of children with exceptionalities in general education programs when they demonstrate readiness and an ability to cope with the general education program.

Moreover, Fyssa, Vlachou and Avramidis (2013) also explored special and regular early childhood teachers' understanding of inclusion from a Greek perspective. Their findings showed that the views of most teachers demonstrate an integrationist perspective rather than one of inclusion. In fact, about 86% of both special and general education teachers described inclusive education from the viewpoint of the types of children's disabilities, their functionality, and how they can adjust to the school environment. As one teacher remarked: "...inclusion is, therefore, only for those children who can participate in class activities and are able to communicate with other children" (p. 228). Additionally, other teachers conceptualized inclusion in terms of pull-out

programs. As another special education teacher pointed out; "For me, for implementing inclusive education, it is essential that the child's needs are catered for in a separate classroom. I refer to that of the pull-out programme" (p. 228). A study by Khan (2012) in Bangladesh that explored secondary school teachers' perceptions of inclusive education showed a similar result. As Khan (2012) pointed out, "some participants thought that inclusive education is primarily related to the integration of children with special educational needs in their regular class" (p. 109). These viewpoints are consistent with Daniel's (2011) assertion that many teachers conceptualize inclusive education as the integration of children with disabilities in regular classrooms. However, apart from the integrationist perspective, Fyssa, Vlachou and Avramidis (2013) reported that 14.3% of teachers conceptualized inclusive education as a multifaceted process of education that should be focused on children's characteristics and school-related factors such as curriculum modifications, materials adaptation, and collaboration among teachers. Also, 73.1% of teachers also defined inclusion in terms of classroom participation and acceptance by peers.

Furthermore, in a study to explore the understanding of a group of South African teachers about inclusion, Engelbrecht, Nel, Nel and Tlale (2015) reported that teachers' understanding of inclusive education was "focused on a deficit, individualized approach to barriers to learning and development" (p. 1). This conception, according to the authors, is due to the form of training the participants received during their teacher training education, which was centered on "a deficit, individualized approach to special educational needs" (p. 7). As reported by the authors, to make their classroom appear inclusive, the participants sometimes created a dual learning environment in their classrooms "for those [learners] who experience barriers to learning, by trying to provide something which is different from that which is ordinarily available for most learners" (p. 6). However, this practice is inconsistent with Florian and Black-Hawkins' (2011) description of

inclusive pedagogical approaches. As emphasized by Florian and Black-Hawkins (2011), in an inclusive environment, rather than providing something different for children with special education needs, teachers should extend "what is ordinarily available in the daily life of the classroom" to all learners (p. 814).

Interestingly, Engelbrecht, Nel, Nel and Tlale (2015) also used the terms "inclusive education" and "mainstreaming" interchangeably throughout their study. This further demonstrates the confusion surrounding the meaning of inclusive education. As Smith et al. (2009) noted, although integration (or mainstreaming) and inclusion involve the joining of learners with exceptional needs into the general classroom, "inclusion assumes that these students belong in general classroom-in the integration phase such students were considered to be special education students who were placed in the general classroom part of the time" (p. 4). Meanwhile, reviews on inclusion and science suggest that teachers' cultures, attitudes, knowledge about pedagogy (Khan, 2012; Moriarty, 2007) and ways of thinking (Ainscow, 2005; Southerland, Gallard & Callihan, 2011) influence how they adopt innovative and inclusive pedagogical approaches in their classrooms.

A study by Cunha (2011) to examine how novice science teachers improve the participation of culturally diverse students in science found that science teachers fail to acknowledge the influence of culture on students' understanding of science and how they construct knowledge. Cunha (2011) reported that science teachers delivered their lessons to culturally diverse students from a monocultural perspective and using a teacher-directed teaching approach instead of adapting multicultural and inclusive teaching practices that engage all students.

In a similar study, Petty and Narayan (2012)) reported that science teachers do not incorporate examples and content based on a variety of cultures to make science meaningful to

culturally diverse students. As reported by the authors, many science teachers hold the view that science is science, irrespective of cultural diversity. However, Mujawamariya, Hujalehand Lima-Kerckhoff (2014) opined that teaching strategies built on the perspective of multiculturalism engage all learners, respond to their diverse learning needs, and provide opportunities for them to learn science with confidence.

Moreover, Southerland, Gallard and Callihan (2011) indicated in their study that factors such as ethnocentrism and embracing equality over equity have the capacity to limit a teacher's quest to adopt inclusive classroom practices. They described teachers' ethnocentrism as a tendency of teachers to view their cultural group as superior to that of their students. Accordingly, an ethnocentric teacher finds it difficult to understand and appreciate the influence of cultural diversity on schooling and in the learning of science. In an inclusive classroom, such teachers hold the opinion that "the actions and behaviors of students from families, backgrounds, or countries different from that of the teachers can only be seen as different, and therefore wrong" (Southerland, Gallard & Callihan, 2011, p. 2200). These practices and attitudes result in science teachers adopting a one-way teaching approach rather than an inclusive approach to the teaching of science.

To make science accessible to all, it is incumbent on science teachers to employ teaching practices that integrate learners' language and cultural experiences (Kelly-Jackson & Jackson, 2011) and bridge learners' home cultures through new scientific concepts that teachers introduce in the classroom (Cunha, 2011).

2.4 Adoption and Implementation of Inclusive Pedagogy

A number of studies indicate that the variability in the inclusion concept influences how it is adapted in classrooms by teachers (Florian & Black-Hawkins, 2011; Makoelle, 2014). Florian (2015) stated that acknowledging the "contested nature of inclusive education and the consequent

variability in practice" lays the foundation for the enactment and implementation of inclusive pedagogy (p. 6).

Research documents several inclusive instructional approaches and frameworks such as differentiation, inquiry-based instruction, explicit instruction, Universal Design for Learning, cooperative learning, and strategy instruction (CAST, 2011, 2018; Florian, 2015; Grumbine & Alden, 2006; Katz, 2012; King-Sears, 1997; Spratt & Florian, 2013; Stefanich, 2001a, 2001b; Tomlinson & Imbeau, 2010) for responding to diverse needs. However, the decision to implement any of such approaches in the classroom depends on the individual classroom teacher (Peterson, 2011).

Jordan, Glenn and McGhie-Richmond (2010) claimed that educational policies and practices that set limits on and assess teachers' effectiveness and quality of teaching based on students' achievement might potentially influence the choice of teachers' teaching practices in the classroom. The authors argued that such practices are common both in Canada and the United States. For example, in the last 20 years, both the United States and Canada have been using state-, provincial-, and territory-wide testing of students to evaluate teacher effectiveness and to hold them and their schools accountable for students' achievement. Barksdale-Ladd and Thomas (2000) noted that "the higher the stakes on a given test, the greater the level of teacher focus on test preparation and the greater the chance of teachers' teaching to the test to the detriment of other aspects of teaching/learning" (p. 386). Meanwhile, Hart, Dixon and Drummond (2006) pointed out that educational policies or practices that set limits using a bell-curve thinking model, which is based on children's ability or organizing schooling along with norm-referenced tests, is inherently unjust and may perpetuate the inevitability of failure and stereotyping. Inclusive pedagogy sets out to redress such limitations (Florian & Black-Hawkins, 2011; Florian, 2015).

The principle of inclusive pedagogy aims at raising the achievement of all learners while safeguarding the inclusion of learners known to be vulnerable to exclusion and other forms of marginalization. It focuses on addressing the learning needs of all children without necessarily setting limits or expectations on individuals' learning outcomes (Florian, 2016).

According to Spratt and Florian (2013), inclusive pedagogy opposes "practices which address education for all by offering provision for most with additional or different experiences for some. Instead, it demands that teachers extend what is ordinarily available so that it is accessible to all" (p. 135). It is about embracing diversity in order to meet the varied learning needs and styles of all learners, with or without disabilities (Beaudoin, 2013; Florian & Black-Hawkins, 2011). As emphasized by Florian (2015), the concept of inclusive pedagogy replaces…

> traditional approaches to teaching children identified as having additional or special educational needs that are based upon the argument that such children necessarily require something 'different from' or 'additional to' that which is ordinarily available, and that what is needed can be matched to learner characteristics. While it does not deny individual differences between learners, it assumes that differences are an ordinary aspect of the human condition. (p. 9-10)

However, the literature on inclusion indicates that making what is ordinarily available in the classroom accessible to all learners is a complex endeavor (Ainscow, Booth, & Dyson, 2004 2004; Florian & Black-Hawkins, 2011; Jordan, Glenn, McGhie-Richmond, 2010). It requires a shift in teaching approaches that are focused on the bell-curve model distribution toward teaching practices that involve "the development of a rich learning community characterised by learning opportunities that are sufficiently made available for *everyone*, so that all learners are able to participate in classroom life" (Florian & Black-Hawkins, 2011, p. 814). A bell-curve thinking

model assumes that "what is ordinarily available will meet the needs of most learners while some at the tail end of a normal distribution, may require something additional or different" (Florian, 2015, p. 7).

As noted by Moriarty (2007), reform efforts in Science, Technology, Engineering and Mathematics (STEM) education place a strong emphasis on the use of inclusive pedagogical approaches to make science accessible to all learners, irrespective of age, gender, ethnic background, or disability. However, Baurhoo and Asghar (2014) argued that contrary to the science for all principles, there are still learners who do not have access to science. According to the authors, issues of stereotyping students with special learning needs by teachers and other students in inclusive classrooms still exists. For example, the authors reported in their study that "56% of science teachers acknowledged that they use disability of students as an excuse for explaining the students' failure" (Baurhoo & Asghar, 2014, p. 61). This finding coincides with Workman' (2012) assertion that the expectations of a teacher toward a particular student may be influenced by student characteristics such as race, ethnicity, and family income level, or indicators of past performance (Workman, 2012). According to the author, such expectations may cause teachers "to differentiate their behavior towards individual students, such that [they] set lower expectations for some students, provide briefer (or no) feedback on student errors—and less positive feedback after correct answers—and grant students less time to answer questions" (Workman, 2012, p. 1). These findings may directly influence science teachers' instructional approaches and student achievement in inclusive classrooms as teachers may set lower academic expectations for students who exhibit any of the above characteristics in the classroom.

The principle of inclusive pedagogy rejects the labelling of learners based on ability; instead, it provides alternative framework teachers can use to organize their lessons by creating

environments with no limitations on both teachers and learners' expectations (Spratt & Florian, 2013). A move toward inclusive science teaching requires the adoption of classroom practices that are "aligned with learners' culture, language, and ways of thinking" so that the learning of science becomes meaningful to the learner (Southerland, Gallard & Callihan, 2011, p. 2184). If teachers organize their classroom practices in line with their learners' social, cultural, and language background experiences, it may potentially increase their achievement in school (Cunha, 2011).

Indeed, in an inclusive classroom, one-size will not fit all, and equal treatment will not be fair. Therefore, teachers who implement inclusive teaching pedagogy must acknowledge that every learner is unique and has the ability to learn. They should aim to raise every learner's achievement standards through the application of inclusive practices that benefit not most but all of their students (Jordan, Glenn & McGhie-Richmond, 2010: Pierce, 2014). This will help diverse students to develop self-confidence in sharing their ideas and learning experiences in science with their teachers and peers (Baurhoo & Asghar, 2014).

Overall, the central theme of inclusive pedagogy is to promote quality education principles that embrace belongingness (Shore et al., 2011), diversity, reduce inequality, and variability in practice (Florian, 2015; Florian & Black-Hawkins, 2011). Inclusive pedagogy provides an alternative teaching approach to current practices that perpetuate 'special or additional support needs' and place a ceiling or limitation on learning opportunities of learners considered to be less able (Spratt & Florian, 2013). As Stefanich (2001a) emphasized, a genuinely inclusive science classroom ensures the provision of a learning environment where all students feel a sense of success and accomplishment in terms of teaching styles and assessment procedures.

2.5 Effective Instructional Practices for Inclusion

The adoption of inclusive education as "a response to the limitations of traditional education, which has been described as patriarchal, utilitarian and segregational" (Hunt, 2007) requires teachers to be well-equipped with the necessary abilities, knowledge, and dispositions to effectively respond to the educational needs of students (Goodnough, 2010). Teaching diverse groups of students requires the adoption of diverse instructional practices that provide fair and equitable opportunities for all students to learn and optimally develop their competencies (Roy, Guay & Valois, 2013), "while simultaneously 'raising the bar' and meeting the standards set with a normed population in mind" (Katz, 2015, p. 3).

Although all students deserve the same learning opportunities in an inclusive classroom, they differ in terms of their learning needs, abilities, and preferences for learning. How each student learns is as unique as his or her fingerprints (Beaudoin, 2013). This implies that all students demonstrate their knowledge and mastery of skills differently (Gordon, Gravel, & Schifter, 2009). Therefore, to be able to respond adequately to their needs, effective teachers need to adopt flexible teaching approaches that inspire and challenge all students, with or without disabilities, and provide them with multiple avenues to enable them to succeed (Meyer, 2006; Novak, 2014; Salend & Whittaker, 2017).

Over the years, educational researchers have documented teaching practices considered to be effective in addressing students' needs in an inclusive environment. In one such study, MacSuga-Gage, Simonsen, and Briere (2012) suggested that effective teachers should be able to "expertly weave together academic, behavioral, and social threads to achieve a unique classroom tapestry" (p. 14). They proposed three key pillars around which effective teaching should revolve: "(a) delivering explicit and engaging academic instruction, (b) implementing empirically

supported classroom management strategies, and (c) building relationships with students and their families" (p. 14). In a similar study, Jordan, Schwartz, and McGhie-Richmond (2009) suggested that effective teaching skills should entail teachers' ability to use right classroom and time management skills to engage students, provide them with the needed support and encouragement, and scaffold their learning experiences to ensure their academic success.

Meanwhile, research indicates that students learn best when instructional practices and strategies are connected to their interests and background experiences (Cimer, 2007; Tomlinson, 2003). This requires teachers to carefully weave together teaching and learning processes to reflect the insights and experiences of students to make the lessons meaningful and relevant to them.

Following the literature review on effective inclusionary practices, a number of teaching approaches and frameworks emerged, including the use of differentiated instruction, inquiry-based instruction, universal design for learning, strength-based approach, and multiple intelligence. To situate this study in the existing literature on effective teaching practices in inclusive settings, the next section of this chapter discusses four of these teaching approaches in detail.

2.5.1 Differentiated instruction. With the push for full inclusion and science for all movements, contemporary classrooms are becoming increasingly diverse and complex (Goodnough, 2010). For example, within the context of inclusive education, many students with various types of disabilities who were previously assigned to specialized classrooms are now receiving education in inclusive environments with their non-disabled peers under the instruction of general education teachers. This increasing trend in diversity in inclusive classrooms is compelling teachers to restructure their instructional approaches to meet students' needs (Subban, 2006) adequately. As Tomlinson and Imbeau (2010) noted, "no two students are exactly alike and … no individual student stays the same over her or his travel through the high school years" (p.

7). This means using the traditional teacher-centric instructional approach cannot meet the multiplicity of needs in such an environment. A diverse classroom instead calls for diverse instructional practices and techniques that will allow students to develop a deeper understanding of the curriculum and achieve the intended learning outcomes (Scott, Schroeder, Tolson, & Bentz, 2006).

As a teaching model, differentiation allows teachers to restructure the traditional classroom by replacing the one-size-fits-all theory of teaching where the teacher is the ultimate source of knowledge with one that caters to the needs, abilities, and interests of individual students (Subban, 2006). However, it is essential to note that the philosophy of differentiation is not the same as the provision of an individualized instructional program for each student. Instead, the teacher differentiates the content, process, and product in a way that accommodates the different needs of students, including the gifted, talented, and those with/without disabilities (Goodnough, 2010; Roberts & Inman, 2009; Tomlinson, 2001).

Theoretically, the philosophy of differentiation is grounded in constructivist theories, including Piaget's theory of cognitive constructivism and Vygotsky's zone of proximal development (Subban, 2006; Thakur, 2014). Piaget's theory stipulates that knowledge cannot be instantaneously transferred to humans (Von Glasersfeld, 1995). Instead, individuals create and construct their knowledge through the process of assimilation and accommodation by interacting with their social and physical environments (Powell & Kalina, 2009; Subban, 2006). Differentiating instruction or learning implies that the instructional activities and supports should be organized to suit students' cognitive levels and background experiences to enable them to construct knowledge based on their learning experiences (Thakur, 2014).

Vygotsky's notion of the zone of proximal development refers to the intermediary stage in a child's development where he or she is able to perform an activity under the guidance of an adult or through peer collaboration (Subban, 2006). Research shows that learning takes place within this zone, as it connects what is known to the unknown (Koeze, 200). The teacher's role in a differentiated classroom, therefore, is one of a facilitator and mediator of activities, creating the enabling learning environment that allows each learner to reach his or her zone of proximal development (Subban, 2006).

According to Tomlinson (2003), teachers can differentiate instruction based on students' readiness, interest, and learning preferences. Differentiating instruction this way provides teachers with the flexibility for incorporating "a variety of classroom organizational, instructional, and assessment approaches and principles" (Goodnough, 2010, p. 243) to maximize student engagement, achievement, and the readiness to accept new challenges (Chamberlin & Powers, 2010; Tomlinson, 2003; Turville, 2013). In fact, evidence shows that when differentiation strategies are incorporated into science instruction, they facilitate the higher achievement of students, enrich students' understanding of and access to science content, and effectively promote their success in science (Oliveira et al., 2013; Maeng & Bell, 2015).

2.5.2 Inquiry-based instruction. The movement toward inquiry-based science teaching has received considerable attention (Goodnough, 2010; King, Shumow, & Lietz, 2001). However, the proposition for this approach to teaching and learning dates to the days of John Dewey, Paulo Freire, and Jean Piaget. For example, in one of his classical works titled *Experience and Education*, Dewey (1986) proposed that citizens in a democratic society need to inquire about the nature of their physical and social environments and actively take part in the building of their society. For this to be achieved, formal education needs to provide students with the skills and attitudes that

enable them to formulate questions that are relevant and meaningful to them devoid of any external influence. Also, in chapter two of Freire's (2018) *Pedagogy of the Oppressed*, he criticized the "banking" model of education as it views the teacher as the ultimate source of knowledge and the student as an empty vessel ready to be filled with knowledge. He argued that rather than dialoguing with students, "the teacher issues communiques and makes deposits which the students patiently receive, memorize, and repeat" (p. 58). This authority-based concept of education fails to produce independent and self-initiated students (Barney, 1971). Rather, it acts as an instrument for oppressing students' ability to construct knowledge based on their personal experiences and interactions with their environment. Freire (1970) therefore proposed that education should begin with resolving this tension in the teacher-student relationship by creating an environment where "both are simultaneously teachers and students" (p. 59). In other words, education should incorporate insights from students because students enter the classroom with a wealth of knowledge and personal experiences as opposed to being empty vessels ready to be filled with knowledge (Deboer, 2002).

Meanwhile, the authors of the *National Science Education Standards*, the National Research Council (NRC), have emphasized the need for all K-12 students to develop the abilities and understanding necessary to perform scientific inquiry (NRC, 2000). These abilities require students to mesh science processes such as observation, inference, and experimentation with scientific knowledge through scientific reasoning and critical thinking. The overarching goal is to produce students who

> possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside school; and have

> the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology. (National Research Council, 2012, p. 1)

To this end, the National Research Council (2000) has outlined five essential features of inquiry that should be emphasized in the classroom. These features include students' ability to (a) engage through scientific-oriented questions, (b) give priority to evidence when responding to questions, (c) formulate explanations based on evidence to address scientifically-oriented questions, (d) connect explanations to scientific knowledge, and (e) communicate and justify their proposed explanations. To achieve these, science instructional practices should be inclusionary and inquiry-based oriented, consisting of "different techniques and approaches that build on students' interests and backgrounds to engage them more meaningfully and support them in sustained learning" (National Research Council, 2012, p. 283). The teacher's role is to flexibly take responsibility for learning activities, use those activities to provide demonstrations and create opportunities that enable students to practice the prescribed inquiry skills (DeBoer, 2002).

According to Barney (1971), students learn best by doing. Their curiosity and creativity significantly improve and develop in a classroom climate that provides flexibility, autonomy, and variation in the learning process. Consequently, engaging them through an inquiry-based instructional approach improves their psychomotor and analytic skills, develops their understanding about the nature of science and what scientists do, and prepares them to be lifelong learners (DeBoer, 2002; Harlen, 1999; King, Shumow, & Lietz, 2001).

2.5.3 Universal design for learning (UDL). As a framework for teaching, universal design for learning (UDL) aims at maximizing students' learning by eliminating barriers regardless of ability, disability, age, reading level, learning style, native language, race, or ethnicity (Burgstahler, 2008). Proponents of UDL maintain that disabilities or barriers are not biological

issues that lie within the students. Instead, it is the school environment which is disabled, hence creating barriers for students (Katz, 2015; Novak & Rose, 2016; Salend & Whittaker, 2017). Thus, instead of fixing the students, teachers and schools should fix those barriers associated with the environment such as the curriculum, instructional planning and practices, and the classroom climate.

As an instructional framework, UDL is known to promote access, participation, and progress for all students (Katz, 2013, 2015; Novak & Rose, 2016). It is rooted in the recognition of heterogeneity in students and the fact that the standardized learning environment is unproductive for diverse students (McGuire & Scott, 2006). That is to say, rather than segregating students into different programs based on their needs, UDL advocates for instructional practices that accommodate the needs of multiple learners with or without disabilities in the same classroom (Katz, 2015). To achieve this goal, proponents of UDL have suggested that teachers should organize the instructional environment and learning activities base on representation, expression, and engagement in order to include all students, devoid of any discrimination (CAST, 2015; Katz, 2012).

Since it was officially recognized as an instructional framework, several studies have examined and reported the benefits of applying UDL principles in inclusive classrooms. In a quasi-experimental study that compared outcomes of using a Literacy by Design (LBD) technology-based learning environment that aligned with the three UDL principles to a control group receiving traditional reading instruction, Coyne et al. (2012) reported that students who received the LBD intervention made significantly higher gains in comprehension compared to those in the traditional reading group.

Marino et al. (2014) conducted a mixed-method study to examine the performance of 57 students with learning disabilities in a UDL-based inclusive science classroom. They followed these students over the course of a school year by alternating between the use of traditional curricular materials and materials that were enhanced with video and print-based texts such that it closely aligns with Universal Design for Learning (UDL) guidelines for selected units of study. Although there was no significant difference in performance between students taught with the UDL-aligned units and those using traditional curricular materials, the authors reported that the UDL-based units led to heightened levels of student engagement.

Browder, Mims, Spooner, Ahlgrim-Delzell, and Lee (2008) carried out a single subject study with three students with multiple disabilities in a special education classroom in a large urban school system in the southeastern United States. The purpose of the study was to examine the literacy skills of these students using principles of universal design for learning. The outcome revealed that all three students showed increases in their independent responses, an indication that there was an improvement in their literacy skills.

Further, in a quasi-experimental study, Finnegan (2013) evaluated the impact of Universal Design for Learning-Expression (UDL-E) on student engagement and student demonstration of content knowledge in inclusive science. The author concluded that students found the UDL-E intervention to be helpful to their learning. They enjoyed exploring the opportunity to express their knowledge of science through the "Expression" principle of Universal Design for Learning.

In another study to examine the effect of UDL framework on high school students' learning and self-regulation skills in a new grammar structure in an English course, Yuzlu and Arslan (2017) reported that the UDL model significantly and positively influenced students' academic achievement compared to the traditional method of teaching.

Based on the empirical evidence on the impact of UDL in inclusive classrooms, the researcher used UDL principles as a theoretical framework to help him examine the instructional practices of participants and how they vary their instruction through representation, expression, and engagement to promote inclusion in their classroom. The next section of this chapter, therefore, describes the principles and guidelines of UDL in detail.

2.5.4 Strength-based approach. The underlying principles of the strength-based approach to education emanate from social work, clinical psychology, and organizational theory and behaviour, which rely on the positive aspects of children such as strengths, capabilities, and resources to enhance teaching and learning (Fan & Fielding-Wells, 2016; Resiliency Initiative, 2011). Lopez and Louis (2009) conceptualized this approach to teaching as practices that shape how teachers engage the teaching and learning process by mobilizing students' strength rather than their weaknesses. It represents a shift from a deficit teaching model, which "inadvertently responds to [children] more negatively and with less enthusiasm (Epstein et al., 2003, p 286) toward a child-centered teaching approach that focuses on the strength and potentials of individual learners. Proponents of a strength-based approach to education, therefore, believe that "everyone has strengths and that everyone has the potential to use these strengths to achieve personal goal" (Brownlee, Rawana, & MacArtthur, 2012, p. 3).

According to Rawana and Brownlee (2009), strength is "a set of developed competencies and characteristics that [are] valued both by the individual and society and is embedded in culture" (p. 256). Advocates of strength-based educational approach subscribe to the adoption of inclusive practices that revolve around the strengths instead of difficulties and challenges of learners to enable them to experience "hope and solutions rather than just problems and hopelessness" within the educational environment (Hammond, 2016, p. 4).

Consequently, teachers who integrate the strength-based approach to manage and address the diverse needs of students in their classroom are encouraged to examine and identify the strengths of every individual learner and tailor their instructional activities around them. As noted by Rawana, Latimer, Whitley, and Probizanski, (2009), "once those strengths are identified and encouraged, it creates a kind of positive ripple effect within a classroom—a type of 'pay-it-forward' scenario where all students 'pay-their strength-forward' without much effort" (p. 16). This enables teachers to manage students' behaviour, identify their learning preferences, interests, and set expectations that meet each learner's academic and social needs (Rawana & Brownlee, 2009; Rawana, Latimer, Whitley & Probizanski, 2009).

Although this approach to education is grounded in the tenets and practices of social work and clinical psychology, Lopez and Louis (2009) identified five basic educational principles that may guide teachers who plan to adopt the strength-based approach in their classrooms:

a) Teachers should measure student characteristics, which includes the assessment of strengths, achievement, and positive outcomes.
b) Teachers should adopt individualization instructional approach by tailoring their instructional practices and activities to suit students' abilities, needs, and interests.
c) Teachers should encourage the formation of networking or collaboration among learners to help them learn from the strengths showcased by their peers during projects and other group activities and to discover their strengths.
d) There should be a deliberate application of strengths within and outside of the classroom to help students develop and integrate new behaviors which are associated with positive outcomes.

e) Teachers should create opportunities such as guiding students to, strategically, select course or program, use of campus resources, involvement in extracurricular activities, internships, mentoring relationships, or other targeted growth avenues that allow students to actively engage in a novel or previously unexplored experiences to develop their strengths. (Lopez & Louis, 2009, pp. 2-6)

Taken collectively, the strength-based model is embedded in the recognition of individual's strengths and learning together as a holistic community, "which means that students are not singled out for needing extra support and students whose challenges might have escaped particular notice also receive a positive intervention" (Brownlee, Rawana, & MacArtthur, 2012, p. 11). In a diverse classroom, teachers must create a classroom environment that provides opportunities for students with and without exceptionalities to recognize and develop their potentials (Epstein et al., 2003) by focusing on their strengths during the teaching and learning process. By responding to the diverse educational needs of students with and without exceptionalities at the same time, "students will be able to take responsibility for their learning and develop their own interest and talents from a strengths perspective" (Rawana, Latimer, Whitley & Probizanski, 2009, p. 17). This will ultimately create a cultural shift from a deficit-based teaching toward one that focuses on strength, motivation, and capabilities so as to reduce barriers, make the curriculum accessible to students, and set the stage for students' academic and social development (Epstein et al., 2003; Rawana et al., 2009).

2.6 Theoretical Framework

Merriam (2015) pointed out that all research studies, whether qualitative or quantitative, are underpinned by a theoretical framework. She defines a theoretical framework as: "the underlying structure, the scaffolding or frame of your study. It is the concepts, assumptions,

theories that inform your study and it is derived from the literature you are reading and consulting about your topic" (p. 128). Grant and Osanloo (2014) argue that a research study without a theoretical framework lacks direction and a sense of purpose because the framework "serves as the guide on which to build and support your study, and also provides the structure to define how you will philosophically, epistemologically, methodologically, and analytically" approach the study (p. 13).

When choosing a theoretical framework, it is imperative for the researcher to consider the problem, purpose, significance, and research questions underlying the study because the theoretical framework links all these together to enable the researcher to choose an appropriate methodology and analytic procedures (Grant & Osanloo, 2014) so as to construct knowledge and make an informed conclusion. According to Scotland (2012), "what knowledge is, and ways of discovering it, are subjective" (p. 14). Depending on the purpose of the study, the researcher may use one or multiple frameworks in his or her study. However, using more than one theoretical framework in a study can help the researcher achieve outcomes that are epistemologically satisfactory and meaningfully contribute to knowledge (Love, 2002).

The purpose of this study was twofold: to explore the perspectives of science teachers on inclusion and examine their instructional practices as they implement inclusion in the classroom. To develop a lens through which participants' perspectives and the implementation of inclusion can be examined, this study was grounded in two theoretical perspectives: *social constructivism* and the *Universal Design for Learning* (UDL) framework. In the next section, a description of each of these frameworks with an explanation of how they serve as a guide to assist the researcher in addressing the research questions has been provided.

2.6.1 Theory of constructivism. In recent years, the instructional practices of teachers have increasingly come under scrutiny as a result of the push for inclusion and *science for all*. Current education scholars (e.g. Czerniak & Chiarelott,1990; Mastropieri & Scruggs, 2010; Rose & Meyer, 2002; Saunders, 1992; Von Secker & Lissitz, 1999; Windschitl, Thompson, Braaten, & Stroupe, 2012) have advocated for a shift from the traditional instructional approach towards one that addresses the needs of the 21st century classroom. The constructivist approach to teaching and learning is one such approach deemed to be effective in responding to this call (Hein, 1991; Mallory & New, 1994).

Proponents of constructivism such as Piaget and Vygotsky argue that individuals do not acquire knowledge through transmission; instead, they construct knowledge and meaning by interacting with their social and physical environment (Greenlees, 2015; Schweitzer & Stephenson, 2008). To them, meaning-making is an individualistic process which depends on the individual's mind and interaction with the world around him or her (Hein, 1991).

According to Vygotsky's (1970) social constructivism, social interaction plays an essential role in cognitive development. Au (1998) asserts that creating a socially supportive environment where there is active collaboration among teachers, parents, and students mediates learning and enhances understanding. Following this, students should be made active participants in a constructivist teaching and learning environment to enable them to interact with their environment. It is only through interaction and engagement with their environment that they are able to construct knowledge and make meaning out of the learning experiences.

Meanwhile, Greenlees (2015) asserted that teachers engage in many social exchanges with students, colleagues, administrators, and parents on a daily basis. These exchanges provide opportunities to promote learning and correspondingly shape the views, knowledge,

understanding, and experiences of teachers of the daily occurrences in the school. As emphasized by Crotty (1998), knowledge and meaning emerge when individuals engage with their world and the objects in it. Situating the current study within the framework of social constructivism, therefore, provides an opportunity for the researcher to engage participants in their natural settings to gain an in-depth understanding of (a) how they conceptualize inclusion and (b) their instructional planning and practices in the classroom.

2.6.2 Framework of universal design for learning (UDL). Advocates of UDL maintain that flexibility in instructional practices is critical in addressing needs in inclusive classrooms (CAST, 2011; Katz & Sugden, 2013; Meyer, Rose, & Gordon, 2014; Novak & Rose, 2016). Theoretically, the UDL framework is grounded in two essential principles: the architectural principle of universal design and cognitive neuroscience principle (Burgstahler, 2011; CAST, 2011; Erlandson, 2002; King-Sears, 2009). However, the recent educational literature on UDL has typically focused on the cognitive neuroscience framework developed by Rose and Meyer (2002). This framework applies the concept of accessibility within the architectural principle to educational settings to maximize learning and make it accessible to all students (Best, 2016; Johnson-Harris, 2014; Katz, 2012).

Like the architectural principle of universal design in which buildings, products, and services are designed to include all individuals, with and without disabilities, the cognitive UDL framework encourages teachers to be educational architects by designing the curriculum and instructions so that they eliminate barriers to learning to promote students' success (Salend & Whittaker, 2017). That is to say; the UDL framework "provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone" (CAST, 2011, n. p) rather than the linear approach to instruction, which treats all students as a single entity.

Contrary to the popular notion that disabilities lie within humans, proponents of UDL argue that it is the educational environment that disables the learner, thereby creating barriers to the learner. Making the educational environment, including the curriculum and instruction, student-friendly and universally accessible to every child in the classroom eliminates barriers and makes the curriculum readily available to all students (Katz, 2015; Novak & Rose, 2016).

Based on Vygotsky's (19780) conditions for learning, the UDL framework developed by Rose and Meyer (2002) is supported by three broad networks of learning which are directly linked to the brain: (a) the recognition network, which deals with the "*what*" of learning; (b) the strategic network, which focuses on the "*how*" of learning; and (c) the affective network, which covers the "*why*" aspect of learning (CAST, 2011; Katz, 2012; Meyer, 2006). Tapping into each of these specialized areas of the brain helps account for individual differences, promotes inclusion, and maximizes learning in students (Best, 2016).

To help general and special education teachers implement the UDL framework in their teaching, the proponents of UDL developed three basic principles along with guidelines:

1. Multiple means of representation, which entails the use of a variety of methods such as discussions, digital texts, and multimedia to present information to students and provide a range of means to support them.
2. Multiple means of action and expression, which involve the provision of alternative ways that enable students to demonstrate what they know such as multimedia presentations, paper and pencil tests, digital recordings, and artworks.
3. Multiple means of engagement, which provides alternative choices such as collaborative learning, instructional games, simulations, real and virtual tours, that enable the teacher to

Table 1

UDL Principles and Guidelines

UDL Principle	Guidelines
Multiple means of Representation	1. Provide options for perception 2. Provide options for language, mathematical expression, and symbols 3. Provide options for comprehension
Multiple means of Action and Expression	1. Provide options for physical action 2. Provide options for expression and communication 3. Provide options for executive function
Multiple means of Engagement	1. Provide options for recruiting interests 2. Provide options for sustaining efforts and persistence 3. Provide options for self-regulation

Based on CAST (2012)

tap into students' interests in order to optimize learning (CAST, 2011; Rose & Meyer 2002; Novak & Rose, 2016).

Each of the principles entails specific guidelines, which are summarized in Table 2 below.

Moreover, to make the use of the UDL principles and guidelines teacher-friendly and straightforward, a group of researchers and practitioners at the UDL-Implementation and Research Network (UDL-IRN, 2011) have further summarized the principles as four critical elements that

should be identified in UDL-aligned instruction. These four critical elements are: (1) setting clear goals, (2) intentional planning for learner variability, (3) flexible methods and materials, and (4) timely progress monitoring (UDL-IRN, 2011). Table 2 provides an overview of the UDL principles developed by Rose and Meyer (2002).

2.6.2.1 ***Examining UDL practices in the classroom*****.** Notwithstanding the increasing support for the integration of UDL principles in inclusive classrooms, questions remain as to what combination of the principles and guidelines need to be present in the classroom for it to be considered inclusionary or universally designed (Johnson-Harris, 2014; Rao, Ok, & Bryant, 2014). There are questions about how the framework "can be effectively applied to curriculum and instruction, and how it can be implemented systemwide to support meaningful inclusion" (Rao, Smith, & Lowrey, 2017, p. 38). Evidence shows that different researchers give different reports on how UDL principles are applied in the classroom. Some provide detailed reports based on all three principles and the associated guidelines, while others provide information related to only the context of their study (Rao, Ok, & Bryant, 2014; Rao, Smith, & Lowrey, 2017). The latter description closely aligns with how the framework was adopted in this study. The purpose of using UDL principles as a framework was not to measure or assess how participants in this study apply the UDL principles in their classrooms. Instead, the intent was to use it as a lens to enable the researcher to examine how participants adopt inclusionary teaching practices in their classroom to enable students to access, engage with and demonstrate an understanding of the science curriculum in ways that suit their individual abilities, interests, and background experiences. In order to achieve this, a UDL template was adopted as an observation protocol (see Appendix I).

The three UDL principles, multiple means of representation; multiple means of engagement; and multiple means or action and expression, constitute the touch points of creating

an inclusive learning environment for students (Nelson & Rose, 2014). Multiple means of representation, which refers to the recognition network, allows the teacher to utilize multiple and flexible instructional approaches to represent information to students. The second principle, multiple means of action and expression, refers to the strategic network and provides various options that allow students to express and demonstrate their knowledge and what they have learned. Lastly, multiple means of engagement is concerned with the affective network which addresses student engagement by answering the *why* of instruction by adopting a variety of instructional strategies to recruit students' interests, sustain their efforts and persistence, and modulate their emotional state to enable them to cope and engage with the environment (CAST, 2018; Pilgrim & Ward, 2017; Rose & Meyer, 2002). Each of the three principles has guidelines for curriculum planning. For example, multiple means of engagement has three guidelines: (a) options for perception, (b) options for language, mathematical expression, and symbols, and (c) options for comprehension. The option for perception provides various options such as visual representations, auditory transmission, using online media, videos and customizing the display of material to students with visual or perceptual difficulties to enable them to access the curriculum and to support their comprehension. The second guideline allows teachers to plan instruction inclusively such as using a variety of formats to define new vocabulary and symbols, work with syntax and structure, and decoding strategies to assist students who have difficulties with language and symbols. The third guideline focuses on students' comprehension and supports. It allows the teacher to activate students' prior knowledge, address essential ideas in the lesson while assisting students with how to process and transfer the information learned (Pilgrim & Ward, 2017). Utilizing the principles and associated guidelines together provides varied options to the teacher to activate the three primary networks for learning: recognition, affective, and strategic networks. This consequently

enables teachers to approach the diversity in the classroom differently to address the diverse learning needs of students (Nelson & Rose, 2014; Pilgrim & Ward, 2017).

Chapter 3

Methodology

Introduction

The quality of any research rests on the appropriateness of the methodology used (Kothari, 2004). A research methodology is a systematic approach used by the researcher to address the research questions and the overall research problem. It encompasses the research methods and the philosophical assumptions underlying those methods to enable the researcher to explore a specific issue of interest (Creswell, 2012; Kothari, 2004). In this study, the researcher adopted a qualitative research design to explore the perspectives and practices of high school science teachers on inclusive pedagogy. To provide a detailed understanding of the research design of the study, Chapter 3 is organized into the following sections: (a) a review of the research questions guiding the study, (b) a detailed description of the research design and rationale, (c) the procedure of sample selection, (d) confidentiality and ethical issues, (e) data collection methods, (f) the data analysis procedure, (g) the limitations of the study, (h) the validity and reliability of the study, and (i) the researcher's role.

3.1 Research Questions

According to (Yin, 2011), good research questions emanate from the review of existing literature on a topic of interest. From the literature reviewed in Chapter 2, it emerged that very little is known about the perspectives and practices of high school science teachers on inclusive pedagogy. Based on this research gap, this study explored the following open-ended research questions to gain insights about participants' perspectives and practices on inclusive pedagogy:

1. What are high school science teachers' conceptions of inclusive pedagogy?

2. How do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diversity in their classrooms?
3. What specific inclusive pedagogical strategies do high school science teachers use to respond to the diverse learning needs of students?

3.2 Rationale for Qualitative Research Design

According to Gay, Mills, and Airasian (2015), a qualitative research study is typically concerned with using research participants' perspectives to provide a deeper understanding of a phenomenon. For this reason, Merriam (2009) suggested three key areas that should be of interest to a qualitative researcher: "(1) how people interpret their experiences, (2) how they construct their worlds, and (3) what meaning they attribute to their experiences" (p. 23). In this study, the researcher aimed to explore the perspectives of high school science teachers to gain an in-depth understanding of how they conceptualize and use inclusive pedagogy to make the science curriculum accessible to their students. As such, a quantitative research design was deemed inappropriate for the study. Instead, the researcher adopted a qualitative research design to allow him to enter the naturalistic world of the participants to gain a holistic understanding of their experiences using their views (Creswell, R2014).

Yin (2011) proposed that a researcher may use several research approaches in a qualitative study. According to (Creswell, 2014), the researcher may adopt a narrative inquiry, phenomenology, ethnography, grounded theory, or case study methodology. However, when deciding on which research approach or methodology to use, he/she must be guided by the research purpose (Baxter & Jack, 2008), research questions, and the philosophical underpinnings of the study (Creswell, 2014; Merriam, 2009). Following this, the researcher adopted a qualitative case study methodology, as it was compatible with the philosophical paradigm underlying this study.

3.3 Rationale for Case Study Methodology

As indicated above, the methodology used in a qualitative study is heavily influenced by the philosophical assumptions of the researcher (Creswell, 2014). The methodology directly affects each step of the research process, from the selection of the topic of interest to the writing of the final report (Yazan, 2015). Epistemologically, this study was conceptualized within the framework of social constructivism. Crotty (1998) asserted that the world and the objects in it "may be pregnant with potential meaning, but actual meaning emerges when consciousness engages with them" (p. 43). Therefore, within a social constructivist framework, the researcher engages the research participants in their naturalistic settings to gain an in-depth understanding of how they construct their own meaning or knowledge (Creswell, 2014: Merriam, 2009; Suter, 2011). Merriam (2009), Stake (2005), and Yin (2011) suggested that a qualitative study that focuses on eliciting an in-depth understanding of a phenomenon within a bounded context may adopt a qualitative case study methodology because it provides an opportunity for the researcher to closely interact with the participants within real-life contexts to examine their thoughts, insights, beliefs, and experiences to gain a holistic understanding of a phenomenon. Based on this, the researcher relied on a qualitative case study methodology for an in-depth exploration and analysis of participants' conceptions and practices on inclusive pedagogy within a bounded system.

Merriam (2009) described a qualitative case study as "an in-depth description and analysis of a bounded system" (p. 40). She explains that the "case" can be a person, a program, a group, a specific policy, or an institution. Also, the "bounded system," according to (Creswell, 2012), implies the case "is separated out for research in terms of time, place, or some physical boundaries" (p. 465). This implies that a qualitative case study should have a finite number of participants with a fixed number of interviews and observations Merriam (2009). This notwithstanding, "the sample

size is not generally predetermined. The number of participants depends upon the number required to inform fully all important elements of the phenomenon being studied" (Sargeant, 2012, p. 1). Therefore, the decisions regarding the selection of participants are informed by the research questions, theoretical perspectives, and evidence guiding the study. Based on this, four high school science teachers from three different schools with experiences in teaching the Newfoundland and Labrador science curriculum were selected as the "case" to explore their perspectives and practices on inclusive pedagogy.

Stake (2005) used three typologies to describe a case study methodology: intrinsic, instrumental, and collective case study. This qualitative case study followed Stake's instrumental case study. According to Stake (2005), an instrumental case study "is examined mainly to provide insight into an issue or to redraw a generalization" (p. 437). The current case study aligns with this description in that the purpose was mainly to provide insight into participants' perspectives and instructional practices on inclusion. Also, the case was used to illuminate the challenges faced by science teachers in inclusive classrooms. Thus, while the findings from this study may not be generalized to represent the practices and experiences of all high school science teachers in inclusive classrooms, they may be useful in shaping science teachers' instructional practices, policy on teacher training, provision of professional development supports, and future research on instructional practices.

3.4 Procedure for Sampling

Cohen, Manion, and Morrison (2007) asserted that "the quality of a piece of research stands or falls not only by the appropriateness of methodology…but also by the suitability of the sampling strategy that has been adopted" (p. 100). There are two basic sampling techniques a researcher may use in a study: probability and non-probability sampling (Merriam, 2009). Since

generalizability was not the intent of this study, a non-probability sampling technique was used. Precisely, the researcher used a purposeful sampling technique to enable him to select participants judged to be particularly informative about the issue of inclusion and its implementation in the science classroom (Merriam, 2009). Rather than generalizing to a larger population (Neuman, 2013), purposeful sampling allows the researcher to hand-pick a specific group of participants with rich experiences to enable him/her to answer the research questions (Creswell, 2012).

Initially, a total of 21 science teachers from high schools across the Avalon Region of the Newfoundland and Labrador English School District were invited through emails to participate (see Appendix A). These teachers were provided with informed consent forms that outlined the purpose of the study, benefits, the researcher's expectations, and rights of participants (see Appendix B). Out of the 21 teachers sampled, four teachers from three high schools accepted the invitation and freely gave their consent to participate. This sample size aligns with Creswell's (2014) suggestion that qualitative case studies should contain about four to five cases, as a smaller sample size allows the researcher to provide an in-depth analysis. Further, it justifies Merriam's (2009) suggestion that case study designs should have a limited number of participants who could be observed and/or interviewed.

In selecting the participants and research sites, the researcher used the following criteria purposefully for the selection process: (a) all participants teach in inclusive schools based on the Newfoundland and Labrador Department of Education and Early Childhood Development 2009 Inclusive Education Initiative, (b) participants are certified science teachers, (c) participants have more than one year of science teaching experience in an inclusive setting, and (d) participants freely express a willingness to participate in the study through informed consent.

The next section provides a summary of each of the participants involved in the case study. Their characteristics based on the sampling criteria have been provided in Table 1, shown on the next page. The total number of years taught in an inclusive setting is based on participants' own account. For the purposes of data analysis and to maintain confidentiality between the researcher and participants, the real names of participants have been replaced with pseudonyms. The next section provides more details about the participants.

3.4.1 Case study participants. As indicated in Table 1, the four participants in this study had several years of experience in teaching science, ranging from five to twenty-three years, at the time of this study. The following are summaries of each participant who agreed to participate.

Table 2

Participants' Characteristics Based on the Selection Criteria

Participant	Total years of teaching	Total years in inclusive setting	Teaching Area	Educational background
Regina	22	22	Biology	B.S.Ed., B.Ed. (Secondary), B.Sc. (Biology)
Janet	5	5	Science	M.P.Ed., B.Ed. (Intermediate/Secondary), B.Sc. (Biochemistry)
Cynthia	13	13	Physics	M.Ed. (Curriculum), B.Ed. (Intermediate/Secondary), B.Sc. (Hon) (Physics)
Edward	12	8	Biology	M.Ed. (Educational Leadership), B.Ed (Intermediate/Secondary), B.Sc. (Biology)

Regina

Regina is a 51-year-old science teacher. She was the only participant trained as a special education teacher with a Bachelor of Special Education degree. She had 22 years of teaching experience and had spent six years at her current school at the time of this study. Her classroom had a straight-row seating arrangement where the students face the teacher. Regina had an average class size of 35 and taught biology from grade 10–12. Her school had a population of about 700 students with 52 teachers. Of these 52-teaching staff, 10 were instructional resource teachers. At the time of this study, Regina was teaching two sections of Biology 3201 and one section of Environmental Science 3205. Regina's class was equipped with a desktop computer and a number of iPads with internet access for students. The availability of technology in her class enabled her to respond to students' diverse needs such as those with language disabilities. She explained that there is a wide range of needs and disabilities in her classroom, including attention deficit hyperactivity disorder (ADHD), anxiety, mental health issues, autism, learning disabilities, physical disabilities, cognitive delays, and hearing impairments. As a science teacher with a special education background, she firmly believes that all children have the right to be educated in inclusive classrooms. Regina explained that she enjoys working with children and watching them explore and learn. This motivated her to become a teacher. Specifically, she specialized in science because she feels that science provides answers to many of the difficult questions in life, and these answers may be proven through experimentation.

Janet

Janet is 28 years old and holds a Master of Professional Education as her highest form of post-secondary education. In addition to a B.Ed. (Intermediate/Secondary), she also holds a Bachelor of Science degree in Biochemistry. She is a general education science teacher. At the

time of this study, Janet was in her sixth year as a science teacher. She taught as a junior high school teacher before moving to her current school, and she is in her second year in her new school. Janet had an average class size of 30 and had a wide range of needs in her classroom, including students with reading and writing disabilities, autism spectrum disorder, anxiety disorder, and ADHD. As a general education science teacher, she described her roles as teaching the Newfoundland and Labrador science curriculum from grades 7–12, providing learning and assessment accommodations for students requiring them including the provision of relevant and meaningful learning experiences for all students for lifelong learning. She taught Science 1206 and 2200, Environmental Science 3205, and Mathematics 2202 at the time of this study. Although her classroom was traditionally arranged with students facing her, there was a lot of peer collaboration and engagement in her class during lessons. She strongly supports inclusion because she believes education is a right and all children should be educated together devoid of any discrimination. On why she became a science teacher, Janet explained that she loved helping people and was involved in many things around her community when growing up. She also performed very well academically and loved science and mathematics. She felt these traits together with the positive influence of her high school teachers and family solidified her decision to go into teaching. Janet loves technology and utilizes it in her lessons to make them more inclusive. She had a desktop computer with internet access. She also had iPads for her students and often used videos in her lessons.

Cynthia

Cynthia is 35 years old and a general education science teacher with a Master of Education degree in Curriculum Studies. At the time of this study, Cynthia had 13 years of teaching experience. Her classes ranged in size of about 26 students, but sometimes fewer, which enabled

her to spend more time with her students. She taught physics in grades 10–12 and described her school as having a multicultural background. She explained that she has a diverse group of students with a wide range of needs in the various classes she teaches, including students in need of special services such as extended time, provision of notes, clarification of instruction, and assistive technology based on diagnoses such as anxiety, attention deficit disorder (ADD), and ADHD. Her classroom had a traditional straight-row seating arrangement with the students facing the teacher. Cynthia is very enthusiastic about teaching. She explained that her past experiences as a student influenced her decision to go into teaching:

> I love interacting with and helping out others and always wanted to teach. I chose physics because I found it difficult as a student but once I understood it, it was an amazing breakthrough for me in learning how to learn. I wanted to share that experience with others (Interview 1).

As a general education science teacher, she explained that her roles and responsibilities include but are not limited to the provision of special services accommodations to students, differentiating instruction and utilizing technology to make her lessons more inclusive, and keeping lines of communication open with students, parents, and staff through phone, email, and meetings. She explained that she uses an inquiry-based instructional approach as well as the traditional approach to instruction in her classroom due to the nature of the subject she teaches. She was equipped with a computer and internet access. She explained that using technology in lessons motivates and enhances students' understanding. However, she felt it is challenging for her to use Google Forms and other online teaching services for mathematics-oriented subjects like physics.

Edward

Edward is a 41-year-old science teacher with a Master of Education degree in Educational Leadership. He had 12 years of teaching experience at the junior high and high school levels and had a diverse teaching background, including teaching in private schools. In addition to classroom teaching, Edward also has a coaching background. He explained that most of his "career choices and job or employment have been working with youth in some capacity (Interview 1)." He had worked with youths in diverse ways, including coaching sports and teaching swimming. As a teenager, Edward was fond of science and always found "laboratory and field studies" interesting, factors which motivated him to go into teaching. Before joining his current school, Edward had taught English, creative writing, mathematics, religious studies, music and art in grades seven, eight, and nine. At the time of this study, Edward was teaching Science 1206 and Biology 2201 and 3201 in his current school. His classroom setup had a straight-row seating arrangement with his students facing him. He had a multigrade classroom with an average class size of 36. He had a diverse classroom including students with visual impairments, anxiety and depression disorders, behavioural disorders, and students with a variety of individual education plans and testing accommodations such as requiring extra time, alternate settings, and the use of technology. He explained that he is "a big fan of how you learn as inclusive" and likes "looking at multiple intelligence as a way to practice inclusion" (I-1). He relied on multiple intelligence data from his students to form groups and give different assignments to his students. Besides teaching the Newfoundland and Labrador science curriculum, Edward doubled as a lead teacher and science facilitator by assisting in professional developments, collaborating with colleagues, and providing peer assistance. His school had a student population of about 875 with 64 teaching staff. Of this number, only seven of the teachers were scheduled as instructional resource teachers.

3.5 Confidentiality and Ethical Issues

Gaining access to sites and participants to collect data in research studies should be ethically respectful to the participants and study sites (Creswell, 2012). In view of this, the researcher must establish a relationship of trust between himself and the participants before the start of data collection (Gay, Mills, & Airasian, 2015: Merriam, 2009). In this study, the researcher strived to prioritize the rights and welfare of participants throughout the study by adhering to the *Tri-Council Policy* underlying research involving humans as espoused by the ethics board of the Memorial University of Newfoundland. That is respect for persons, concern for welfare, and justice. Most importantly, this study underwent an ethical review and received clearance from the Interdisciplinary Committee on Ethics in Human Research at Memorial University of Newfoundland (ICEHR #: 20180743-ED) (see Appendix C). Following this, the researcher consulted different gatekeepers at different levels to gain access to participants and research sites due to the in-depth and complex nature of the study (Creswell, 2012: Marshall & Rossman, 2014). Creswell (2012) describes a gatekeeper as "an individual who has an official or unofficial role at the site, provides entrance to a site, helps researchers locate people, and assists in the identification of places to study" (p. 211). For example, the researcher requested and received permission to conduct research from the Newfoundland and Labrador English School District (see Appendix D and F). Further, permissions were sought (see Appendix E) and granted by principals of high schools involved in the study before visiting participants and study sites to collect data.

Participation in the study was entirely voluntary in that participants had the right to withdraw their consent and involvement at any time without prejudice. In case a participant decided to withdraw from the study, any data from him or her would be deleted, except if the decision to withdraw occurred at the period of writing the report as explicitly expressed in the

informed consent form. Besides, the researcher discussed the benefits of participation with participants, including the opportunity to contribute knowledge to the growing body of literature on inclusive instructions and practices in education. For transparency and fairness, all participants were allowed to review transcripts of their interview recordings, observation notes, and to learn about the results of the study. Moreover, to safeguard participants' confidentiality, an alphanumeric coding system was used to collect and analyze data. Participants' real names and the names of their schools were replaced with pseudonyms. For example, in sharing and discussing information from this study with his supervisor, the researcher used Ob1/S2-Cn to denote observation number 1, a second school, and a participant with the pseudonym Cynthia.

Although there were no risks of physical danger to participants, there was an anticipated risk of participants becoming stressed or troubled when sharing their understanding of and experiences about inclusive pedagogy. As such, the researcher prioritized their welfare by providing information on counselling services through the Mental Health Crisis Line and informing them of the right to quit the study without prejudice as overtly expressed in the informed consent form. Consistent with Memorial University of Newfoundland's ethical policies and procedures on anonymity, the researcher made all efforts to ensure that all contributions, participation, and participants' identities were always held in confidentiality.

3.6 Data Collection Methods

Methods used to collect qualitative data should be adequate to assist the researcher to answer the research questions (Cohen, Manion, & Morrison, 2007). Gay, Mills, and Airasian (2015) asserted that no one procedure explains how researchers should collect data in qualitative studies. It is up to the researcher to "determine what data will contribute to his understanding and resolution of a given problem and collect the appropriate and accessible data for that problem" (p.

413). As such, multiple data sources such as interviews, direct observations, and documents analysis may be used to collect data (Marshall & Rossman, 2014; Patton, 1990; Yin, 2011). Triangulating data using multiple sources and methods strengthens trustworthiness and validates the research findings (Merriam, 2009; Patton, 1990; Yin, 2011).

Drawing from the above, three sources of data (semi-structured interviews, observations, and documents) were relied upon to obtain in-depth insight into participants' conceptions and practices of inclusive pedagogy. The adoption of these data collection methods and sources required the researcher to immerse himself in the setting under study for a considerable time to collect as much relevant empirical data as possible (Gay, Mills, & Airasian, 2015). Therefore, data collection in this study began in the Fall 2017 semester and ended in the Winter 2018 semester, lasting for six months. The next section discusses each of the data collection methods used in detail.

3.6.1 Interview procedure. The researcher adopted the person-to-person or one-on-one interview approach to elicit information from the participants (Creswell, 2012; Merriam, 2009). In a one-on-one interview, the researcher collects data by asking participants questions and recording the answers concurrently (Creswell, 2012). Two semi-structured interview protocols were developed by the researcher using open-ended questions based on the research questions. Depending on the participants' responses, the open-ended questions were interlaced with probes to seek clarification and elicit additional information. The researcher utilized semi-structured interviews due to the subjective nature of the study. Since the researcher is the primary instrument of data collection (Merriam, 2009), he/she brings a particular lens to his data collection process. This lens is not free from preconceived notions, as no lens is free of bias (Mason, 2017). As such, using semi-structured interviews with open-ended questions offered an opportunity for two-way

interactions: the researcher engaged participants to elicit their views, while participants unrestrictedly shared their experiences with the researcher without being limited by the researcher's preconceived notions (Crotty, 1998; (Yin, 2011) based on his experiences as a general education science teacher.

The first interview (I1) consisted of 12 open-ended questions, which directly aligned with the research questions and purpose of the study (see Appendix G). The intent was to obtain information on how participants conceptualized inclusive pedagogy and their perspectives on their instructional practices in an inclusive environment. The researcher used interviews to engage participants because meaning is socially constituted, so the use of interview conversations served as a pipeline through which the participants shared knowledge with the researcher (Weinberg, 2002). It allowed the researcher to understand the participants' perspectives on their lives, work, experiences, and situations as expressed in their own words (Merriam, 2009). The second interview (I2) was a follow-up after the researcher had examined participants' instructional practices through observations. Specifically, the intent of the second interview was twofold. First, it aimed to acquire data about indicators that inform participants' choice of instructional practices, and, second, it allowed participants to reflect on their instructional practices and experiences and share them with the researcher. The second interview consisted of seven items, which included questions that elicited participants' opinions on effective instructional practices in an inclusive setting and specific indicators that will guide their choice of teaching pedagogies in the future when planning to teach diverse groups of students (see Appendix H).

Contingent on the fact that qualitative researchers acquire rich data by entering the natural world of the participants (Creswell, 2014; Gay, Mills, & Airasian, 2015; Merriam, 2009), the researcher interviewed all but one of the participants in their schools. All interview sessions,

interview locations, and times were based on the preference of the participants. As chosen by the other participant, the first interview was conducted in a private location, while the second one took place over the phone due to time constraints. Each interview lasted between 30–45 minutes and began with a review of the purpose of the study and informed consent. All interviews were digitally audio-recorded for transcription.

In addition to semi-structured interviews, the researcher used informal interviews as part of the data collection process. This helped him to develop a better understanding of participants' instructional planning and practices. According to Merriam (2009), informal interviews are usually used in conjunction with observations to gain insights and a better understanding of a setting of interest. In this study, the researcher engaged participants in open conversations right after lesson observations to discuss and to seek clarifications on some events of interest during the observations. He jotted down participants' responses and later developed them into fieldnotes for analysis.

3.6.2 Classroom observations. Since this study was conceptualized within a framework of social constructivism, knowledge was constructed from the social world of participants by observing their experiences and practices in a real-life setting (Mason, 2017). The researcher followed up the data collection process with classroom observations after the first semi-structured interviews. The purpose of the observations was to capture how participants facilitate inclusion in their classrooms. Precisely, the observations were used to examine the instructional practices of participants as related to research question three: *What specific inclusive pedagogical strategies do high school science teachers use to respond to the diverse learning needs of students*? A classroom observation data sheet, which was prepared based on the UDL framework (see Appendix I), was used. Like interviewing, observation is one of the most valuable data collection

tools in a qualitative study because it assists the researcher in gathering first-hand views of participants' experiences and practices in natural social settings (Marshall & Rossman, 2014). As a data-gathering technique, observation is systematic and addresses specific research questions. When it is used in conjunction with interviewing and document analysis, it triangulates emerging findings from the study (Merriam, 2009).

One key question about observation is what to observe during the process. According to Merriam (2009), what to observe or look for during observation is determined by the research problem, the research questions, and the theoretical framework. In this study, the researcher used an observation protocol (see Appendix I) based on the UDL framework as explained in chapter two under the theoretical framework. The observation protocol was based on the three fundamental principles of the Universal Design for Learning: (a) multiple means of engagement, (b) multiple means of representation, and (c) multiple means of action and expression (CAST, 2018). As indicated in the literature review, the purpose of adopting this protocol was not to score or assess how participants enact UDL principles in the classroom. Instead, it was to provide a lens that enables the researcher to examine how participants adopt inclusive practices in the classroom, as this framework is known to provide a blueprint for responding to inclusion by means of representation, expression, and engagement (CAST, 2018; Hall, Meyer, & Rose, 2012; Katz, 2012). The researcher used the UDL observation protocol, which served as a guide, alongside the four critical elements of UDL: (a) clear goals, (b) inclusive, intentional planning, (c) flexible methods and materials, and (d) timely progress monitoring that were developed by the (UDL-IRN, 2018) (see Appendix J) to examine science teachers' adoption of inclusive practices.

Overall, science teachers' practices, actions, and behaviours observed in their classrooms were recorded in the form of notes to constitute research data (Mason, 2017). The researcher

expanded these notes into descriptive and reflective information to constitute field notes after each observation. The descriptive and reflective notes helped the researcher to use words to capture the details of what transpired at the observation sites (Creswell, 2012; Mason, 2017; Suter, 2011). To prevent disruptions to participants, gatekeepers, and other individuals at research sites, the researcher adopted a non-participatory observation approach. As a non-participant observer, the researcher only observed and recorded behaviours and activities of the participants without directly embedding himself in what was being observed (Creswell, 2012; Gay, Mills, & Airasian, 2015; Merriam, 2009).

In all, there were a total of 10 observations: three observations each for three of the participants and one for the other participant as explained above. There were two observations in Cynthia's classroom and one each in the classrooms of Janet and Regina during the fourth quarter of the fall semester. No observation took place in Edward's classroom during this period due to the non-availability of the participant. As indicated above, the classroom observation period lasted between the Fall 2017 and Winter 2018 semesters. During the winter semester, the researcher continued the observation process with two visits each to the classrooms of Janet and Regina. In the case of Edward, only one observation was possible due to time constraints. Each observation lasted between 45 to 60 minutes and took place in participants' classrooms or science labs. Detailed descriptions of participants' instructional practices, strategies, and assessment formats will be discussed in chapter four under research outcomes.

3.6.3 Documents. Merriam (2009) describes documents as "a wide range of written, visual, digital, and physical material relevant to the study at hand" (p. 139). In this case study, documents in the form of teachers' lesson notes or lesson plans, classroom rules, and posters were collected. The use of these documents as a source of data helped the researcher to understand the activities

and instructional processes of the participants. Further, it guided the researcher about important questions to pursue during the observation and after the interview ((Patton, 1990). For example, using participants' lesson notes provided the researcher with information on the objectives of the lesson and the grouping strategies used. It also enabled the researcher to ask participants questions on their thinking process when preparing lessons to facilitate inclusion. These data were essential as they contributed to the researcher's understanding of how the participants described their instructional planning and practices.

All data collected from participants were encrypted and will be retained for a minimum of five years on a secure, password-protected laptop and electronic drive that is not accessible to any individual outside the study.

3.7 Data Analysis

Unlike quantitative research, data analysis in qualitative studies is not linear nor governed by strict rules or fixed procedures (Creswell, 2012; Kuckartz & Kuckartz, 2002). The researcher may adopt various techniques to analyze and make sense of the data, including the use of manual coding, computer programs (Creswell, 2012), or certain types of displays (Glesne, 2015). The researcher should analyze the data alongside the data collection process (Gay, Mills, & Airasian, 2015; Merriam, 2009) to enable him to reflect on and sculpt the study as it progresses (Glesne, 2015). However, a more intensive analysis of data to explore the research questions should take place at the end of the study. Data analysis is a process that "involves organizing what you have seen, heard, and read so that you can make sense of what you have learned" (Glesne, 2015, p. 130). It encompasses data consolidation, reduction, and the interpretation of participants' words and the researcher's observations (Merriam, 2009).

In this study, analysis of data occurred alongside data collection with the researcher transcribing all the audio interviews and observations into text form and reading through data thoroughly after each transcription to identify any emerging patterns in the course of the study. The repeated patterns identified at the initial stage were coded to form themes. Merriam & Tisdell (2015) defined coding as "assigning some sort of shorthand designation to various aspects of your data so that you can easily retrieve specific pieces of the data" (p. 199). The researcher used memo writing to record his initial thoughts and insights on key ideas from the data during the coding process. Leavy (2017) described memos as "a link between your coding and interpretations, [which] document [the researcher's] impressions, ideas, and emerging understanding" (p. 152). The patterns that emerged were recorded the in the researcher's research journal to guide him to generate insights about the data and to shape the study as it proceeded (Glesne, 2015; Yin, 2011). For instance, based on the patterns identified in the first interview transcript, the researcher's line of questioning for participant two, three, and four slightly changed.

To obtain in-depth insights into teachers' conceptions and practices of inclusion pedagogy, data were analyzed using the 2018 version of MAXQDA software tool. MAXQDA is a qualitative and mixed method software data analysis program developed by VERBI GmbH. The software provides researchers with maximum flexibility when analyzing data as it helps them to collect, organize, analyze, visualize, and publish a diverse range of data types (MAXQDA, 2019). As noted by Glesne (2015), using software tools in data analysis assists the researcher "in sorting, referencing, counting, coding, and displaying data" (p. 146). It facilitates "communication among members of a research team" (Merriam & Tisdell, 2015, p. 221) and provides an opportunity to address methodological weaknesses such as the lack of transparency and certainty associated with qualitative studies (Kuckartz & Kuckartz, 2002). Merriam (2009) and Yin (2011) point out that

data organization and management are key components in data analysis. They allow the researcher to easily locate or retrieve data for each of the cases in the study. Prior to the intensive analysis phase in a case study, the researcher must bring together all the information about the case, including interview logs or transcripts, field notes, and reflective memos "so the researcher can locate specific data during intensive analysis" (p. 203). Drawing from this, the researcher prepared a case study database by creating electronic folders for each of the cases which contained the transcripts, field notes, and documents from participants. He assigned labels to the data and uploaded them into the document system using the MAXQDA software. For example, labels such as Tr1/Cn and Tr2/Cn were respectively used to denote first and second interview transcripts of a participant by name Cynthia (Cn). Also, Ob1/S2-Cn and Ob3/S2-Cn were labels used to illustrate the first observation (Ob1) and third observation (Ob3), respectively, in school number two (S2) within Cynthia's classroom. The researcher edited the data after transcripts had been carefully reviewed by the participants to obtain comprehensive data ready for intensive analysis (Merriam, 2009).

For the intensive analysis, the researcher adopted an inductive multi-case analytic approach. The analysis was done inductively due to the researcher's "desire to prevent existing theoretical concepts from over-defining the analysis and obscuring the possibility of identifying and developing new concepts and theories" (Silver & Lewins, 2014, p. 6). So, rather than testing an existing theory or a hypothesis, the researcher made sense of participants' views and practices by inductively ordering and combining "bits and pieces of information from interviews, observations, [and] documents…into larger themes" (Merriam, 2009, pp. 15-16). With regards to the multi-case analysis, two analytic phases were followed: within-case analysis and cross-case analysis (Merriam, 2009). In the within-case analysis, data from each case were analyzed by

reading each of the transcripts slowly and thoroughly to identify and code recurring patterns or repeated words. For example, words such as *acceptance*, *equal opportunities*, *belong*, and *individual differences* that emerged from participants' descriptions of inclusive pedagogy were coded. Next, the coded patterns were compared with participants' lesson notes, posters, and the researcher's reflective notes on a case-by-case basis to gain in-depth insights into the participants' perspectives and practices on inclusion based on the research questions. The next phase of the analysis was to use colour-coding to connect similar patterns. Making connections in qualitative studies makes the research piece meaningful to the researcher and the reader (Glesne, 2015). It enables the researcher to generate tentative categories or themes from the data (Silver & Lewins, 2014).

Once the within-case analysis was completed, a cross-case analysis followed. A cross-case analysis as used in this study refers to a method of synthesizing the outcomes of two or more case studies to produce integrated evidence (Cruzes, Dyba, Runeson, & Host, 2015). To do this, the researcher used a constant comparative method to cross-compare the themes that emerged from each of the cases during the within-case analysis. He relied on the frequency at which patterns recurred and regrouped these common themes into broader themes with sub-themes (Miles & Huberman, 1984). The process of constant comparative analysis involves the researcher "comparing one segment of data with another to determine similarities and differences" (Merriam & Tisdell, 2015, p. 32). The emerged themes helped the researcher to identify the developing trends in the data to understand participants' conceptions of inclusion, how they described their instructional planning, what factors influenced their choice of instructional strategies, and challenges confronting them in inclusive science classrooms. To validate the themes that emerged from the analysis, the researcher discussed and reviewed each stage of the analysis with his

supervisor. Several suggestions were provided during this process. For example, during the initial stage of the analysis, the researcher created about 18 themes with sub-themes. However, after reviewing the analytic process with his supervisor, the data were re-analyzed, some sub-themes were collapsed into broader themes, while other themes were refined to constitute the final findings.

3.8 Limitations of the Study

As with any qualitative study, this study has several limitations. The first limitation is the sample size. This study sampled four high school science teachers purposefully to examine their conceptions and practices on inclusive pedagogy. Although this sample size was appropriate for a case study (Creswell, 2014; Merriam, 2009), the application of the outcomes of this study to other settings should be made with caution because the findings may be insufficient to draw generalizable conclusions. Moreover, participants were sampled from only high schools across the Avalon region of the English School District of Newfoundland and Labrador. Contextually, these participants may differ from their counterparts elsewhere in terms of school and administrative policies on inclusion, physical boundaries, and cultural diversity. Further, readers should note that the sample for this study contained more female science teachers than their male counterparts. Having a balanced ratio of male and female science teachers could potentially provide a different dataset which may alter the outcomes of the study.

Additionally, the researcher intended to have a total of two interviews and three classroom observations for each of the cases in this study. However, there were several challenges, including the recruitment of participants, resources, and time constraints, which influenced the study. As a result, one of the cases had only one observation in addition to the two interviews. The lack of data from this participant may have limited the researcher's ability to obtain rich information by

observing and cross-comparing the participant's perspectives on inclusive pedagogy against his instructional practices. Notwithstanding these limitations, the researcher's efforts to triangulate data sources and data collection methods coupled with the use of member checking criteria in the study make the outcomes trustworthy for future research. However, future researchers need to expand the scope of the study and strengthen its reliability by addressing the limitations highlighted above.

3.9 Issue of Trustworthiness (Validity)

Validity in qualitative research as described by Leavy (2017) "speaks to the quality of the project, the rigor of the methodology, and whether readers of the research findings feel you have established trustworthiness" (pp. 154-155). The trustworthiness of research outcomes is of utmost importance to the researcher (Creswell, 2012) since he/she is the primary instrument of data collection and analysis (Merriam, 2009; Merriam & Tisdell, 2015). Therefore, it is imperative for the researcher to incorporate measures that strengthen the trustworthiness of research findings into his work. According to Leavy (2017), one way of establishing validity or trustworthiness is to triangulate the study by using multiple data sources and data collection methods. The process of validating a research project requires the use of an appropriate research method "for a particular research purpose and [ensuring] that the data gathered and the conclusions drawn from the research findings are also determined to be appropriate" ((Leavy, 2017, p. 155). Apart from triangulation, trustworthiness or validity in qualitative research can be strengthened by addressing issues of credibility or internal validity, transferability or generalizability, dependability or reliability, and the researcher's bias (Creswell, 2014; Gay, Mills, & Airasian, 2015; Mason, 2017; Merriam & Tisdell, 2015).

3.9.1 Credibility or internal validity. According to Merriam and Tisdell (2015), credibility is concerned with the congruency of the research outcomes to reality. In this study, the researcher adopted several strategies to ensure the findings are credible and valid. He employed methodological triangulation in which interviews were used in tandem with classroom observations and document analysis to enhance the quality of data (Mason, 2017). Mason suggests that social phenomena are multi-dimensional, so researchers should use multiple methods to "approach their research questions from different angles, and to explore their intellectual puzzles in a rounded and multi-faceted way…[to] enhance validity" (p. 190). Also, since researchers are "the primary instrument of data collection and analysis, …interpretations of reality are assessed directly through their observations and interviews" (Merriam & Tisdell, 2015, p. 243). To this end, the researcher ensured that all classroom observations and six out of the eight interviews took place at the natural settings of the participants. This enabled the researcher to capture the views and practices of participants about the topic at hand in a real-life context.

The researcher spent adequate time with the participants during the data collection process. After using interviews to elicit participants' views on inclusion, he corroborated these data with three classroom observations and followed up with post-interview sessions. These measures strengthened the credibility of the findings by ensuring that the research data genuinely reflect the real-life experiences of the participants (Merriam, 2009). Further, another safeguard measure used by the researcher to ensure that the findings reflect the reality of the participants involved was reviewing and discussing the research outcomes with his supervisor, a professor of science education with decades of experience in qualitative research. Not only did the researcher allow for an expert review of the findings, but he also solicited feedback from the participants through

respondent validation. Incorporating these measures into the study provided an opportunity for the outcomes to be scrutinized to rule out any potential misrepresentation (Merriam & Tisdell, 2015).

3.9.2 Transferability or external validity. Merriam (2009) describes transferability as "the extent to which the findings of one study can be applied to other situations" (p. 223). Every research outcome is expected to be meaningful and transferable to the reader. It is therefore relevant for qualitative researchers to include context-relevant statements that enable the reader to decide whether the research outcomes apply to his or her context (Gay, Mills, & Airasian, 2015). This study purposefully sampled participants with rich background experience in teaching science in an inclusive setting as explained under sampling procedure in Chapter 3. This sampling technique increases transferability because it enables the researcher to obtain information-rich data, thereby allowing for "the possibility of a greater range of application by readers or consumers of the research" (Merriam & Tisdell, 2015, p. 257). Also, the researcher meticulously kept a detailed record of the research process. Data were alpha-numerically labelled, carefully organized, and stored based on dates, time, and location to enable him to retrieve them with ease. Extensively managing data this way allowed the researcher to analyze and provide a thick description of the study thoroughly (Mason, 2017; Merriam & Tisdell, 2015). Further, he strengthened transferability by adopting a cross-sectional analysis in which he constantly compared themes from individual cases together to obtain broad, unified themes (Mason, 2017).

3.9.3 Reliability or dependability. Reliability or dependability in qualitative research means that the researcher followed accurate and consistent research methods and techniques in his study (Creswell, 2014; Mason, 2017). To establish reliability in this study, the researcher employed the triangulation of methods and data sources. Triangulation of methods means he used interviews in tandem with observations and documents to collect data (Mason, 2017; Merriam, 2009). He also

used multiple sources of data by comparing and cross-checking evidence from the three data sources: interviews, observations, and teacher documents (Merriam & Tisdell, 2015). Triangulating the study enabled the researcher to build coherent and justifiable themes using perspectives and practices of participants. Establishing themes this way increases the quality and reliability of the research findings (Creswell, 2014; Mason, 2017; Merriam & Tisdell, 2015).

Further, the researcher kept an audit trail of the investigative process to ensure consistency and reliability. An audit trail in a qualitative study is a record of events that allows the researcher to give an account of how she/he arrived at their findings (Merriam & Tisdell, 2015). Readers or consumers of the study can follow this trail of the researcher to authenticate the outcomes of the study (Merriam, 2009).

3.10 Researcher's Role

As indicated above, qualitative researchers as the primary instrument for data collection and analysis (Merriam, 2009) bring into their study a particular lens which is not free from bias (Mason, 2017). Therefore, it is imperative for them to, reflexively recognize the biases, values, and personal background they bring to their study (Creswell, 2014). Being aware of these subjectivities helps researchers to strategize and monitor the study to shape their analysis to prevent any possible distortion of the findings (Glesne, 2015).

As a general education science teacher with 13 years of experience in teaching science, the decision to undertake this qualitative study was influenced by the researcher's professional and educational experiences. Having been in the classroom as a junior high school science teacher and subsequently as a high school physical science educator in Ghana and South Africa, respectively, the researcher brings to this study significant experiences in the areas of instructional planning, instructional practices, and assessment. His roles and responsibilities as a science teacher required

lesson planning and teaching science to diverse groups of students. It is accepted that the pedagogical beliefs of teachers significantly influence their teaching practices, as "these beliefs are manifested in the teaching methods, in choosing the subjects and activities, decision-making, and evaluation in the classrooms" (Khader, 2012, p. 73). Therefore, in carrying out his teaching responsibilities, his personal beliefs, values, and professional ideals acted as a lens through which he made decisions on instructional planning, practices, and strategies.

Prior to starting his graduate studies, the researcher taught physical science in a general education classroom for three years after obtaining his bachelor's degree in science education. He also acted as an assistant principal in a private high school for almost one and a half years. During these periods, he enriched his professional experiences by participating in several professional development training sessions. As an assistant principal, he assisted in teacher recruitment. Also, as part of his supervisory role, he reviewed teachers' lesson plans and used observation to monitor the instructional practices of teachers. Although these experiences did not occur exclusively in inclusive schools, they highlight his background experiences in relation to the current study. His status as a Master of Education student with a concentration in curriculum, teaching, and learning studies further deepens his skills and knowledge in educational research, including teaching and learning. These experiences have acted as a scaffold that assisted the researcher in completing this qualitative study.

To reduce the influence of these experiences on the outcomes of this study, the researcher employed a number of techniques such as the triangulation of data sources and methods, keeping an audit trail of the research process, seeking permission from gatekeepers for access and entry, and using member checking. All these measures have carefully been addressed in the previous section under trustworthiness. Also, as an international student, the researcher had no prior

connections with the participants, school authorities, or schools involved in this study. As such, there was no conflict of interest. Although the researcher's position as an international student coupled with his lack of experience in teaching science in an inclusive environment had the potential for raising "insider-outsider" issues, this was addressed by the researcher requesting access and entry from gatekeepers and ensuring that he did the study "with the participants" and not "on the participants" (Merriam & Tisdell, 2015). More specifically, he established rapport with the respondents before the data collection process by paying a visit to each of them, explaining the purpose of the research, and expressing his appreciation to them for accepting to participate in the study. Also, he ensured that his stance as a researcher was non-judgmental and respectful towards respondents, other staff members of the schools involved, and the students.

Chapter 4

Outcomes

Introduction

The purpose of this qualitative case study was to explore three primary research questions: (a) What are high school science teachers' conceptions of inclusive pedagogy? (b) How do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diverse needs in their classroom? (c) What specific pedagogical strategies do high school science teachers use in inclusive classrooms to respond to the diverse learning needs of students? This chapter reports a summary of the findings that emerged from the study. First, the reader is given an overview of the study, followed by a review of the main findings that emerged from the data. The findings are organized around each specific research question.

4.1 Overview of the Study

As indicated above, this study examined the conceptions and practices of high school science teachers in inclusive pedagogy. A multi-case study approach was employed in which four high school science teachers were purposefully sampled. They ranged from 28 to 51 years old and included one male and three females. One of the participants was a trained special education teacher with a Bachelor of Special Education degree, while the remaining three were general education teachers. All four participants were sampled from three high schools across the Avalon region of the English School District in Newfoundland and Labrador and had science teaching experience ranging from five to twenty-three years.

To address the research questions, multiple methods and sources of data were utilized. Data on participants' conceptions of inclusion, their instructional planning, and practices were captured through semi-structured interviews, observation, and document analysis. To provide a foundation

for constructing knowledge and eliciting insights from participants' data (Grant & Osanloo, 2014), this study was grounded in two theoretical frameworks: social constructivism and Universal Design for Learning (UDL). A combination of the two frameworks enabled the researcher to answer the three research questions guiding the study. Specifically, based on the theory of social constructivism, the researcher was able to rely on the views and experiences of participants to construct meaning regarding how they conceptualized inclusion and described their instructional planning and practices. Also, the UDL framework served as a lens through which participants' instructional practices were examined. Data were coded, categorized, and analyzed with MAXQDA software. The next section discusses the general findings of the study.

4.2 Findings

After a cross-case and constant comparative analysis of data, seven themes emerged. The themes were based on patterns that emerged from participants' interviews transcripts, documents, and the researcher's field notes. The findings have therefore been organized thematically and will be discussed in relation to each of the research questions that guided the study. In the next page, the major themes and sub-themes have been summarized in Table 2.

4.3 Themes across the Studies

As indicated above, the discussions on each of the theme will be guided by the specific research questions guiding the study.

4.3.1 Multiple conceptions of inclusion. This theme was guided by the research question: *What are high school science teachers' conceptions of inclusive pedagogy*?

Table 3

Themes and Sub-Themes of Research Findings

Themes	**Sub-themes**
1. Multiple conceptions of inclusion	a. Acceptance and belonging b. Recognition of diversity and response to individual needs c. Creating equal opportunities for all
2. Classroom experiences on conception and adoption of inclusion	
3. Factors that influence science teacher's choice of instructional methods when planning for inclusion	a. Students' abilities and interests b. Time c. Understanding learner variability d. Curriculum content
4. Collaboration is an essential variable when planning for inclusion	

Themes	Sub-themes
5. Science teachers plan their instructions around the needs of underachieving students	
6. Science teachers adopt multiple instructional strategies to address students' diverse needs	a. Multiple means of representation b. Multiple of action and expression c. Multiple means of engagement
7. Science teachers encounter several barriers in the adoption of inclusion	a. Contextual barriers • Inadequate professional development • Inadequate instructional resource teachers • Class sizes b. Barriers associated with the curriculum c. Barriers associated with teachers d. Barriers associated with administration

Analysis of participants' responses to this question revealed that inclusion is a popular concept for the participants. As indicated in Table 2 above, two major themes with three sub-themes emerged from this area: (1) multiple conceptions of inclusion-acceptance and belongingness, recognition of diversity and individual differences, and creating equal

opportunities for all, and (2) science teachers' conceptions of inclusion appear to be influenced by classroom experiences. Participants expressed varied opinions about what constitutes inclusive education. The most dominant perspectives as expressed by participants were descriptions of inclusion as (a) acceptance and belongingness, (b) recognition of diversity and individual differences, and (c) the creation of equal opportunities for all students.

Acceptance, belonging, and social integration

One way participants conceptualized inclusion was an education that promotes acceptance, belongingness, and social integration. Three participants stressed the importance of not excluding or singling out any student from inclusive classroom based on abilities or background. Regina noted that being inclusive means accepting everybody rather than isolating certain students in designated rooms based on their abilities. She remarked:

> You don't wanna [sic] single them out. Like, you want them to be included. So, inclusive means accept everybody based on what they're doing ... I don't think we should be isolating children in rooms based on their abilities. Are they able to be in our classroom? They should be in our classroom. (Regina-I1)

Regina emphasized that educating all children, with or without disabilities, inclusively enables students to learn from each other. She explained that allowing all of them to learn in the same classroom leads to "a really accepting environment" because all the students "are learning acceptance, they're learning social cues, they're learning if this child can sit down and do the work quietly, why can't I, and they pick up the behaviors and vise versa." (I1)

Similarly, Janet shared in the first interview (I1), that inclusion means "an environment that includes everybody and reaches everyone." She felt that all students should be accepted in the regular education classroom because they "have the right to be in a regular classroom and that we

should be adopting our teaching practices to ensure that they're all in there and having the equal opportunity to learn." She explained that they should not be isolated into separate classrooms because "even if they aren't always getting some of the academic outcomes, socially what they are getting is irreplaceable. Like, they wouldn't get that if they were isolated in a separate classroom with just four of them all day long."

Cynthia also indicated that comparing the pull-out model, where instructional support was provided to students with special needs outside the general education classroom, to the current inclusive model, "there was much more of a divide [in] the pull-out model, [because] students… have [sic] to leave" the class. She explained that with the adoption of the inclusive education system, those children who used to be taken out of the regular classroom for additional support now feel that they are part of and accepted in the inclusive classroom because they "feel that they are on a level playing field and …[they] definitely feel equal."

Participants felt that the school should welcome all students, regardless of abilities, disabilities, or background, and encourage them to participate actively and fully in all aspects of school life, both academically and socially, in an atmosphere where everyone is respected, recognized, and valued.

Recognition of diversity and responding to individual needs

In addition to conceptualizing inclusion in the context of acceptance, belongingness, and social integration, participants in this study viewed inclusive education based on diversity and in response to the needs of individual students. Edward, for example, shared his conception of inclusion in two ways. First, he indicated in the first interview that his basic understanding of inclusion "would be including students based on physical ability." However, beyond this conception, Edward shared a second view of inclusion as: "including kids based upon interest

types, learning styles, ...even social inclusions, students who don't normally interact, socially, or don't feel comfortable in the social environment. I guess the whole range of possibilities are examined" (I1). To him, the overarching concept of inclusion is understanding the student as an individual and adopting appropriate instructional practices to account for this diversity. This view was apparent in his comment below:

> For me, inclusion is personal. It's just good teaching methodology. It's nothing radically difficult about understanding it or implementing it. But for me, it really comes down to the granular 'Do I know this person well? Do I know the family? Do I know what they like? Do I know what they don't like? Their music tastes? Do they play video games? What movies do they like?' (I1)

During the second interview, Edward summarized his perspectives on inclusive pedagogy by indicating that being inclusive pedagogically means the teacher must adopt…

> basic good teaching practices which consider the ability, interest level, and the maturity level of the students in question. Also, maybe their physical ability to participate in class and essentially trying to meet the need of the learner as a sort of fully-formed individual. So, you vary your teaching methods to meet them as best as they learn. (I2)

Cynthia shared similar conceptions. She explained that the recognition of individual needs in terms of learning style and other forms of diversity is key in inclusive education. She commented: "Inclusive education addresses [a] variety of needs of learners and recognizing the fact that all learners do not learn in the same way or the same manner" (I1). Cynthia discussed the need for teachers to recognize students' diverse needs and adopt appropriate instructional practices to address those needs. She articulated these views in the statement below:

> So, regardless of any kind of exceptionality whether it be a higher intelligence person, someone with exceptionality that has AD/HD or even someone who's … on a regular prescribed curriculum may learn using different styles. A lot of it has to do with… being able to present educational information in a variety of methods in order to try to differentiate your instructions to give students different opportunities to be as successful as they can be. (I1)

When asked during the second interview to describe how she would explain inclusive pedagogy to a colleague, Cynthia stressed the need for teachers to know and understand their learners and treat them as individuals:

> There is [an] overall understanding of changing methods to deliver education to best suit your learner, and before you can do that, you need to know your learner. So, although inclusive pedagogy is an education for all, there is an element of education for one. You have to know each and everyone in your classroom before you can have a view of the best methods that meet their needs. (I2)

Regina emphasized the need to recognize diversity and individual needs in the classroom. She noted that being inclusive means: "ensur[ing] that every child in that room is learning to the best of their ability regardless of sex, race, their abilities and intellectual disabilities, physical disabilities…You have to make sure that everybody learns at their pace and their level." (I1)

Janet's conception of inclusion also reflected the recognition of diversity and individual needs. She explained that in the classroom there are "a lot of different levels; everyone learns differently; everyone reaches different levels, and success means something different for every single student." To her, being inclusive involves "using practices that make that [the curriculum] accessible to everybody whether there is language barriers or just academic barriers or whatever

the case may be… So, you will have to take everything, every aspect, into consideration when you think about that." (I1)

When asked during the second interview to explain what she considers to be inclusive pedagogy, Janet shared: "one that reaches people with different learning styles, different cultural backgrounds, different socio-economic backgrounds, ones even with different abilities and different social skills."

The views expressed by participants indicate that an inclusive school should embrace individual differences and celebrate diversity by creating an environment where all students will be respected, recognized, and understood in order to respond to their diverse needs.

Creating equal opportunities for all

In addition to the views expressed above, participants' views were consistent when it comes to creating opportunities for students in the inclusive classroom. Three participants viewed inclusion as "creating equal opportunities" for all students to learn.

Janet indicated that any "student from anywhere" irrespective of their background should be able to enter "into [an inclusive] classroom and have an equal opportunity to learn the same material" (I1). When probed to elaborate on this view, she explained that it is important to "create an environment that allows everyone [to have] ...an equal opportunity to make the path from the floor to the ceiling" in order to "reach their full potential" (I1). Likewise, Cynthia shared that "inclusive pedagogy is about delivering a well-rounded education for all…meeting the needs of all learners through different instructional practices" (I1). Also, Regina explained:

> To me, in terms of inclusive, people think that it is just people with different abilities. It is somewhat, but you also have to make sure that everybody is included regardless of race,

> culture, religion, ability …I like to make sure that everybody in my room is included, regardless. That's me. My idea is no kid [left] behind. (I1)

Regina disagrees with definitions that group children based on labels. To her, all children deserve to have equal opportunities to learn.

> No child left behind. It doesn't matter—like society needs to go away from this idea of what's normal. There is no normal. Your normal is different from my normal, and in this classroom, I want every child in this room to learn regardless of their walk of life, regardless of where they came from, regardless of what their sexual orientation is, regardless of what they are; you need to learn, and I'm gonna [sic] do my best to help you learn. (I1)

These perspectives strongly reflect the notion that inclusive education should eliminate barriers by creating equal opportunities for all students to learn.

4.3.2 Classroom experiences influence teachers' perspectives and the adoption of inclusion. In addition to expressing varied perspectives about inclusion, the analysis of data concerning research question one revealed that participants' experiences in inclusive classrooms appear to influence their understanding and adoption of inclusion. For example, in discussing what informs participants' understanding and adoption of inclusion, their comments reflected this perspective:

> I'd like to say my undergraduate degree, but not really because the undergraduate is so quick, and we only do one course on inclusive education, right, more on exceptionalities, really. So, I guess what influences it is when you see the need yourself. Like when you first step into the classroom. Like on my internship, and then when you first start becoming a teacher, and you see that the need is there, and you start to realize how important it is to

> make it inclusive for everyone. And you start to see these students who are falling behind and slipping through cracks, and you want to do more for them. (Janet-I1)

> For [the] most part, I think first in my career, I was surprised at the range and diversity of learners, abilities, and also early in my career, I realized that the diversity of people and their abilities as I meet them in the classroom range. For example, some kids know a lot of material about the topic we're about to learn, some know little, some know nothing, and, trying to find out where they are before I begin to teach them, I quickly realized how important that would be in terms of including students based on their knowledge. (Edward-I1)

Regina compared the experiences of a novice teacher to an experienced teacher: "For a new teacher, it's very difficult [to be inclusive]. But for a seasoned teacher, like myself, I know what will work because I've had the years of experience standing up, talking to a bunch of kids" (Regina-I1). She went on further to propose that all pre-service teachers in internships should have the opportunity to experience the feeling of a "true classroom" during their internship programs.

> I think when teachers come out of university, they need to be indoctrinated… Here at the schools we force those students, we force the university students to spend time in our general classrooms, to spend time with our students that require extra support, so they get a true feeling of what your classroom is. In classrooms, out of a group of 35, you're not gonna [sic] have the perfect room. It doesn't exist; it doesn't exist, so you need to be indoctrinated into exactly what a true classroom is. (I1)

These remarks strongly suggest that authentic or first-hand experiences with students in inclusive classrooms are vital in fostering teachers' understanding, appreciation, and adoption of inclusion.

For instance, all participants indicated during the discussions that they have received inclusive education policy documents from the Department of Education (e.g. the Safe and Caring Schools Policy), and that their understanding and adoption of inclusion are heavily influenced by their interactions and experiences with students in inclusive classrooms.

Summary

Evidence from the data revealed that inclusion is a familiar and well-known concept for the participants in the study. Data from various sources showed that high school science teachers have varied conceptions on inclusion. All four participants described inclusion as an educational system that recognizes diversity, individual differences, and responds to diverse needs. Also, most participants conceptualized inclusion as a system of education that provides equal opportunities for all students in the regular classroom irrespective of background or exceptionality. Two participants described an inclusive classroom as a place where every student should be able to feel accepted. When sharing their perspectives on inclusion, none of the participants demonstrated a lack of understanding or negative attitude toward inclusive education, contrary to what has been reported in many studies (e.g. Avramidis, Bayliss, & Burden, 2002; Hodkinson & Devarakonda, 2009; Rose, 2001). Generally, the participants articulated that as teachers, they are expected to use pedagogical approaches that fit every child and ensure success for all.

4.3.3 Factors influencing teachers' choice of instructional methods. To understand participants' instructional planning process, the following research question was addressed*: How do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diversity in their classrooms?*

In exploring this question, the data revealed three significant themes: (a) a variety of factors influence science teachers' choice of instructional methods when planning to support

inclusion, (b) science teachers' instructional planning is centred on meeting the needs of weak students, and (c) collaboration is a key variable in successful planning for inclusion.

Evidence from participants' descriptions of their instructional planning processes showed that their choice of instructional methods to meet diverse needs in inclusive classrooms is influenced by various factors, including students' abilities and interests, time, learner variability, and the content of the curriculum. These factors are discussed below along with their Sub-themes.

Students' abilities and interests

One sub-theme that emerged from high school science teachers' instructional planning and selection of instructional methods was the abilities and interest levels of students. Specifically, all four teachers mentioned that they consider their students' background including their abilities and interest levels when planning lessons to facilitate inclusion. The influence of students' abilities and interests on participants' instructional planning and the choice of instructional methods is reflected in the comments as:

> Usually, the first three days of the school year, I'm not really teaching anything important or directly related to the curriculum. I'm just finding out: What's your favourite science activity? Who is your favourite science teacher and why? So, I have a list of questions that I ask to probe what their perceptions of coming into this room are? I feel that I need to adapt to the audience. They don't need to meet me in my classroom. What are my expectations? Not mine, but what are their expectations. And you quickly start to see that these students, they hate lab activities. They just want to sit and take notes. These other kids, they hate sitting and taking notes. They want to do lab activities. (Edward-I1)

> Well, I guess at the beginning of the year, getting to know one-on-one is where I focus most of my energy... So, one thing I do at the beginning of the year, I put everyone in alphabetical order for two reasons, both behaviour but I also want to get to know their names and how can you learn what someone else needs if you don't even know who they are?... So, if I do have a class with students that have a variety of needs, I do consider several of them when modelling the lesson for everyone. (Cynthia-I1)

> So, to teach the material in a way that is accessible to everyone … [you need] to be conscious of, first of all, knowing your classroom. So, knowing the dynamics, what is everyone's background, both academically, culturally, socially? What supports do your students need? And then, ensuring that every lesson you teach has those supports in place and is centred around teaching to all those diverse learning styles. (Janet-I1)

> I have a list of every child in my room and every type of disability they have, and I find myself trying to make sure that the lessons that I am teaching and the activities that I include are not going to leave anybody out. (Regina-I1)

Besides, Cynthia stressed that the type of instructional planning and strategies a teacher adopts depend on "the type of learner you have in front of you." She explained that "if [she]I was doing instructional strategies for [her] AP Physics class or Physics 3204 class, that would be very different from what [she] would do for Science 1216 pilot course." When she was probed to explain why she responded:

> Science 1216 [is a] pilot course, you know, a grade 10 course where you have a much diverse background of learners, different abilities, so on and so forth. So, from one year to the next or from one class to the next, I might choose to address the content [in] a different way based on those students.

From the views of participants, knowledge about students' background, abilities, and interests is key to responding to their needs in inclusive classrooms. Moreover, these perspectives strongly align with the notion that differences in abilities or background are not obstacles to learning in an inclusive environment. Instead, they serve as avenues that enable the teacher to make decisions about his or her instructional planning and methods to make the curriculum accessible to all.

Learner variability

Another factor identified by participants as influencing their instructional planning and strategies was learner variability. Participants' views signified that in an inclusive setting, the ability to plan and respond to the needs of students requires teachers to know and understand every student uniquely. For example, Edward described how he uses multiple intelligence data from his students to understand his students as individuals in order to meet their needs accordingly:

> I like looking at Multiple Intelligence as a way to practice inclusion… It tells me who's who or who they feel like they are. It's their own information. And sometimes I use that to form groups… Sometimes I use that to form different assignments for different people. (I1)

Further, Cynthia shared that the diverse nature of her class encourages her to modify her instructions. She remarked:

> I teach a grade 10 class which is a variety of learners, and it is a general science class that every grade 10 student has to take…I found that that…group of learners helps and motivates me in order to change up my style and be more aware of inclusive education. (I1)

She asked: "how can you learn what someone else needs if you don't even know who they are?" She shared a strategy she learned from her favourite university professor and how she relies on this strategy to study the individual characteristics of her students. This enables her to gain a better understanding of their needs and tailor her instructions to meet those needs:

> There is … an activity I adopted from one of my effective educators in university, and it is a little cue card… I have taught 13 years now, and I have 13 years of cue cards... It's a window into who they are. So, name, birthday, hobbies, interests, what they wanna [sic] do when they leave school, one thing that makes some different from others, expectations for the year… It's kind of like the touchy-feely side of the education, personal touch. So, it's very important to me in the beginning to establish personal relationships with the student. (I1)

When Regina was asked to describe how she plans to meet diverse needs in her class, she explained that after 23 years of experience, it is something she does instinctively: "it's something you automatically do… it's become an innate thing" (I-1). She continued to elaborate on how she addresses the needs of high- and low-order learners:

> You have your high-order learner, and if I use certain words, they will know what I mean. But then, I have to think about the child on the lower end. Does he understand what I am saying? So, sometimes it is a matter of rephrasing what you've said in four or five different ways. (I1)

This finding was corroborated during the researcher's lesson observations. For example, Edward's students sat in groups of four or five before the start of his lesson on genetic disorders. He had indicated in his lesson plan that he used "balanced grouping" based on multiple intelligence (MI) data from his students. After the lesson, the researcher had an informal interview with

Edward. During the discussion, he opened a folder on his desktop that contained a list of students and MI data. He explained that the list is organized based on multiple intelligence data. He shared that he relies on this list to group his students, give assignments, and conduct other activities, as it enables him to know and understand each student's strengths, interests, and how they learn.

Likewise, Cynthia knew all her students' birth dates. In one of her lessons, she wished Joana (pseudonym) a happy birthday before beginning her Physics 3402 lesson. Before the start of the lesson, Cynthia told a story to her students which got them excited and laughing. This was followed by a birthday message to Joana, who had celebrated her birthday on the weekend. During the lesson, Cynthia was seen moving and chatting with specific students and helping them with some of their tasks.

Time

Three participants identified time as another common factor that influences their instructional planning and selection of instructional strategies. For example, Cynthia stated: "So, it's, you know, doing what you can in the time limits and constraints that you have." She shared how time influences her instructional planning and pedagogy: "you have outcomes to meet, you are on a timeline crunch... you are very much limited to how often you can employ varied methods to deliver a specific curriculum, in particular with physics."

Edward mentioned: "For me, it [the planning] sort of starts at the high level. Let's look at the course as a whole. How many hours are mandated for me to spend on each unit?" He described how he allocates his instructional planning and strategies to fit into the time allocated for each course or topic:

> Every lesson plan gets developed with five minutes of review over what we did last, five minutes of introduction to the activity, facilitating ten, fifteen, twenty minutes of activity,

> debriefing, and reviewing the activity, assigning something … So, I break it down in terms of the fifty-six-minute lesson, keep a close eye on my watch, but as we discussed before, that doesn't usually go according to plan, but I have to make those plans, and that allows me the flexibility. (I1)

This description offered by Edward was apparent in his classroom during the researcher's visit to observe his lesson. As explained in chapter 3, there was only one observation for Edward. The observation took place during the first period. His lesson was well organized and seemed well planned. He commenced the lesson by giving a brief introduction and stating the learning goals to students. A short video followed this. Halfway through the video, he stopped and explained how offspring might inherit chromosomal abnormalities from their parents. With students already seated in groups, he engaged students using a case study scenario. Students were to act as "genetic counsellors whose job was to discuss with expecting mothers any genetic disorder that may affect their children" (In). His lesson was systematic, well planned and organized to fit into the 56 minutes indicated in his lesson plan.

Janet also described how time influences her planning:

> I... focus on different subjects at different times...if I'm gonna [sic] try to do something more elaborate or more hands-on, then that's more prep time, you know. So even last week, like the last class you came in, and we did the lab, that would have taken me more prep time. Because I saw it from actually planning it and figuring out, 'Here's what they're gonna [sic] do.' I have to go down then and set it up, make sure you know everything is safe, take time in class to prepare the students for what we are going to do so that they know how actually to do the lab. (I1)

She elaborated that she plans "[her] lessons pretty flexible." However, she makes sure that she is "sticking to certain timelines and getting things done" (I1).

While most participants highlighted the essential role of time in making the curriculum accessible to students, they also noted the importance of being flexible in order to create an environment that allows every student to succeed based on their abilities.

Curriculum

The last factor identified by participants as influencing their instructional planning and the selection of instructional methods was the curriculum content. All the participating teachers mentioned that they consider the course content during their instructional planning. For example, Janet remarked:

> I would start planning, say one course at a time for the whole week. And every day I'm looking at, 'Okay this is the information I'm gonna [sic] teach. These are the outcomes I'm gonna [sic] be covering and here's how I'm gonna [sic] cover them'. (I1)

In describing how she selects her instructional methods, Janet explained that it depends on the course she is teaching because "in some courses, the only way to give them [the] information is to put it up on the board, talk to them about it, discuss and have them copy it down and then do some activities afterwards." (I1)

Similarly, Regina described how the curriculum might influence teachers' instructional practices or methods:

> If you're doing 2201 Bio, 2201 Chem, those kinds of things, you have [the] flexibility to do activities and things that would make it more close and help kids to learn. When you hit the 32s, which is the public exam courses, now you're struggling because you have to teach

> the material to a course, and you have no choice but to get through the material. If not, your children will be at a disadvantage when the time comes to write that final exam from the department, which the department has and not us. (I1)

Cynthia shared that during planning, she sits "with the curriculum guide … to address the outcomes." She remarked: "I find that when planning instruction, it almost depends on how much of a good view you have on the content overall, the unit overall, the chapter overall, where they come from and where they are going." (I1)

Edward described his instructional planning experiences:

> As I said before, at the beginning of the year, I picked big items there. What's the central theme in unit one, two, three and four? Those are the lessons that are going to get the most thorough teaching. I don't know if that's appropriate, but if I could have less material, fewer students with the same amount of time, I feel that education could radically be altered perfectly. (I1)

Summary

Data on participants' descriptions of their instructional planning processes revealed that a variety of factors influenced their planning and choice of instructional methods. These factors were: (a) students' abilities and interests, (b) time, (c) learner variability, and (d) curriculum. Participants' responses indicated that the curriculum and students' abilities and interests constitute the most influential factors when planning to support inclusion, as these factors featured in the descriptions of all four participants. They noted that curriculum outcomes, abilities and interest levels of students considerably determined their choice of instructional activities, groupings, and questioning styles in order to address all needs in their classroom. Moreover, they reported that time and learner variability significantly affect their instructional planning processes, as they had

to think about how to meet the needs of students across the high- and low-order learning spectrum while meeting the demands of the intended curriculum outcomes at the same time.

4.3.4 Collaboration is an essential variable when planning for inclusion. One theme that emerged from participants' data was the need for collaboration among professional peers when planning to meet diverse needs in inclusive settings. During the semi-structured interviews, three participants described collaborating with their peers during instructional planning. Janet remarked that it is vital to "collaborate with other teachers as well. Like, as a young teacher I've learned so much, every year that I have taught so far, from every teacher that I taught with." She shared her experience of collaborating with an instructional resource teacher:

> I don't have that special education background, so as much as I can plan, sometimes it is great to run over to them [instructional resource teachers], or ask them, you know, what can I do to help this student? And sometimes they just know some background of students that we don't know. So yeah, I would say it is extremely important to collaborate with them all the time. It's almost more like co-teaching, especially in the general courses that I am teaching because we really do come in, you know, you don't get a lot of just lecturing, [or] one person teaching. We come in and, more kind of like, cohesively working together, and then we kind of tend to branch off, and we have certain people that each of us tends to work with. (I1)

Similarly, Regina reflected:

> I will find a lot of teachers will come to me because they would have kids in their classroom who are struggling, and they would say "What else can I do to help that child?" And I will sit with them and go through the different types of things you can do; if you wanna [sic]

> do little groups to decide where one child helps the other or we have two bodies in the room. (I1)

She noted that they collaboratively work "side-by-side ... to make sure the curriculum is inclusive to everybody".

Edward described his instructional planning and the need to seek assistance from his professional peers with knowledge on inclusion: "I would seek expertise from people who understand how to implement lessons using inclusive models, and I would use that to guide everyone else through it." He indicated that he prefers "work[ing] together to plan, and … share the teaching" with his professional peers with specialized backgrounds.

Collaboration among professional peers was identified during one of the lesson observations. In one of the lessons observed in Janet's class, the researcher met another teacher, Johnson (pseudonym), with both teachers co-teaching the students together. Specifically, Janet was teaching Chemical Reactions in grade 10 during the second period. The two teachers collaboratively worked together, as Janet taught the lesson, while Johnson moved around the classroom, interacting with and helping students with the most difficulty.

4.3.5: Science teachers' instructional planning is centered around the students with the most needs. Another theme that emerged from participants' interview data was that science teachers' instructional planning targeted students with the most needs in class. When describing their instructional planning processes, two participants, Regina and Janet, noted that to make the science curriculum accessible to all students, their instructional planning centers around students with the most difficulty. Regina reported: "I find myself trying to make sure that the lessons that I am teaching and the activities that I include are not going to leave anybody out." She indicated that:

> Sometimes the kids in here say "Miss, why are we doing Jeopardy?" and it's not for my kid who's the 90+ student, it's for my kid who doesn't know how to study, who don't know how to do the information, that they get that little bit of extra, but in the process, my higher-order learner is learning as well. (I1)

Janet explained that her planning is "directed toward the students who need the inclusive education or who need the extra practices put in place." She explained: "once I do that, then I know that I am kinda [sic] targeting everyone, and I am really including everyone in an equal learning opportunity." She described her general thoughts during her planning:

> So, I'm generally thinking about my weakest students or the ones, I guess, that have the most challenges. And I'm trying to figure out, how can I make this material accessible to them? And what supports can I put in place for them? You know, what learning strategies can I use that I know will appeal to them? So, I start with that, cos [sic] I feel, you know, they're easily the most challenged. That's the biggest challenge you have; it's reaching those students. So, once I have that covered, then I kind of backtrack and make sure, okay am I challenging the other students enough? Am I making it interesting for everyone? Because you don't want to make it too easy at the same time. (I1)

To make the science curriculum accessible to all students, Janet and Regina focused their instructional planning and practices on students with the most needs. They structured their activities and instructional methods so that they would appeal to various ability levels and learning-style preferences in their classrooms.

Summary

Overall, participants' descriptions of their instructional planning processes showed that several factors including abilities and interests of students, learner variabilities, time, and content

of the curriculum influence high school science teachers' instructional planning and the selection of instructional practices. The science teachers involved in this study identified students' abilities and interests as the most influential factors in their instructional planning and strategies in inclusive classrooms. Although time and curriculum did not appear to be the most influential factors, participants indicated that their ability to be more inclusive in their lessons is dependent on these factors. All four participating high school science teachers felt the nature and the outcomes to be covered usually determine their instructional practices in inclusive classrooms. Beyond these factors, the analysis also revealed that participants' instructional planning is generally focused on meeting the needs of all by targeting students with the most needs in the classroom.

4.3.6 Adoption of inclusion in the classroom. This theme was based on the research question: *What specific pedagogical strategies do high school science teachers use in their classrooms to respond to the diverse learning needs of students*? The intent of this research question was twofold: to gain insight into how high school science teachers adopt inclusion in their classrooms and to explore the challenges faced by science teachers in making the science curriculum accessible to students in inclusive settings. Two broad themes emerged from this area. These themes have been organized into (a) adoption of inclusive pedagogy and (b) barriers to the adoption of inclusive pedagogy, and they will be discussed along with their sub-themes.

In terms of making the science curriculum accessible to all students, all four participants indicated that they employ various inclusionary practices in their lessons. Their descriptions revealed that they employ flexible teaching practices that provide opportunities for all students regardless of abilities, disabilities or cultural background to access the curriculum and actively participate in the teaching and learning process. Participants' inclusionary practices were

organized into three sub-themes based on the UDL framework: *multiple means of representation*, *multiple means of actions and expressions*, and *multiple means of engagement*.

Multiple means of representation

In examining the various data sources, it emerged that participants adopt multiple ways to present the content of the science curriculum to students. All teachers interviewed described using a variety of teaching approaches and representative tools including hands-on activities, videos, games, online sources, Google Classroom, interactive whiteboards, and iPads in their lessons to help students make connections with the information presented and acquire knowledge. For example, Cynthia explained the teaching approaches she uses to ensure the information she presents reaches all students:

> Any kind of hands-on activities that you can do that [is] not necessarily a core lab but demonstrations that you could enter into the classroom. Re-wording, even just re-wording of things or the introduction of a video to help with the topic, even just getting them to reflect. (Cynthia-I1)

When asked to expand on specific teaching practices she utilizes to create a learning environment that enables all students to have access to the information she presents and obtain meaning from it, Cynthia remarked:

> Posting material… [and using] Google Classroom... Again, …you are helping students ... [to gain] ownership of the material... So, supplementing that way, questioning; having direct questions, teaching them how to question themselves, using videos in class, or getting them to, you know, look at the internet and find instructional videos to look at that may help them. (I1)

Cynthia's description of using multiple means of representation was also noted during the lesson observations. In the first observation, she was teaching "Energy Changes During Melting and Evaporation" under Weather Dynamics in unit 2 of the grade 10 science course. Cynthia used whole group instruction to teach the class. She began her lesson by asking students if they had managed to complete the previous day's assignment. She marked the assignments and began the new lesson with a brief review of the objectives and told her students that the second part of the lesson was an experiment that would take place in the science laboratory. During the laboratory work, students worked in groups to measure and record the temperature of crushed ice at one-minute intervals with the help of a thermometer and hot plate. This activity was hands-on, interactive, and engaging. She used many questions to gauge students' understanding. She also encouraged students to ask each other questions such as "Why does the ice melt?" and "What causes the temperature to increase?" This session of the lesson was primarily child-centered, hands-on, and very interactive.

During the second observation, Cynthia was working with students on fields from unit two of Physics 3204. She described the lesson objectives including how to illustrate electric and gravitational field lines of spherical objects. She reviewed the meaning of force of gravity and performed calculations involving the force of gravity with students. Although this part of the lesson was very teacher-directed, students were actively engaged, as they listened and contributed to the lesson, especially during the calculation part. One critical observation made about Cynthia's instructional practice was the use of questions to elicit and evaluate students' understanding. In one such question, she asked students to explain what happens to make balloons negatively charged. A student answered that it is due to the electric force. Although students had copies of the lesson notes, she also projected the salient points in the lesson on the Smartboard. There were

moments when she asked students to volunteer to go to the board to help with the calculations. Following these activities, Cynthia introduced the concept of gravitational fields and illustrated how to draw gravitational field lines around a spherical object to students. To consolidate students' understanding, she integrated technology into the lesson by using a 3D format to demonstrate how to draw gravitational field lines. Cynthia explained to students that the arrows on the field lines indicate the direction of the gravitational force. After the demonstration on the interactive whiteboard, she allowed students to practice what they had learned by inviting them to come and illustrate the movement of the gravitational field lines. This part of the lesson was mostly student-centred and very engaging, as the rest of the students assisted their classmates to draw the electric field lines correctly by offering suggestions on the starting point of the field. Students practiced the drawing of field lines involving both "like" and "unlike" charges.

Another science teacher noted that he does not rely on a one-way teaching approach. He emphasized during the interview that students have diverse needs, and as a science teacher, you need to "vary your teaching methods to meet as best they learn" and provides learners with "very tactile and hands-on" learning experiences (Edward-I1). He shared his experiences on how he responded to the needs of two students by providing them with options to access the information he presents in class and to make the students feel included. In the first example, he remarked:

> See that reflection of Student A, who loves working on his truck in his shed. That's all he does. And I said, "Oh, but can't you record your notes on your phone and just listen to them while you're working on your truck?" And he said, "Yeah, I guess I can do that." "Or why don't you try? Just put it on. I mean, what are you listening to?" … Like kids today, their music, they don't like to joke with them. He said: "Okay." I said, "Try it. I dare you to try it, just to see what happens." And I told his parents, "No, leave him alone. Let him go out

> on his truck. Just have him listen to it while he's working on his truck, doing something he likes. It will go in his brain". Now this, I know, and sure enough, next test, eighty! …I kid you not. And all he did was listen to his notes he recorded himself. (Edward-I1)

In the second example, he reflected:

> I had a student who is visually impaired, and I quickly realized…that in the biology lab or science lab context, it wasn't enough to say, 'the setup is over there.' I had to say, 'The setup is to your right, about ten feet or four meters,' and I had to be explicit with my verbal instructions so that this visually impaired student could be included. (Edward-I1)

This science teacher felt that "we all ... learn visually very well and as a very visual-dominated society" it was not enough to use one way to present information to students in a class with a visually-impaired student. He noted that it was important for him to use inclusive teaching practices by giving "not just verbal direction with visual cues but, verbal direction with auditory cues as well" (Edward-I1).

Also, when Regina was asked to describe the teaching approaches, she uses to make her lessons accessible to all students, she indicated that she does not believe in a one-size-fits-all teaching approach. She remarked: "In terms of strategies, I do whatever I need to do. It could be a game; it could be a puzzle; it could be a written assignment; it's group work." She stated that she provides different options "for the kids in [her] classroom who are tactile, who need to get up and move around… [including] things like mnemonic devices to [help them] learn some of this information" (I1). Regina felt that lessons which are teacher-centred do not work for students, so she is always thinking about "what kind of activities can I put in this room that makes everybody included?" She wants her lessons to be hands-on and meaningful for students:

> Look, I can talk all that I want, but I want them to have hands-on, I want them to be able to see them, I want to extend the experience to them. Whatever there is out there to do, they need to do it, and sometimes just the teacher standing in front of them doesn't work. (Regina-I1)

She shared how the integration of technology in her lessons helps her to break language barriers and facilitate inclusion:

> I have a child in here who is from China. Does he understand what I'm saying? Absolutely not, but I still have to make sure that he learns. So, what I do for him is to allow him to use Google Translate. He can take that and put my test in an iPad, and he can translate my test to Chinese so that he truly learns what's in the room. (Regina-I1)

Likewise, Janet described her instructional practices as providing different options to help students perceive and make sense of the information she provides them. She shared:

> I generally do give them sets of notes, and they will fill in the blanks. So, I do a little bit of that or will get up on the board, but when I'm showing notes or showing things and talking, I'm always showing videos with it. I'm showing pictures or diagrams. I'm often doing, like hands-on demonstrations so that they can relate it back to something realistic so that they can make that memorable learning experience happen as well. (I1)

According to Janet, rephrasing her questions in multiple ways and situating her instructions in real-life contexts is another way of helping students to acquire the information she presents and understand the concept:

> And then when I ask questions, asking them in multiple, different ways. So, like I could ask one student a question one way, and then the other student has no idea. But if I rephrase the question, they now know what I'm talking about.

Janet used a lesson taught the previous day to demonstrate how the adoption of varied instructional practices to present information to students helps them to understand the topic:

> So, when I explain something, [I'm] backing that up with what occurs in real-life representation. So yesterday, for example, when I taught about the heart in Biology, I followed that up by passing around an actual model of the heart that showed all the different parts that I just talked about. So, for a lot of learners who are, you know, a lot more hands-on and need to see and feel it to understand, that kind of tied everything together for them. So, giving them models and showing them demonstrations. (I1)

Upon visits to Janet's classroom to observe her lessons, it was evident that she is very flexible and diverse with how she presents information to her students. She used videos and pictures alongside her notes to explain concepts to her students. In one of her lessons on chemical reactions, she began the lesson by showing a video on chemical reactions to students. She also projected pictures on the interactive whiteboard to explain the concept of physical and chemical changes and to illustrate how the particles of matter change.

Multiple means of engagement

Of the four participants, Regina, Janet, and Edward explained that they provide multiple and flexible teaching practices including the use of scaffolding, diversified assessment strategies, and the provision of constructive feedback to prompt and sustain the attention, interests, and curiosity of their students. Their descriptions revealed that they rely on games, technology, demonstrations, and other inquiry-based activities to engage students and set appropriate challenges that are aligned to students' abilities, interests, and background. For example, Regina explained that using games, videos, and hands-on activities makes her classroom "fun" and "enjoyable." She remarked: "The kids are enjoying the lessons … They're all here [because]

they're interested, they wanna [sic] be in the room, they wanna [sic] learn because it's not boring, it's exciting, it's different, and it's showing" (I1). When asked to elaborate on specific practices she employs to arouse and sustain her students' interest, she indicated that she integrates games very often in her lessons:

> I want the kids [to] enjoy being in the classroom. I can't sit there blaahblaahblahh- and it reminds of Charlie Brown sometimes … That's not my classroom...I am big [sic] on things like games … I teach biology and a lot of time for reviews, we're playing Jeopardy, we're playing Cool's Ball, and the kids think they pretty need [to] throw a ball onto my Smartboard, but they don't realize that they are learning. (I1)

She continued to explain how she integrates cooperative learning in her lessons using peer-based activities. She felt that allowing students to learn or complete a project in groups is another way to sustain their interest and keep them engaged. As such, she does not "put kids separately" but in a "team of four" to engage and help them learn from their peers. She articulated how she groups her students:

> In that group, I have a kid who's struggling but they don't know I have done that, that I have put them in such a way that they are included, so they work in a group of four or group of five, and from that then, they are able to figure out, "Ok he's helping me learn, she is helping me learn." (I1)

Also, Janet indicated that she relies on differentiation and the technology "so heavily even if it's just to show … notes and … presentation on the board" (I1). She felt an instructional practice that is heavily centred on lecturing and note-taking does not engage or stimulate the interest of students. Rather, differentiating your instruction, integrating technology in a lesson, while

providing students with the options to use them in whichever way possible helps to activate and sustain their interest in the lesson:

> Using technology in any way that you can, whether it's showing a video or having them use apps on iPad or the Chromebooks. And, you know what, sometimes even just having them do a worksheet like typing it on a Chromebook, they are more interested in that than they would be if they were gonna [sic] write the same worksheet out with a paper and pencil. So, even little things like that. It doesn't have to be, you know, a huge change. (I1)

She also uses "Plicker" in her assessment, whereby students "just hold up a card and scan it around the classroom and it comes up on the board. So, they really enjoy that" (Janet-I1).

Similarly, Edward reported on using hands-on activities to engage students. He described the reactions of his students whenever they have lab activities:

> They're like, "What are we doing…today?" And I say, "I've got a worksheet for us to do today." And they're, "Uuuhhhhhh!!!" Or they see when I open up the lab doors, because the lab is a part of my room, and they say, "Oh we're going to the lab today!" I'm just like, "Yeah! We're going to do a two-part lab." And they get really excited because they know that that's going to be enjoyable. And they're going to be engaged. They get to socialize a little bit, too. They're not just forced to sit and write. And then other times it's "Okay, we've got these ten review questions to do, everybody. Let's go." But, they like the changeup. (I1)

These descriptions by participants were corroborated by the researcher's findings during lesson observations. For instance, in Regina's classroom, it was observed that all students had copies of her notes on reproduction and development alongside their iPads and in some cases, some used their mobile phones to search for information on the internet. She used video and images

to explain the terms "ultrasound," "fetoscopy," and "amniotic fluid" to her students. Indeed, her classroom was stimulating, fun, and engaging, as students listened and observed during the lesson presentations. The researcher observed a cordial teacher-student relationship, as students freely expressed their views by asking or responding to questions while the teacher gave positive feedback to students. Using real-life and personal experiences, Regina explained the effects of drugs and smoking on pregnancy to students. At this point, she projected an image of a child born without limbs on the Smartboard as an example of such effects. When a student asked about the meaning of pathogenesis, Regina referred the questions back to the students and asked them to use their phones to search for the answer on the Internet. This task got all the students engaged and very active. In fact, this session of the lesson was very interactive and engaging, with students asking Regina a lot of questions, while she gave constructive feedback to them. These observations were noticed in almost all the lessons observed in Regina's classroom.

Further, Janet engaged her students by integrating videos and hands-on activities in her lessons. In one of her lessons, the researcher observed that Janet was working with students on a chemical change experiment. She had set up six different stations in the laboratory with different chemical substances and the experimental procedures. She referred to a video the students had watched in the previous lesson on chemical reactions to explain the aim of the experiment to students. In groups and with the guidance from her and an intern teacher, students followed the lab procedure to carry out the various experiments. At this stage of the lesson, Janet and the intern teacher became facilitators. They moved round to observe, interact with, and guide the students. Janet used questions such as "What type of reaction is taking place?" and "What did you observe during the reaction?" to guide students to complete their experiments. This part of the lesson was very hands-on, student-directed, and engaging. Thus, regardless of students' abilities or

background, the strategies used by Janet enabled all students to participate in the lab activities actively. They freely interacted with the materials, measured their own chemicals, performed the experiments on their own and switched activities to allow each group to carry out the remaining experiments.

When the researcher visited Edward for lesson observation, he was teaching genetic disorders in Biology 3201. He had his students seated in groups. He distributed karyotype spreadsheets, a pair of scissors, and glue to students. After a short video and a brief introduction of the lesson, he engaged the students by asking them to use a karyotype spreadsheet to determine different forms of normal and abnormal human karyotypes. This session of the lesson was hands-on and student-centred. Students were very engaged as they cut out the chromosomes from the karyotype spreadsheet and used it to analyze and determine the possibility of parents giving birth to children with a chromosomal abnormality. There was a lot of collaboration and engagement among the students. Many students asked multiple questions for clarification. Edward provided constructive feedback to students' questions. His classroom set-up allowed for easy movement. He moved around the class during the activity to interact with students and assist them where necessary. He also challenged the students to give reasons for the answers they provided. After the activity, Edward projected lesson notes on the interactive whiteboard for students to copy.

In a discussion to find out the type of groupings he uses and how often he uses these strategies in his lessons, Edward mentioned that he does this "very often." He, however, noted that he uses the "lecture and notes taken approach" (informal interview) when he's "preparing students for public exams or have a lot of outcomes to meet" (informal interview). In terms of groupings, he relied on multiple intelligence data from his students. According to him, using students' multiple intelligence data helps him to learn about his students' interests, abilities, and background,

which inform him on how to group them, give them assignments, and plan for activities that will not exclude any of the students in the classroom.

Multiple means of action and expression

The last theme observed among the participants was creating multiple opportunities for students during the lesson to demonstrate and express their learning and understanding of science. During the semi-structured interviews, it emerged that all participants ensured that students are provided with a variety of options for responding to, demonstrating, and expressing what they have learned in the lesson. Participants reported on giving students multiple options with the use of materials and tools to complete a given task. They used different forms of assessment including matching cards, games, conversation, projects, and other types of presentations in their lessons. This provided students with the flexibility to express their skills and communicate their understanding of what they have learned. Also, to enable learners to create their own learning experiences and reach the same learning objectives, participants provided them with several options of learning experiences such as watching videos, accessing the internet to search for information, using Google Forms, having group discussions or soliciting information from their peers who know the topic. One teacher, for example, said that for "students who cannot [write with] pen and paper," he provides them with other options such as "typing their responses…[using] Google Forms" (Edward-I1). Another teacher indicated that she supports her students through executive functions by helping them to plan and set goals using a checklist. In discussing their teaching methods and strategies in terms of multiple means of action and expression, Edward shared how his students demonstrate and express what they know in class:

> One student had to do a PowerPoint presentation; another person made a video, another person did a Rick Rant, sort of like a two-minute critique of something. If I can provide

> multiple ways to be assessed, I can find a way to include everybody in on the success. Showing me how you learn something doesn't have to happen just on a test. I know that's the finite or ultimate goal. But along the way, how you show me you've learned can be represented in so many ways. (Edward-I1)

When probed to elaborate on specific options he uses to help students express what they have learned, he noted:

> I use technology a lot of the time. I use the Google Classroom; I use Google Forms. This way, they can work on the process. I can be a part of that process. It's real time. Most people won't want this, but I can check my phone. I see everything on my phone as they're typing assignments, I can watch them do it on my computer. They can work on it at home if they have access to the internet … And I think that is a sign of the times. We're slowly adapting. I know my school is far ahead in technology comparatively. We have ten class sets of Chromebooks, three computer labs, and many people use Google Classroom as a virtual space. For me, these days, my focus on inclusion and assessment and teaching is a lot of technology in school. (Edward-I1)

Moreover, for students with executive functioning issues such as learning and attention difficulty, Edward checks in frequently on them to track their understanding. He explained that in order not to expose the weaknesses of such students to the rest of the class, he relies on non-verbal cues or "informal strategies" such as "Give me a little thumbs-up in front of your chests if you understand. Give me a thumbs-down if you don't. Nobody can see it" (I1). Alternatively, Edward stated:

> I use a little exit card, where they ask me one basic question based on today's lesson. They pass it to me on the way out the door, and I just informally assess, okay. And then I have plots, and then I can check up and make sure they do know. (I1)

Further, Cynthia indicated that she supports her students through executive function by helping them to plan and set goals using a checklist effectively. She stated:

> So, one thing I have done in the past with Physics 2204 is a general entry, getting them to use or put words to paper in terms of where they are with their understanding, almost taking like a checklist at mid-term exam time, you know. What can I change? Asking them what have you seen? What do you like? What do you not like? What would you like to see differently? (I1)

Janet also reported that "when it comes to the assessment piece," she makes sure "the assessments are very diversified and that you're not assessing them …just [the traditional] paper and pencil, that you're allowing them all to have equal opportunities to show what they know" (I1). She elaborated on how she diversifies her assessment strategies to include the needs of all students:

> So, it's not always just paper and pencil cos [sic] that, you know, doesn't reach everybody. It's not everybody like I said because, I can go to one student and she can explain what she knows to me just by telling it to me, or there is another student just to write it down, and another student has to show it to me or relate it back to something else. So, in terms of when we do formal assessment pieces, like more, you know, tests and quizzes and midterms and things like that, they are always tied so that there is different styles and different levels of questioning. (I1)

Janet also employs a peer-based assessment strategy to help consolidate students' understanding. She remarked:

> So, rather than having them do a worksheet where they're writing out all the definitions, often times, I'll give them matching cards and say, "Okay, match the definitions together

> or, quiz each other like Quiz-Quiz trades." So, they'll go around the classroom and have questions and quiz one another and have to say all the responses out loud. So, for a lot of students, that's a lot more beneficial than sitting down, trying to write a response out on paper, because they're actually thinking more about it when they have to say it to their peers, right? Then, their peers are there to say, "Mmm, that's not correct. Try again." Or you know, "Maybe you could add this in as well." So, they're working together.

Regina discussed two examples of using technology to provide students with opportunities for expression while she tracked their understanding of the lessons. In the first statement, Regina described how Google Classroom enables her to monitor her students' understandings.

> If you're working through Google Classroom, it's fantastic cos [sic] you can see what the kids are doing, and I can look and see at any moment in time which kid is not doing the assignment or set up because they may be struggling. That way, you are able to look through the grades and say, Okay, Student X and Student Y and whoever else are only halfway through. That means they are suffering. That way, you can go down and check with those kids. So, those are the ones you can check because everybody else is finished without actually having to pinpoint, you know. They don't have to be pinpointed in the room and for everybody to know. You know, because you can very discretely walk down and see what's happening.

Regina also described how she utilized technology to address the need of her students with reading difficulties:

> For my non-readers, it's a matter of using Google Classroom or the iPad to make sure that when I'm giving any form of assessment that they're included because they're hearing my voice when the test is being read to them, or the information is being read to them.

She explained that not only does the use of technology provide children with the option of expressing what they know or have learned, but it also eliminates barriers, promotes inclusion, and provides a medium through which the teacher can attend to students' individual needs without exposing their weaknesses to other students in the class.

Summary

Participants in this study appear to utilize multiple instructional practices to represent information, engage students, and provide options for students to express their knowledge and what they have learned. Based on the UDL principles of learning, key instructional strategies used by participants included:

a. *Multiple means of representation*: Teachers used multiple instructional strategies such as the adoption of multiple media including videos, graphics, and Google Classroom. Participants also relied on the use of inquiry-based instructional approaches to extend what is being learned to students' background knowledge as well as providing multiple ways of asking questions and giving feedback to provide options for perception and comprehension.

b. *Multiple means of engagement*: Teachers mainly relied on videos, games, experiments, peer collaboration, and technology to ignite and sustain students' interests and engagement in their lessons. Overall, the use of multiple means of engagement appeared to be the dominant instructional approach of participants. This suggests that teachers in this study use the child-centred instructional approach as recommended by the National Research Council (1996).

c. *Multiple means of expression*: Participants provided students with a variety of options to respond to, demonstrate, and express what they have learned in the

lesson. These options included the use of traditional testing and quizzing as well as using technology such as iPads with text translation to help students with language difficulty express themselves, Google Forms to provide an option for students with difficulty in writing to type their responses, diversifying assessment to give students an option for expression, and supporting students through executive function to help them to plan and set goals using a checklist.

4.3.7 Barriers to inclusion. The last theme that emerged from the data was barriers to inclusion. Although all participants expressed positive views about inclusion, they all raised a variety of concerns about several barriers that hinder their ability to make the science curriculum accessible to all students. These barriers have been categorized into four major themes: contextual barriers, barriers associated with the curriculum, barriers associated with teachers, and policy and administrative-related barriers. Table 4 provides a summary of the barriers along with their sub-categories.

Contextual barriers. The most common barriers to inclusive pedagogy identified by participants in this area included inadequate professional development, a lack of instructional resource teachers, and class size.

Inadequate professional development

When asked to describe some of the challenges they face and the interventions needed in their classrooms, all participants remarked that there is a need for more effective professional development. Edward highlighted the need for support services and time for professional development, especially for the "science department [to come] together to discuss ... barriers and to help each other develop strategies to change and grow [their] teaching methodologies" (I2). Edward felt inclusion works best when teachers work together as a community because this gives

them an opportunity to come together and learn from each other. For example, he indicated "there are a lot of online communities where lesson plans, which are highly inclusion-based, already exist" (I2). An opportunity to "practice with other lessons is useful so that you can alter and tailor them to meet the needs of your specific classes" (I2).

Cynthia, on the other hand, felt that science teachers at the high school level do not get the needed professional development that targets explicitly how to use inclusive pedagogy to address diverse needs. She shared:

> One thing I feel that is lacking is instruction for teachers that is specific to science or like instructional strategies for inclusion is often given in a very general way. And it's also often given for a lower age level or maturity level audience. (I1)

Cynthia felt that professional development "on how to be more inclusive, specifically with higher-needs students" with regard to "science and math... [at the] high school level is particularly lacking" (I1). As such, she wished that her participation in the study would have offered her and the "rest of [teachers in the] science department or even science teachers in the district" an opportunity on how to be more inclusive with their instructions. She explained that although she has been making efforts to improve upon her instructional practices when she gets the opportunity for professional development, she needs more support because what she is receiving currently is inadequate:

> I also have been seeking in my professional development ways to be more inclusive in physics education. It's such a small narrow focus topic that I want more people to be involved in and to see that it is something that is for everyone but getting physics people to think inclusive, it is almost like you studying two separate things, right? So, I would like more strategies. I'm kind of looking for more ways, and I think that those kinds of support

are necessary even for students who are still achieving very well but could be achieving higher. I think a lot of our allocations are based on who is the lowest as opposed to the needs, right. (I2)

Table 4

Barriers to Inclusion

Theme	**Sub-theme**
1. Contextual barriers	i) Inadequate professional development ii) Lack of instructional resource teachers iii) Class size
2. Barriers associated with the curriculum	i) Standardized testing ii) Inflexible curriculum
3. Barriers associated with teachers	i) Lack of knowledge and competence in responding to special needs ii) Workload and time constraints iii) Lack of collaboration between general and special education teachers
4. Barriers associated with administration and policy	Lack of monitoring

Moreover, Janet expressed the same concerns about the lack of effective professional development. She indicated that professional developments are "great [and] there is not even enough of them." According to her, teachers "only get an opportunity maybe to go only once or twice a year," but she acknowledged that opportunities for professional development "are super valuable." Janet shared her experience when she was asked to describe the impact of professional development on her instruction:

I think that they have a lot of work to do here in our province … I heard someone talking the other day. He's like "You go to a PD session, and they teach you in all the ways that

> we are not supposed to be teaching students." You know, they get up and lecture and talk to us. We're not supposed to be doing that for students, but they are already doing that. (I1)

She felt that professional development in science should be hands-on and engaging. It should equip teachers with the skills and knowledge on how to keep students motivated, interested, and engaged. She described one such professional development, which she said was "fantastic":

> The Let's Talk Science one was fantastic, you know. I went to that, and they gave a very brief introduction, and then we had the whole day to actually work on resources and a plan that we can take back and integrate right into our classroom. So, when it is done like that, I find it very beneficial. But a lot, you know, I have been to, probably more than I would like to, where it is the opposite, and you walk away feeling like well, that was just a kind of a waste of a day. (I1)

Regina shared her thoughts that for teachers to be more effective in the adoption of inclusive pedagogies, more training and support are needed. When asked to share specific supports and interventions needed to help science teachers be more inclusive with their instructions, she commented:

> I really think we need to do some method courses and how to teach [in an inclusive classroom] ... You really have to educate teachers. I truly believe that every single teacher in this province needs to have some form of special education courses under their belt to truly understand what inclusive education means. It's not based on just intellectual disabilities. We all have to do those courses. Every person who gets an education degree in Newfoundland has to do a course based on disabilities. (I1)

She explained that much training is needed to change the mindset of some teachers about inclusion and how to respond to students' needs in inclusive environments.

Instructional resource teachers

The lack of instructional resource teachers was another barrier identified by the participants as affecting their efforts toward inclusion in the science classrooms. Three participants expressed a lack of instructional resource teachers as a barrier to inclusion. Regina, an instructional resource teacher, stated:

> There's not enough of us [instructional resource teachers]. … Inclusion works if you have the manpower to make it work. In a diverse classroom, it would be very nice to have two teachers. So, it works, it's effective that way. So, if you've got learning needs in this room, my science classroom, it's only me. It's hard to get to those kids. (I1)

Similarly, Janet shared the same thoughts on the lack of instructional resource teachers. She noted that "having an instructional resource teacher in every classroom really is needed. But I know that will probably never happen." Also, when Cynthia was asked to share what support she needs, she mentioned "Instructional Assistance and Students Support Services who are onboard with teaching inclusive pedagogies for high school level, and if any exists specifically for science" (I1). When she was asked if she currently receives any assistance from an instructional resource teacher during lessons, she responded: "No, I don't. I am not assigned any IAs [instructional assistants] or anything for my classes in particular. So, it gets to be a bit of an extra workload in terms of providing notes or any of that" (I1).

Participants felt that professional development and other support services are essential to enable them to respond effectively to the complex needs in inclusive classrooms.

Class size

Two participants indicated that the inability to have an appropriate classroom size is a barrier to inclusion. For instance, Edward identified classroom size as "some of the barriers of learning" as evidenced in the statement below:

> I think the immediate and simplest thing that could be accomplished to allow me to have a more inclusive classroom or work toward one would be lowering the number of students in my class to allow [me] to have the time to develop several strategies in each lesson to meet the diverse needs of the learners. (I2)

Likewise, Janet stated: "I would like to have smaller class sizes. It is a huge one." She described how large class sizes affect her instructional practices: "My academic students, I have 33 students in that class and there are just as many needs in there … So, … I am not able to do as many things in that class" (I1).

***Barriers associated with the curriculum*.** In terms of barriers to inclusion associated with the curriculum, participants identified two critical areas of concern: the overreliance on standardized testing in schools and inflexible or rigid curriculum.

Standardized testing

Three of the participants identified overreliance on standardized testing as a critical barrier to inclusive education. The participants explained that they mostly focus on how to prepare their students for public exams. This hinders their ability to be fully inclusive in their lessons, as they must teach to the test. Cynthia shared her concerns: "You need to make sure you're ready for that test. But you have a human sitting in front of you that needs skills, not for that test in June, for a lifelong process." She described two factors that influence her instructional planning and practices

in science. First, she mentioned that she has to accomplish the curriculum outcomes in order to meet the 50% final mark requirement for the public exam:

> Public exam course [sic] in science are bound by a curriculum guide and it doesn't matter who has registered for the course. You have a 50% final at the end of the year… I find you are very much limited to how often you can employ varied methods to deliver a specific curriculum, in particular with physics (Cynthia-I1).

Second, she indicated that the overreliance on standardized testing [public exam] compels teachers to focus "on the grade [and] the mark" rather than making the instructional process a child-centred one. She remarked:

> My only fear or caveat … is that everyone gets caught up on a number, the assignment, the tests. And it's not about the grade. It is about what process that led to the grade, and I think everyone's focus is on the grade, the mark, the outcome rather than the bigger picture of how you best learn. (I1)

Also, Regina indicated that the overdependence on standardized testing as criteria for assessing students creates barriers for many students in inclusive settings. She noted that there are students who "know the material" but may not be able to "put that on paper" (I1). Therefore, assessing them through standardized testing "sometimes puts [such] kids way off. It doesn't mean that they don't understand the material" (I1). She remarked:

> I think a student who shows growth in terms of when you sit, you talk with him and they [sic] can tell you and understand the material, that shows me growth. I don't have to write it here [pointing to a paper]. But this is the way that we go. We go with the test and I think that is a disservice to the students. (I1)

She continued that assessment should be diversified in an inclusive classroom. Instead of focusing on standardized testing, other forms of informal assessment such as oral assessment, projects, and drawings should be equally recognized to make the lesson more inclusive. In her view, "If you can draw a human reproductive system and show me where every part is, you understand the material, but that's not formal assessment" (Regina-I1). She remarked:

> For me, I would love to sit with the child and orally test him. I would love to. In this classroom, I have people who can do really well on the test. They're fine with it. They will go with it. (I1)

While standardized testing may work for the majority of students, Regina is of the opinion that other forms of assessment such as oral assessment, drawings, and projects should be recognized and accepted for students who struggle with standardized tests.

Evidence of standardized testing as a barrier to inclusive pedagogy was identified in the researcher's field notes when he visited Edward for lesson observation. Edward's lesson, as observed, was very hands-on, engaging, and student-centred. After the lesson, the researcher chatted with Edward to inquire how often he uses inquiry-based learning in his class. He responded that he does so very often. However, there are also moments when he relies on the usual lecture approach. When probed further to find out why, he remarked: "When I'm preparing students for public exams and have a lot of outcomes to cover, I usually use the lecturing and notes-giving approach" (I1).

Inflexible or rigid curriculum

In relation to the curriculum, Edward, Janet, and Regina all commented that the curriculum as it currently exists has not been designed to align with the concept of inclusion. For example, Edward stated: "I'm not sure that the textbooks and guides are written from that [inclusion] point

of view" (I1). Similarly, when Janet was asked if she experiences any challenges in making the curriculum accessible to all students, she shared that the lab activities are fixed, so teachers do not have the flexibility to modify them to fit every student. She remarked:

> Yeah, labs for sure. Because for the most part of the labs are kinda [sic] laid out for us, 'This is what you need to do, you know; here is the procedure, here is the goals.' So, it is definitely challenging finding ways to make the lab completely accessible to everyone. (I1)

Regina also felt that "there is a lot of dysfunction" (I1) and a lack of flexibility with regard to the curriculum:

> There is a lot of dysfunction. Like, for a third-level science course that I have this year, you don't have much flexibility, so you tend to push the material because you have to cover so much material and you have to teach to an exam…So, the department, if they want us to do the inclusive education, they're also gonna [sic] have to step back and not control on what we can and can't do. (I1)

When probed to share her expectations in terms of any modifications or changes she hopes to see, she remarked: "Freedom to teach the way I want to teach. Freedom to teach the material that I think these kids should know instead of being tied to teaching to an exam" (I1).

Barriers associated with teachers. Another theme that emerged from the analysis of interview data was barriers associated with teachers. All participants spoke of several barriers that hinder the implementation of inclusive education in their classrooms. As indicated in Table 4, these barriers are categorized into the lack of knowledge and competence to address special needs, workload and time constraints, and the lack of cooperation or collaboration among general and special education teachers.

Teacher knowledge and competence

With regard to this theme, three participants mentioned their lack of knowledge and professional competence to effectively integrate inclusionary practices to make the curriculum accessible to all students, especially those with special needs. Participants reported that many teachers in inclusive classrooms are still not familiar or comfortable with the integration of technology in their lessons. For example, Regina and Janet explained that rather than diversifying their instructional strategies through the integration of technology, such teachers would prefer to rely on traditional teaching approaches. Evidence of these thoughts is reflected in participants' responses as shared below.

> Yes! Teachers are not comfortable with it [technology]. Teachers who are not comfortable with technology are not going to use it. And unless we force teachers to learn it, it's not going to be implemented. You have to be open. You have to, in order for these kids to learn. And you want them to learn. You've got to get on their level. And that's the thing. (Regina-I1)

> You know what, there's a lot of teachers[sic] still not familiar with the use of technology. So, to those teachers, it's probably intimidating and it's hard when you're learning it yourself to feel comfortable integrating it into your classroom, right? Because you're worried 'what if something goes wrong and I don't know how to fix it, then my whole lesson is gone?' (Janet-I1)

Cynthia, on the other hand, highlighted the lack of teachers' knowledge: "Our [teachers] knowledge is very lacking in terms of what the research is telling us and what is working elsewhere…I feel that my knowledge is very limited" (I2). When asked if she integrates

technology in her physics lessons, she answered in the affirmative but felt it is difficult to integrate it expertly in her physics lessons. She shared:

> Yeah. I have a Google Classroom. I started Google Classroom this year. The Google Forms and the online things are very difficult for math-type settings like [physics], so it's harder to access but it [is] something that I am looking into.

She called for more support for teachers in inclusive classrooms "in order to better meet the needs of the students. It doesn't mean putting more teachers in the class, right? It's 'if you teach me, I'm good to take this and run with it'" (I2).

Workload and time

Edward and Cynthia mentioned teachers' workload and the lack of time as barriers to inclusion. Edward shared that the "barriers that teachers face or [he] face[s] in meeting the needs of diverse students primarily include the time required to plan and prepare and properly execute" (I1) the curriculum. Edward felt this "is sometimes limited by curriculum and other duties required of teachers outside the teaching." He mentioned that considering "the amount of material [they] have to cover in the curriculum, to do a high-quality job inclusively is impossible for every topic" (I1). When probed to explain further, he responded: "There's too much material, not enough time to thoroughly meet the needs" (I1).

Likewise, Cynthia indicated that "we have to meet outcomes. And we have such a wide and narrow curriculum guide. Like it's a mile long and a centimetre fixed. So, you have so much to cover and that you just need to cover" (I1). She felt that the workload and the lack of time negatively impact her ability to meet all needs inclusively. For instance, she observed that she has "two new courses this year" and hence cannot be more inclusive "when the workload is very high" (I2).

Lack of collaboration

The last barrier to inclusion identified by three teachers was the lack of collaboration among regular and special education teachers. Although two participants indicated that they collaborate with their colleagues during instructional planning and teaching, the findings revealed that there appears to be a lack of effective collaboration among general education and special education teachers. For example, Regina shared during the discussions that:

> Not every teacher feels that they need somebody in the classroom, and they feel intimidated by us [instructional resource teachers] sometimes. And I don't know why because we're a resource, and they are intimidated by us. I think they think maybe we're coming to spy on them. (I1)

When Cynthia was asked to identify some of the interventions, she would need to help her meet the diverse needs of her students, she remarked:

> I think, what will have to happen is that the instructional assistants, student support services team would meet … and work with the science [teacher], and we have two very different methods of educational delivery, and there is a place where those two worlds can meet and work together, and right now there is a huge divide. So, there will have to be, again, some kind of top-down approach to facilitate and then provide time for that relationship to develop and interact such that they can work with each other. (I1)

Edward discussed his experiences with instructional resource teachers when asked if he collaborates with them during planning and teaching: "I've had lots of experience with someone in my class… I prefer when we work together to plan and we share the teaching and when I'm not the person teaching every day." Interestingly, Edward indicated that this form of collaboration

"has never really happened for me, and the times it has happened, it's been conflict and struggle, because our duties, in my opinion, are not clearly defined." He further elaborated:

> I feel that the Special Services Team sometimes doesn't want to share those responsibilities. They want just to do the support of the students that are in their caseload. And yes, that's one model. But we're discouraged from pointing out / singling out students with weaknesses. We're encouraged to include them. And we're encouraged to share the division of labour and to share the responsibility of all the students' successes. And every now and again, I meet the right-minded person. And it goes very well, but it still is a conflict and a struggle to get the person to a shared view of what inclusion is for the classroom. (I1)

Although participants recognized that effective collaboration among general education and special education teachers is needed to respond effectively to students' diverse needs in inclusive classrooms. They felt that to establish this type of relationship, there should be a clear understanding of each other's roles and responsibilities.

Administrative and policy-related barriers

The last barrier to inclusion discussed by participants was barriers associated with policy and administration. For two teachers, the lack of an appropriate monitoring or accountability system on the part of administrators and policymakers was another barrier to effective inclusion. Specifically, Edward and Cynthia indicated that the concept of inclusion as currently practiced lacks an appropriate accountability system. For example, during the discussions, Edward noted: "I don't even know if the monitoring [of inclusion] is happening. I don't know if the direction is being given. I think right now, as a model it is just floated out there and like-minded people who [sic] use it" (I1). Similarly, when Cynthia was engaged during the first session to share how the department promotes inclusion in schools, she said:

> There's a safe and caring schools' policy, and there is an inclusive education, although I must admit it's not as present or push forward. In September, you are given a list of these policies to adopt or use and how they are integrated is [sic] as never followed up. I mean, there is the dissemination of information and what you do with that is on you. So, I feel that although it all looks good on paper that there is a policy there and they're all supposed to be doing it. It is very much an individual responsibility as to whether you have ethically and morally adopted it yourself. Whether or not it's done in every classroom, I don't think anyone really knows. (I1)

When probed further during the second interview to share whether there is any monitoring mechanism in place toward the implementation of inclusion by teachers, she retorted:

> No, no… That's not happening, and I think what ends up happening is very reactive rather than proactive. You end up having students with problems, with challenges, with difficulties and then it comes out after the fact, after the midterm, after few tests that or maybe we need to change what we're doing to help the student, whereas if it was done in the beginning, perhaps that student would never have to feel that distress and evaluate their self-worth on their progress from a number of grades had we been inclusive from the get-go. (I2)

This implies that the lack of adequate and appropriate monitoring mechanisms for inclusion in schools may deny education authorities the opportunity to have first-hand experience and appreciation of the difficulties faced by science teachers in inclusive classrooms. This, consequently, may affect the students negatively both socially and academically.

Summary

Analysis of the various data revealed that there are several barriers to the adoption and implementation of inclusion by high school science teachers. Overall, nine barriers to inclusion were identified by the participants: (a) inadequate professional developments, (b) inadequate or a lack of instructional resource teachers, (c) class size, (d) standardized testing, (e) inflexible or rigid curriculum, (f) teachers' lack of knowledge and professional competence in responding to special needs, (g) workload and time constraints, (h) a lack of collaboration between general and special education teachers, and (i) a lack of appropriate monitoring mechanisms on inclusion. All participants involved in this study felt that a lack of professional development is a significant barrier to inclusion. Specifically, participants identified the lack of professional development on inclusive pedagogy in the science classroom as a significant barrier to the implementation of inclusion in the science classroom.

Chapter 5

Discussion

Introduction

This chapter presents the synthesis of the results outlined in the previous chapter. The study set out to explore the perspectives and practices of high school science teachers on inclusive pedagogy. In this chapter, a review of the research questions that guided the study is provided. This will be followed by a discussion and interpretation of the main findings in the study based on the research questions and existing literature.

5.1 Review of the Research Questions

The current study addressed the following research questions regarding high school science teachers' conceptions and practices of inclusive pedagogy:

1. What are high school science teachers' conceptions of inclusive pedagogy?
2. How do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diversity in their classrooms?
3. What specific inclusive pedagogical strategies do high school science teachers use to respond to the diverse learning needs of students?

This next section provides a discussion of the main findings as related to the literature on teachers' conception of inclusion, instructional planning, and adoption of inclusive teaching practices in the general education science classroom. Also, a discussion on the barriers faced by general education science teachers in inclusive classrooms is provided.

5.2 Discussion and Interpretation of Findings

For an in-depth discussion, the findings have been organized around four broad areas based on the research questions: (a) conceptions of inclusion; (b) description of science teachers'

instructional planning processes; (c) adoption of inclusive practices; and (d) barriers to inclusion. The discussion will, therefore, be presented based on these areas along each of the specific research questions.

The first section addresses research question one, focusing on findings that emerged about participants' conceptions of inclusion. The next section addresses the second research question with the focus on participants' descriptions of their instructional planning processes for designing lessons that are appropriate for diverse students in an inclusive environment. Further, the factors influencing science teachers' choice of instructional strategies in inclusive classrooms will be looked at in this section. The final section focuses on the findings of research question three. It focuses on participants' adoption of inclusionary practices including their instructional strategies and assessment. Since the Universal Design for Learning (UDL) principles were used as a theoretical framework for examining participants' adoption of inclusive practices in the science classroom, the discussion in the final section will be aligned with the three fundamental principles of UDL. Also included in the final section are the barriers faced by science teachers in their efforts to make the science curriculum accessible to all students using inclusionary practices. The following discussion is based on data from transcripts of the recordings from participants' interviews, the researcher's observation and field notes, and documents from participants.

5.2.1 Section One: Conceptualization of inclusion. This section addresses research question one: "*What are high school science teachers' conceptions of inclusive pedagogy*?" Previous studies have indicated differences in how inclusion is conceptualized and implemented by general education teachers (Hodkinson, 2006; Hodkinson & Devarakonda, 2009; Woodcock & Hardy, 2016). However, the review of the literature showed a lack of extensive research in the area of how high school science teachers conceptualize inclusive pedagogy. Research question one,

therefore, attempted to address this gap by exploring the perspectives of high school science teachers on inclusive pedagogy. Participants' conceptions and views of inclusion were interpreted based on keywords, or phrases from their interview transcripts.

The result under research question one indicated that participants hold multiple conceptions about inclusion. This finding appears to strengthen the complexity surrounding the definition of inclusive education. Daniel (2011) has reported that…

> the lack of consensus in the definition of what constitutes *inclusion* may contribute to the lack of understanding and agreement of what is considered inclusive education in all provinces, jurisdictions, and even from school to school within a single jurisdiction (p. 36)

Although participants in this study provided different views about what inclusion means, their views did not demonstrate a lack of understanding of inclusion as reported in previous literature (Daniel, 2011; Vaughn, 1994). In describing their perspectives about inclusion, participants used keywords or phrases such as accept everybody based on what they're doing (Regina-I1); they [special needs children] should be in our classroom (Regina-I1); a really accepting environment (Regina-I1); they [should be] part of and accepted in the general education classroom (Cynthia-I1). These phrases reflect the notion that inclusion is pivoted on acceptance, a sense of belongingness, equal opportunity for participation, and the right to be educated in the general education classroom devoid of any form of discrimination. This result was not surprising as it aligns with previous studies on inclusive education (Fyssa, Vlachou, & Avramidis, 2013; Hodkinson, 2006; Woodcock & Hardy, 2016). As indicated in chapter two under literature review, Fyssa et al. (2013), for instance, reported in their study that Greek's regular and special preschool teachers' hold multiple perspectives on what constitutes inclusion. Of the 77 teachers interviewed, 73% of them conceptualized inclusion within the context of participation and acceptance by peers.

One significant difference in the result of the current study, as compared to previous studies on inclusion, was the fact that participants' conceptions of inclusion were not characterized by the integrationist standpoint. Previous studies have reported disparities in how regular and general education teachers conceptualize inclusion. Earlier studies indicate that many teachers conceptualize inclusion from the integrationist standpoint (Daniel, 2011; Fyssa, Vlachou, & Avramidis, 2014; Khan, 2012), which accepts that it is the responsibility of "students enrolled in school… to adapt themselves to the existing school environment (curriculum, methods, values and rules), regardless of their mother tongue, culture or abilities" (Acedo, Amadio, Opertti, & Brady, 2009, pp. 12-13). Conversely, participants in this study conceptualized inclusion within a broader context of ensuring equity, acknowledging and accepting individual differences, and responding to students' diverse needs in an environment where everyone is valued, respected, and protected. This finding aligns with those reported by Woodcock and Hardy (2017). In a study that explored Canadian elementary and secondary teachers' understandings and engagement of inclusion in the southern part of Ontario, Woodcock and Hardy (2017) reported that 92% of participants were confident in their responses that "inclusive classrooms were effective environments for all students to learn" (p. 674).

Evidence from research supports that the discussion about inclusion should not be based on the contrast between inclusion and integration as the two are closely related (Acedo et al., 2009; Ekins, 2010). Instead, the debate about inclusive education should be focused on the extent to which "each school has made progress towards understanding its moral responsibility for the inclusion of all [children]" (Acedo et al., 2009, p. 39). Inclusion should be anchored in the acceptance of all students, with or without disabilities, in an environment where they feel respected and safe with a sense of belonging (Katz, 2012; New Brunswick Department of Education & Early

Childhood, 2013; New Zealand Ministry of Education, 2017; Ontario Ministry of Education, 2014; Specht, 2016).

While the majority of views expressed by participants centred on the notion of acceptance and belongingness, some participants conceptualized inclusion in the context of the right to be educated in a regular classroom and the recognition of student diversity. This rights-based perspective is delineated in the *Constitutional Act* of 1982 as enshrined in the *Canadian Charter of Rights and Freedoms Charter of Rights and Freedoms* (Smith & Foster, 1996) and in other international declarations and conventions such as Article 24 of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), of which Canada is a member (UNESCO, 1994, 2005, 2009). Thus, participants' notion of inclusion as a right to education seems to suggest that the adoption of inclusive in Canada should be done in tandem with the *Canadian Charter of Rights and Freedoms*, a standpoint that was highlighted by Hutchinson (2010). As indicated in the review of the literature, Hutchinson (2010) claimed that in Canada, inclusion is "an issue within the context of Canadian society, not just within the context of Canadian schools (p. xxi). Thus, accepting to teach in Canadian schools is equivalent to accepting to educate children in an inclusive setting.

Similarly, there are multiple international studies such as Spratt and Florian (2013), the American Institue for Research-AIR (2017) and UNESCO (2009) that share similar views that inclusion should embrace human diversity while addressing individual needs. For instance, Spratt and Florian (2013) noted that "human diversity is seen within the model of inclusive pedagogy as a strength, rather than a problem" (p.135). Also, AIR (2017) emphasized this point by indicating that the success of inclusion depends on the ability of teachers to "discover where each of their students [is] academically, socially, and culturally to determine how best to facilitate learning" (n.

p). In this study, participants felt that an educational system should not be grounded on the principle of differential treatment where learners are grouped or categorized based on differences in their cognitive and physical abilities (Davis, Sumara, & Luce-Kapler, 2013). Acedo et al. (2009) claimed that "an inclusive school has no selection mechanisms or discrimination of any kind. Instead, it transforms its pedagogical proposal into ways of integrating the diversity of students, thus fostering social cohesion" (p. 10). Meanwhile, Spratt and Florian (2013) argued that the principle of inclusive pedagogy rejects the labelling of learners based on abilities. All children should be treated respectfully and provided with the needed support and opportunities to enable them to succeed (Alberta Education, 2017; Department of Education and Early Childhood Development in Newfoundland and Labrador, 2017; Ontario Ministry of Education, 2014).

Consistent with Engelbrecht et al.'s (2015) claim that teachers' understanding and interpretation of inclusion directly affect how they adopt and implement inclusive pedagogy in the classroom, it was not surprising to find participants connecting their conceptions of inclusive pedagogy with teachers' instructional practices in the classroom. These connections could be seen in phrases like you vary your teaching methods to meet them as best as they learn (Edward-I2); being able to present educational information in a variety of methods (Cynthia-I1); basic good teaching practices which consider the ability, interest level, and the maturity level of the students in question (Edward-I2); to differentiate your instructions to give students different opportunities to be as successful (Cynthia-I1*);* and using practices that make that [the curriculum] accessible to everybody (Janet-I1). Interestingly, these descriptions appear to reinforce the principles of inclusion as "a pairing of philosophy and pedagogical practices" as opined by the New Brunswick Department of Education and Early Childhood Development (2013, n.p). The result also agrees with Roy, Guay, and Valois's (2013) claim that teaching diverse students requires the adoption of

multiple instructional practices that provide fair and equitable opportunities for all students to learn and optimally develop their competencies. Similar views have been expressed in studies on inclusive education (Andrews & Lupart, 2000; UNESCO, 2009).

Moreover, there were instances in this study where participants cited the influence of classroom experiences on their perspectives and adoption of inclusion. This result is consistent with the literature that discusses the impacts of teaching and professional experiences on teachers' perspectives and attitudes toward inclusion (Avramidis & Kalyva, 2007; Niemeyer & Proctor, 2002; Minke, Bear, Deemer, & Griffin, 1996). As "an emotive and value-laden concept", Ekins (2010) maintained that inclusion "will always be impacted upon by the particular personal feelings and experiences of those involved" (p. 108), which will consequently influence how it is adopted and implemented in the classroom (Engelbrecht et al., 2015).

To sum up, the discussion on participants' conceptions of inclusion indicates that to be inclusive means:

a) understanding each student as an individual; recognizing and embracing the differences in interests, abilities, culture, language, gender, and race;
b) a shift from the principle of the mere placement and right to be in an inclusive classroom toward the adoption of appropriate teaching practices that account for the above differences within an environment where a feeling of belongingness and safety is guaranteed.

Taken collectively, it is imperative for teachers, particularly those teaching sciences, to adhere to these tenets as any form of differential treatment in the classroom resulting from a stereotype or negative attitude toward a learner in school can impair his or her academic achievement, interests, and participation in science-related programs (Ruggs & Hebl, 2012).

5.2.2 Section Two: Science teachers' instructional planning processes. The second research question was "*How do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diverse needs of learners in their classrooms*?" According to Stefanich (2001b), "prior planning is essential in preparing students for learning" (p. 14). Research question two, therefore, attempted to analyze science teachers' instructional planning process regarding their choice of instructional methods, their thinking process during lesson planning, how they plan to meet diverse students' educational needs inclusively, and their views about collaborating with their professional peers during the planning process. Data from participants suggest that (a) several factors influence participants' choice of instructional methods when planning for inclusion, (b) participants' instructional planning is focused on meeting the needs of students with most needs, and (c) participants consider collaboration as an essential variable in successful planning for inclusion.

Factors influencing teachers' instructional planning and practices

Consistent with previous studies on instructional planning in the inclusive science classroom, science teachers are encouraged to consider their students' abilities and interests, strengths and weaknesses, experiences, and language skills when planning lessons for diverse students (Stefanich, 2001a, 2001b; Watson & Houtz, 1998, 2002). Participants in this study discussed thinking about students' abilities, interests, learner variability, time, and curriculum content when planning lessons to meet the diverse needs of students in an inclusive classroom. They explained that these thoughts influence how they select their instructional methods including the type of activities and groupings in the lesson. Of noteworthy was participants' explanation that ability and success as dominantly used in the general education classroom to describe the effectiveness of teaching and student learning are relative and subjective. According to these

participants, each child's cognitive ability level and learning needs are unique and needs not to be compared with others to determine their success or otherwise. This notion aligns with Beaudoin's (2013) claim that "all brains are not alike and therefore students don't all learn the same way" (p. 4). Accordingly, planning for diverse students will require the consideration of several factors including but not limited to the cultural background, experiences, abilities, and learning preferences of students in order to meet their varying needs effectively and equitably.

Interestingly, similar results have been reported by previous studies. Watson and Houtz (2002) noted that although it is essential to provide students with equal access to information, science teachers should do so by carefully considering the variabilities in students' abilities, degrees of learning including their learning needs when planning and organizing their lessons. Winter (1997) proposed, among other things, that planning for inclusion requires teachers to (a) consider and compare the characteristics of individual students and the curriculum; (b) view their instructional approaches from a constructivist perspective by adopting a child-centered learning approaches; (c) plan for different learning styles and preferences; and (d) plan for differentiated instruction. According to Laswell (2016), recognizing the variabilities in students' abilities and interests during instructional planning enables the teacher to create "learning environments that leverage student strengths while minimizing barriers to learning" (n. p).

Apart from learners' variability, abilities, and interests, other factors reported by participants as influencing their instructional planning and selection of instructional approach were time and curriculum. All the participating teachers mentioned that their instructional planning is influenced by the course content and the amount of time available to accomplish the curriculum outcomes. This result was to be expected as recent studies have reported similar outcomes. In a study to investigate the instructional strategies of elementary general education teachers in

inclusive classrooms, Peterson (2011) found that nine out of the fifteen participants involved in the study described the curriculum as the most influencing factor on their instructional planning while two of them considered time as a factor when planning instruction. Similar studies have reported that teachers often rely on time and the demand of the curriculum outcome to plan lessons for diverse learners (Mackey, 2014; Schumm, Vaughn, & Leavell, 1994; Superfine, 2009; Van Garderen & Whittaker, 2006).

Planning to meet students' needs

Peterson (2011) reported that general education teachers instructional planning and strategies in inclusive classrooms aims at addressing the needs of students with special needs. Similar findings were reported by Schumm, Vaughn, and Leavell (1994). In a study to investigate the beliefs, skills, and instructional planning and practices of 60 effective elementary, middle, and high school general education teachers, Schumm and colleagues found that elementary teachers instructional planning concentrated on meeting the needs of students with disabilities. These findings agree with the current research because science teachers in this study explained that their instructional planning targets students with the most need in the classroom. Once they achieve this, they then differentiate their instruction to provide the rest of the students the needed support, encouragement, and challenge while scaffolding their learning experiences to ensure their academic success (Jordan, Schwartz, & McGhie-Richmond, 2009). Although the findings from this study are generally in agreement with instructional planning of the elementary teachers found in Schumm, Vaughn, and Leavell's (1994) study, they run counter with the instructional planning processes of the middle and high school teachers who participated in their study. As reported by the authors, the high school teachers although expressed the willingness to provide additional help for students with exceptional needs, they shifted such responsibilities on the students. Rather than

approaching students to find out their challenges or needs to provide them with the needed assistance or intervention, those teachers expected the students to approach them first.

Collaboration is essential in inclusion

Evidence suggests that collaboration among professional peers is a critical factor in the success of inclusive education (Hwang & Evans, 2010: Johnson, & Pugach, 1996; Soodak, Podell, & Lehman, 1998). Of the four participants involved in this study, three considered collaboration as an essential component in planning for diverse learners in inclusive settings. While they may not have the needed knowledge and skills for addressing the needs of learners with special needs effectively, participants in this study had a positive attitude toward collaborating with their colleagues to make the curriculum accessible to all students. In order to be more inclusive and respond effectively to students with special needs, participants planned their lessons in collaboration with the instructional resource teachers and other colleagues whom they considered to be more experienced in dealing with children with special needs in inclusive environments. While this study is consistent with the literature that discusses teachers' perception toward inclusion and the impact of collaboration between general education teachers and their professional peers (Ali, Mustapha, & Jelas, 2006; Austin, 2001; Roy, Guay, & Valois, 2013), it is at odds with those reported by Peterson (2011). Most of the participants involved in Peterson's (2011) study planned their instructions in isolation. Similar studies (Engelbrecht, 2006; Villa et al., 1996; York & Tundidor, 1995) have also reported a lack of collaboration between general and special education teachers in inclusive classrooms.

As noted by Villa et al. (1996), "collaboration is an integral process for meeting the needs of students eligible for special education services or at risk for school failure" (p. 170). Specific to inclusive schooling, Soodak, Podell, and Lehman (1998) maintained that collaboration is one of

the "most powerful predictors of teachers' positive attitudes toward inclusion" (p. 483). Given these findings, it was not surprising that participants in this study had a positive attitude toward inclusion and adopted inclusionary practices that made the science curriculum accessible to all of the students in their classrooms including those with special needs in their classrooms.

5.2.3 Section Three: Adoption of inclusion in the classroom. This section of the discussion addresses research question three: *What specific pedagogical strategies do high school science teachers use in inclusive classrooms to respond to the diverse learning needs of students*? This involved analyzing how participants adopt inclusive practices in their classroom to address students' diverse needs using the principle of Universal Design for Learning (UDL) as a theoretical framework. This research question also involved examining the barriers or challenges faced by the participants in inclusive classrooms. As such, the result in this section will be discussed in three parts based on the UDL principles.

UDL Principle 1: Multiple means of representation

Multiple means of representation refers to a flexible instructional approach where the teacher represents information to students with diverse abilities using varied options during instruction to support students' comprehension, providing alternatives (e.g. provision of auditory, visual, and tactile modes), using online media, and videos to enable students to access the curriculum. The idea is that adopting multiple teaching strategies based on UDL principles to present information provides maximum students' learning by eliminating barriers (Courey, Tappe, Siker, & LePage, 2013; Burgstahler, 2017) while providing them with a broad range of opportunities to acquire information and knowledge (CAST, 2011; Rose, D. H., & Meyer, 2002).

In this study, participants mentioned using a variety of teaching approaches and representative tools in their lessons. The transcripts and observational data revealed that high

school science teachers in this study incorporated hands-on activities, videos, games, online sources, Google Classroom, and the use of interactive whiteboards and iPads during instruction to help students make connections with the information presented and acquire knowledge. Adopting these strategies in science lessons suggests that the teachers in this study took cognizance of the diverse learning needs of the students in their classrooms. This result seems to validate the notion that teaching diverse groups of students requires the adoption of diverse instructional practices that provide fair and equitable opportunities for all students to learn and optimally develop their competencies (Roy, Guay & Valois, 2013).

Additionally, multiple studies support that before presenting a new concept to students, it is imperative for teachers to understand and activate students' prior knowledge as it forms the foundation on which they build new concepts and construct knowledge (Alvermann, Smith, & Readence, 1985; Courey, Tappe, Siker, & LePage, 2013; Gee, 2012). As indicated above, the use of videos and graphics were among the instructional strategies adopted by participants to introduce their lessons. They followed this up with brief explanations and reviews of students' previous lessons. Participants explained that using videos in their lessons allowed students to relate the lesson to real-life experiences in order to create a memorable learning experience. Also, participants relied on videos and questions to illustrate science concepts and gauge students' previous knowledge about the new topic or concept being taught. Using videos, graphics, and questions provided an avenue for participants to probe students' background knowledge to enable students to make connections between their existing knowledge and what was being taught. This finding seems to back up Meier's (2013) finding that participants involved in her study embedded videos in their lessons "as a tool to bridge the gap between what was being taught and a student's background knowledge, and as a way to relate instructional information to real life" (p. 126).

Similar studies support that presenting information through the use of multiple media and strategies such as videos, graphics, questioning, and text format breaks learning barriers, while allowing students to make connections between their prior knowledge and new concepts (Ambrose, 2010; Courey, Tappe, Siker, & LePage, 2013; Okolo, 2006).

Further, the practices participants used in their lessons to extend the learning experiences to all students and to support their learning involved the adoption of inquiry-based activities, technology, and mnemonic devices. For example, Regina used mnemonic devices and pictures to assist her students in learning and processing new and challenging concepts of science while increasing the accessibility of the curriculum by breaking language barriers through the use of Google Translate. Also, Cynthia combined textbooks with a visual representation using the interactive whiteboard and gravitational field in a 3D format to teach the concept of gravitational fields to her student. As Spencer (2011) noted, "there are many elements a teacher can consider when presenting information using UDL" (p. 13) to address the needs of diverse students in an inclusive environment. Using keyword strategies such as mnemonics, pictures, and technology as explained by participants are some of the options for clarifying vocabularies, activating students' background knowledge, connecting what is being taught and learned to their prior knowledge, promoting understanding, and providing an opportunity for students to learn and retain new concepts.

One final point that relates to the adoption of multiple instructional strategies was the use of differentiated instruction by participants to provide students with multiple options for taking in information and making sense of ideas. Two teachers, Janet and Cynthia, explained that differentiating instruction provides a natural entry point and multiple pathways that provide every student access and equal opportunity to reach some form of success based on their ability levels.

Evidence supports that a teacher who differentiates his or her instruction helps students to access and understand the content being taught as s/he is able to vary the difficulty of the material in diverse ways by presenting complex concepts in smaller and simpler forms (Hall, Strangman, & Meyer, 2003).

UDL Principle 2: Multiple means of engagement

The UDL principle of engagement involves the teacher addressing the affective network of students. Specifically, it focuses on how teachers activate and sustain students' interests in the curriculum and the school as a whole by using multiple instructional approaches that challenge and motivate students to learn (Rose & Meyer, 2002; Spencer, 2011).

In terms of instructional strategies to support engagement, the results indicated that participants relied on multiple and flexible teaching practices including the use of scaffolding, diversified assessment, allowing students to choose to work as a team or individually, and providing constructive feedback to prompt and sustain the attention, interests, and curiosity of students. The use of multiple instructional strategies to engage students demonstrates participants' recognition that there are different motivators for students to learn, and an instructional approach that motivates and engages one student may cause disengagement for another (Hall, Cohen, Vue, & Ganley, 2015; Rose & Meyer, 2002).

Research indicates that one of the essential components of student engagement is reducing threat and stereotype within the learning environment. Hilton and von Hippel (1996) defined stereotype as "beliefs about the characteristics, attributes, and behaviors of members of certain groups" (p. 240). While such beliefs or characterizations may not necessarily be negative, "stereotypes about out-group members are more likely to have negative connotations than those about in-group members, even when the attributes they include may seem objectively positive"

(Hilton & von Hippel, 1996, p. 240). Evidence from previous studies suggests that differential treatment in the classroom resulting from stereotype based on race, gender, or ability may impair a student's academic achievement, interests, and participation in science-related programs such as STEM (CAST, 2015, 2016; Ruggs & Hebl, 2012; Singletary, Ruggs, Hebl, & Davies, 2009). A teacher can reduce threat by providing students with the autonomy to choose to either work in a group or individually (Spencer, 2011). Participants in this study reduced threat by creating a conducive classroom climate that allowed students to make decisions on whether to work in a group or individually. They also ensured that they provide students with mastery-oriented feedback that rewards efforts rather than perceived innate abilities, a practice that is known to lessen stereotype threat and motivates diverse students who may be struggling in class to learn (CAST, 2016; Spencer, 2011).

Interestingly, two top instructional approaches participants found to be more engaging with students were the use of technology and hands-on learning. When asked to describe how they motivate and engage students in learning, all participants indicated that they provide students with flexible options for engagement including the use of hands-on learning and technology in their lessons to support student learning. This was evidenced in phrases like hands-on demonstrations so that they can relate it to something realistic (Janet-I1); I want them to have hands-on…to extend the experience to them (Regina-I1); any kind of hands-on activities that you can do (Cynthia-I1); it was very tactile and hands-on (Edward-I1). Numerous studies (e.g. Juriševič, Vrtačnik, Kwiatkowski, & Gros, 2012; Stefanich, 2001a; Vrtačnik & Gros, 2013) support that the use of hands-on learning approach to science teaching in the classrooms not only promotes collaboration and active participation in the learning but offers many benefits to students including increased learning, motivation to learn, enjoyment of learning; and skill proficiency. For instance, in a study

to investigate the impact of hands-on teaching and learning visible spectrometry on students' achievements, Vrtačnik, Juriševič, and Gros (2012) found that the use of a hands-on approach to instruction stimulated students learning process as it offered students with high autonomy to explore and search for information on their own, without constant guidance by the teacher.

Of concern in this result was the seeming lack of pedagogical efficacy with regards to the utilization of technology in science curricula by some teachers. As the National Science Education Standards noted, science should be taught using inquiry-based, hands-on, and child-centred instructional approach (NRC, 1996). Curry, Cohen, and Lightbody (2006) recommended the integration of instructional technology through the lens of universal design for learning as one of the ways of implementing an inquiry-based curriculum in the K-12 science classroom. Although participants in the current study indicated using technology in their lessons to motivate, promote, and enhance student learning in an inclusive classroom, there appears to be a perceived challenge with how to integrate technology in specific science topics. Evidence to this effect comes from how some participants described their instructional practices: "I started Google classroom this year. The Google forms and the online things are complicated for maths type settings like [physics], so it's harder to access but it something that I am looking into" (Cynthia-I1). Another participant remarked: "there're a lot of teachers still not familiar with the use of technology. So, to those teachers, it's probably intimidating, and it's hard when you're learning it yourself to feel comfortable integrating it into your classroom" (Janet-I2). Thus, teachers who lack pedagogical efficacy in regards to the use of technology may result in using the traditional teacher-centred instructional approach which excludes many students with diverse learning needs in the inclusive K-12 classroom.

UDL Principle 3: Multiple means of action and expression

Under the principle of multiple means of action and expression, teachers provide learners with various options to enable them to interact with information, express their knowledge or mastery of information, while supporting learners' executive functioning as they learn new materials (Johnson-Harris, 2014). Providing multiple means for students to interact with the materials and demonstrate their knowledge implies students may use different approaches based on their interests and preferences to achieve the same lesson objectives (Johnson-Harris & Mundschenk, 2014).

In this study, participants diversified the assessment format by providing different options to learners to demonstrate how they have mastered the learning objectives. For example, while Edward ensured that "students who cannot [write with] pen and paper" were provided with other options such as "typing their responses…[using] Google Forms" (I1), Janet made sure that "the assessments [in her lessons] [we]re very diversified and … not assessing them …[using] just paper and pencil" (I1). She provided various options that allowed "all [learners] to have equal opportunities to show what they know" (I1). Research suggests that when teachers provide learners with different options to demonstrate their understanding and mastery of new material based on their strengths, interests, and preferences, it improves their participation and academic performance, maximizes their strengths and minimizes their weaknesses (Johnson-Harris, 2014; Rose, & Meyer, 2009).

Not only did participants diversify the format of the assessment, but they also provided learners with multiple ways to interact with information and participate actively in the lesson. The majority of the participants relied on technology to respond to the individual needs of students. Regina, for example, utilized text-to-speech software to assist students with reading difficulties.

This enabled such learners to have access to the curriculum. Integrating technology in science lessons does not only provide children with the option to express what they know or have learned, but it also eliminates barriers, improves academic performance (Carver, 2016; Spektor-Levy & Granot-Gilat, 2012), promotes inclusion, and allows the teacher to attend to students' needs individually without necessarily exposing their weaknesses. As noted by Williams, Nguyen, and Mangan (2017), the use of technology to support students' learning has the "potential to make learning more relevant and engaging and to develop the skills considered essential for learners in the 21st century" (p. 29).

Furthermore, two participants, Edward and Cynthia, provided support for students with executive functioning issues such as learning and attention difficulty. Cynthia, for instance, supported learners' executive functioning by helping learners to manage and organize their learning. She assisted them in using a checklist to plan their learning and set their learning goals. Participants' ability to support students' executive functioning is very significant as evidence suggests that promoting executive functions for diverse learners remains one of the key challenges facing teachers in inclusive classrooms (Garcia-Campos, Canabal, & Alba-Pastor, 2018). Research indicates that students' academic success is greatly influenced by core executive function processes such as their ability "to plan their time, organize and prioritize information, separate main ideas from details, monitor their progress, and reflect on their work" (Meltzer, 2018, p. 166). Thus, teaching them the strategies that address such processes helps to eliminate barriers to learning, promotes independent learning skills which ultimately allows students to learn effectively and efficiently based on their strengths. Overall, teachers in this study intentionally planned and delivered their lessons by identifying the individual needs of their learners. They used

flexible assessment strategies and provided learners with multiple ways of interacting with new information based on learners' interest, strengths, and preferences.

5.3.4 Section Four: Barriers to inclusion. To examine participants' instructional practices, the researcher also probed the barriers or challenges faced by the participants in their adoption of inclusive practices. Teacher participants in this study discussed four key barriers that they experience in their adoption of inclusive pedagogy in the classroom. These barriers include: (a) contextual barriers, (b) curriculum barriers, (c) teacher related barriers, and (d) administrative barriers.

Contextual barriers

Under contextual barriers, participants cited inadequate professional development, a lack of instructional resource teachers, and class size as the most common barriers to inclusion. Specifically, participants in this study discussed the need for more effective professional developments. Although all participants indicated receiving professional development occasionally, they felt that a lot of the professional development activities are general and not directed at providing them with the needed tools and pedagogical expertise to address the complexity of needs in their classrooms. This finding is very significant because professional development remains the only conventional avenue for teacher education apart from the primary education provided to teachers through university programs (Collins, Fushell, Philport, & Wakeham, 2017).

As research indicates, several obstacles affect the implementation of inclusion, but "the absence of professional development [for] teachers is the key challenge and the most important obstacle to policymakers' efforts to create inclusive education" (Bhatnagar & Das, 2014, p. 97). The result in the current study supports Beres' (2001) study, which investigated challenges faced

by junior high school teachers in the inclusive education classroom. In that project, Bares (2001) found that 77.5 % of the respondents felt that the professional development opportunities available to them with regards to instructional planning and practices were not adequate although 82.93% of the participants felt the regular classroom was the rightful place for students with learning disabilities. Similar concerns have been reported by international studies on the implementation of inclusion (Avramidis, Bayliss, & Burden, 2000; Bhatnagar & Das, 2014; Hemmings & Woodcock, 2011). Research supports that more professional development is needed for general education teachers, especially those at the secondary level, to be able to respond to the diverse needs of students with and without disabilities (Beres, 2001). The training or professional development activities provided for teachers should be relevant to their expectations and instructional needs (Barrington, 1995; Lobosco & Newman, 1992) including "the provision of assessment tools as well as strategies for differentiating the classroom instruction" (Beres, 2001, p. 47). This reinforces the recommendation by the Premier's report on the improvement of educational outcomes in Newfoundland and Labrador that suggests that an effective teacher professional development should be built around three pillars: "(1) quality (is evidence-based, has subject and pedagogical content, focuses on student outcomes, meets teacher and system needs); (2) design (engages teachers, is collaborative); and, (3) support and sustainability (is ongoing, is resourced, and engages leaders)" (Collins, Fushell, Philport, & Wakeham, 2017, p. 113).

In addition to the lack of professional development on instructional practices, three participants in this study expressed concern about the lack of instructional resource teachers as a source of barrier in the adoption of inclusive practices. As reported in chapter four, participants were critical of the lack of instructional resource teachers as illustrated in the following comments: "inclusion works if you have the manpower to make it work. In a diverse classroom, it would be

very nice to have two teachers… [but] there's not enough of us [instructional resource teachers]" (Regina-I1); "I am not assigned any IAs [instructional assistants] or anything for my classes in particular. So, it gets to be a bit of an extra workload in terms of providing notes or any of that" (Cynthia-I1); "having an instructional resource teacher in every classroom is really needed. But, I know that will probably never happen" (Janet-I1).

As presented in chapter four, the participants felt that more instructional resource teachers are required to assist in planning, classroom instructions, and reduce the workload in their classrooms. This result reinforced similar outcomes in previous studies in which general education teachers expressed concerns about the lack of support from special education (instructional resource) staff to support inclusion (Fuchs, 2010; Forlin & Chambers, 2011; Sharma, 2001). The existing empirical research on the barriers to inclusion emphasizes that meeting the diverse needs of students in inclusive classrooms requires the provision of more specially trained personnel to offer support to the classroom teachers (Beres, 2001; Zigmond, 1995).

The last contextual barrier to inclusion identified by participants was the large class size. However, only two of the four participating science teachers mentioned large class sizes as a significant source of a barrier to inclusion because it made it difficult for them to focus more on students who need extra attention. This was somehow surprising as multiple studies have documented large class sizes as a significant concern among general education teachers in inclusive classrooms. For example, in a study to explore junior high school teachers' perceptions on the inclusion of students with learning disabilities in the inclusive classrooms in Alberta (Canada), Beres (2001) found that 82% of the respondents expressed the need for reduced class size when students with learning disabilities are included. Beres' (2001) finding confirmed Barrington's (1995) study in the same province which explored the integration of students with

special needs in regular classrooms. In her study, Barrington (1995) reported that reduced class size was one of the critical factors missing in all of the case-study schools.

Similar findings have also been reported in other jurisdictions. In a study to investigate variables associated with inclusion in India, Singal (2008) reported that participants in her study indicated large class size as a significant barrier in the implementation of inclusion programs in their schools. Unambiguously, the participants in the study explained that providing individual attention to students becomes difficult due to large class sizes. Other international studies (Beres, 2001; Bhatnagar & Das, 2014; McCrimmon, 2015; 2015; Peterson, 2011; Tan, 2015) have provided similar reports about the effects of large class sizes on the successful implementation of inclusion. Research suggests that inclusive classrooms should have class sizes of fewer than 20 students (Scruggs & Mastropieri, 1996) to enable students with special needs to get the needed attention from their teachers and time to actively participate in the classroom activities (Beres, 2001).

Curriculum barriers

As indicated by Kearney (2009), the curriculum is "a powerful force in including or excluding students" from accessing education (p. 51). Consequently, the expectation is that within any inclusive environment, teachers should be able to tailor the curriculum to suit the specific needs of each learner to make education accessible to all (Donohue & Bornman, 2014). Paradoxically, teacher participants in the current study identified the curriculum as a barrier to the implementation of inclusive education in their classroom. Specifically, they raised two critical issues with regards to the science curriculum: standardized testing and inflexible or rigid nature of the curriculum.

In terms of standardized testing, three of the four participating teachers felt that the overreliance on standardized testing as currently practised in public schools in Canada compels classroom teachers to focus more on grades and marks, a situation that shifts their instructional

practices from an all-inclusive child-centred to teaching the test approach. Standardized testing has received considerable attention in recent literature as a critical barrier to inclusion. In a study to explore parents and teachers' perspectives on state testing, Barksdale-Ladd and Thomas (2000) found that most teachers tend to focus on test preparation which results in teachers teaching to the test to the detriment of other aspects of teaching and learning. For the most part, 75% of teachers involved in their study reported that they change their instructional practices by abandoning instructional activities that (a) are pleasant for teachers and the students; (b) provide options for reinforcement of skills and in-depth understandings of the content; and (c) involve peer collaboration, independence, and higher order thinking skills among students. In fact, with regards to science and mathematics, the participants shockingly revealed that they had discontinued instructional practices and activities like science experiments, the use of games to motivate students and enhance their learning, and manipulative mathematics experiences. Science teachers in the current study raised similar concerns. As one participant remarked: "When I'm preparing students for public exams and have a lot of outcomes to cover, I usually use the lecturing and notes-giving approach" (Edward-I1). These concerns seem to echo Barksdale-Ladd and Thomas's (2000) findings.

Saunders and Debeer (2007) also highlighted the negative impact of standardized testing on minority groups such as students from First Nations, low income, immigrant and students with disabilities in Canada. Research indicates that the current school system is inherently biased because the curriculum is organized around those considered to be academically non-disabled (Lloyd, 2008). Such a system, according to Hart, Dixon, and Drummond (2006), is inherently unjust and has the potential of perpetuating failure, stereotyping, and exclusion.

A second barrier to inclusion in relation to the curriculum was inflexible or rigid nature of the curriculum. As described in Chapter 4, three participants of the four participating teachers raised various concerns about the inflexibility of the curriculum. These concerns align with the existing literature that documents barriers posed by the curriculum in inclusive environments. In Kearney's (2009) study to investigate the nature of school exclusion against students with disabilities in New Zealand, it was reported that one of the critical barriers to inclusion is curriculum access and participation. While most parents of students with disabilities involved in the study expressed concern about the failure of teachers to modify the curriculum to include their children, classroom teachers and school principals felt that the curriculum lacks flexibility, which makes it challenging to fit the learning needs of students with special needs. Similar findings were reported by Mugambi (2017) who identified a rigid curriculum and inappropriate teaching practices as a critical source of a barrier to inclusive education.

As noted by the proponents of inclusion, *Education for All* cannot be achieved with a rigid and inflexible curriculum (CAST, 2011; Katz, 2012; Mitchell, 2015; UNESCO, 2005). Since the curriculum is the fulcrum around which inclusion revolves, it should "be flexible enough to provide possibilities for adjustment to individual needs and to stimulate teachers to seek solutions that can be matched with the needs and abilities of each and every pupil" (UNESCO, 2005, p. 25).

Teacher-related barriers

Another critical barrier for inclusion identified by participants was teacher related barriers. As outlined in the previous chapter, three significant concerns were raised here: (a) the lack of knowledge and competence to address special needs, (b) workload and time constraints, and the (c) lack of collaboration among general and special education teachers.

Teachers' knowledge and competence

Notwithstanding their views that all children should be educated in inclusive classroom, three of the four participants felt that they lack the knowledge and professional competence to effectively integrate inclusionary practices in their lessons to make the curriculum accessible to students with special needs. This finding reinforces Baurhoo and Asghar's (2014) report that science teachers in inclusive classrooms in Canada struggle to meet the diverse needs of learners in science. Evidence supports that teachers usually become overwhelmed and frustrated when they encounter challenges that they do not feel they are well trained to handle (Wiggins, 2012). The issue of lack of knowledge and competence to address the learning needs of students with special needs is well documented in the literature on inclusive education.

McGhie-Richmond, Irvine, Loreman, Cizman, and Lupart (2013) reported that teachers who participated in their study in rural school district in Alberta, Canada felt they were inadequately trained to respond to the diverse needs in the inclusive classroom, a finding which is consistent with several international studies (e.g. Beres, 2001; Kearney, 2009; Sposaro & Lensink, 1998). The notion of teachers being inadequately trained could also be found in Forlin and Chambers' (2011) study as well as Schumm and Vaughn's (1995). While Forlin and Chambers (2011) reported that pre-service teachers were more concerned about lack of knowledge and increased workload, teachers involved in Schumm and Vaughn's (1995) study felt they lack the knowledge and skills to address the diverse needs of students in inclusive classrooms.

Workload and time constraints

Cognizant of the amount of work to be accomplished in inclusive classrooms, participants in this study felt that they do not have enough time to implement inclusionary practices that adequately address every child's needs. This finding was not surprising as multiple studies have

found extra workload and the lack of time as significant obstacles towards the implementation of inclusion in the classroom.

In a comparative study to examine the opinions of teachers in Finland and Brandenburg, Germany about inclusion, Saloviita and Schaffus (2016) found that almost 90% of teachers in Germany expressed workload concerns with teaching students with special needs in an inclusive environment. In a similar study, Rose (2001) reported that 25% of teachers interviewed held the view that managing the needs of students with special needs takes more time compared with their peers with no disabilities.

In fact, the literature appears inexhaustive as several international studies (e.g. Avramidis, Bayliss, & Burden, 2000; Karge, McClure, & Patton, 1995; Schumm, Vaughn, S., & Leavell, 1994; UNESCO, 1994) document extra workload and lack of time as critical obstacles among teachers toward the implementation of inclusive education. As emphasized by Cole (2005), meeting the multiple needs of students in inclusive settings are often involving and would require enough instructional time, planning, and support in order to address those needs adequately.

Lack of collaboration

While all participants expressed interest in collaborating with instructional resource teachers during instructional planning and teaching, a detailed analysis of participants' interview transcripts revealed a perceived tension or a lack of an active collaboration between them and the instructional resource teachers. As indicated in the result section in the previous chapter, participants' responses depict a seeming lack of collaboration between general education teachers and instructional resource teachers. This result runs counter with the recommendation by the department of education that

> Educators [should] share responsibility for the education of all students: all teachers are responsible for all students. Classroom teachers and special education teachers (instructional resource teachers or IRTs) [should] work together with [each other] to improve the teaching and learning of all. Teachers may consult, participate in collaborative planning, provide direct instruction and/or co-teach. (Newfoundland and Labrador Department of Education and Early Childhood Development, n. p., 2018)

Similar themes were reported by Peterson (2011), in which she indicated that there was a lack of collaboration between general and special education teachers when planning instruction for students with special education needs. Participants involved in her study indicated that they plan their lessons in isolation without collaborating with their peers who are specialized in educating children with special needs. In fact, of the fifteen teachers interviewed, only one of the participants expressed an interest in collaborating with the special education teacher to plan instruction. Meanwhile, on a broader research study that explored teachers' profiles of attitudes and self-efficacy towards inclusive education, Savolainen, Engelbrecht, Nel, & Malinen, 2012) found that Finnish teachers reported higher self-efficacy beliefs in collaboration compared to their South African counterparts, who had the lowest score in self-efficacy beliefs.

It is important to note that the need for collaboration, which involves a shared responsibility between general and special education teachers in addressing the needs of students with special needs in inclusive classrooms, cannot be overemphasized (DeSimone & Parmar, 2006; Wiggins, 2012). Embedded within the Education Action Plan towards the implementation of the recommendation made by the Premier's Task Force on educational improvement in Newfoundland and Labrador is the acknowledgement of the need for stronger collaboration and partnership among various stakeholders of education including teachers towards the improvement of

educational achievement in the province (Government of Newfoundland and Labrador, 2018). As Pam Anstey, the executive director of the *Newfoundland and Labrador Association for Community Living* noted, one of the most critical elements that promote inclusion is a collaboration. "We can all work together to see how we can make inclusive education work in this province better than it is now" (Delaney, 2017, n.p). As such, no stone should be left unturned in making collaboration an integral part in the schools' culture.

To address the barriers of and promote collaboration in inclusive environments, several studies have attempted to highlight the factors or reasons behind the lack of collaboration among teachers. Villa, Thousand, Nevin, and Malgeri (1996) cited inadequate teacher preparation as one of the barriers to effective collaboration. The authors contend that the categorizations of programs such as special education, general education, gifted and talented, and English as a Second Language program in our teacher training institutions create an environment that promotes opposition, rather than collaboration and teamwork among teachers. Although current teacher training colleges and universities offer models of combined general and special education programs, Bondy and Brownell (1997) noted that when a teacher views his or her role in a narrow and specialized terms such as "a secondary mathematics teacher, a teacher of the gifted, an elementary education teacher, or a learning disabilities teacher" (p.113), it limits collaborative and team building efforts. According to the authors, such teachers see themselves as only responsible for teaching certain groups of students or subjects. Other studies have cited factors such as a lack of planning time, limited resources, a lack of professional development focused on collaboration (Walther-Thomas, 2000), a lack of clarity of roles and responsibilities and a formal framework to guide general and special education teachers to build a collaborative relationship (Crawford, 2005; Landever, 2010). These findings suggest a need for more teacher training and professional

development efforts focused on team building and collaboration among teachers. Also, the roles and responsibilities of special and general education teachers should explicitly be clarified to avoid confusion and shirking of responsibilities on other partners.

Administrative and policy-related barriers

The last barrier identified in this study was linked to administration and policy on inclusion. Notably, a detailed analysis of data suggests a seeming lack of an appropriate monitoring or accountability system on how the policy of inclusion is being implemented in the classroom. Participants felt that there are no mechanisms in place to monitor and evaluate the strengths and weaknesses of how inclusion is being implemented in the classroom by teachers. For example, a participant acknowledged that the department of education usually provides teachers with "a list of policies to adopt or use," [however], "how they [the policies] are integrated is never followed up. She emphasized that although "there is the dissemination of information [but] what you do with that is on you" (Cynthia-I1).

Evidence supports that adequate supervision, monitoring, and evaluation from stakeholders at all levels of government, including provincial and territorial departments of education are crucial for the development and successful implementation of any educational program or intervention (Banks & Zuurmond, 2015; Collins, Philpott, Fushell, & Wakeham, 2017). A proper monitoring system provides stakeholders and policymakers with firsthand experiences that allow them to assess and evaluate teachers' strengths and weaknesses in the implementation of a given policy or program. As reported by Rosen-Webb (2011), the use of Special Educational Needs Coordinators (SENCo) in mainstream schools in the UK, for example, provides monitoring and support mechanisms for inclusion by developing specialist teaching and management skills to enhance teaching and curriculum access to diverse students.

Chapter 6

Summary, Conclusion, and Recommendations

The sections in this chapter include a summary of the purpose, methodology, and results of this study. This is followed by conclusions, which will be discussed based on insights gleaned from the study findings. Then, a set of recommendations are provided based on the research outcomes and for future research.

6.1 Summary

6.1.1 Purpose and methodology. Given the increasing push for inclusion and science for all as evidenced in the literature, this study was conducted to examine the perspectives and practices of high school science teachers on inclusive pedagogy. The research was undertaken within selected high schools in St. John's, Newfoundland and Labrador, Canada. A qualitative case study was utilized, and four high school science teachers from three different high schools within the Avalon Region of the English School District of Newfoundland and Labrador were purposefully sampled to examine their conceptions and adoption of inclusive pedagogy. The use of a purposeful sampling approach allowed the researcher to select experienced science teachers with rich information about the issue under investigation (Merriam, 2009). It is a strategic sampling approach that provides an opportunity for the researcher to sample information-rich participants "in order to best address the research purpose and questions" (Leavy, 2017, p. 79). The study was triangulated by the adoption of multiple methods and sources of data collection including interviews, observation, and document analysis to elicit participants' perspectives and practices of inclusive pedagogy. Triangulating the data using multiple sources and methods strengthened the trustworthiness of the data and validated the research findings (Merriam, 2009; Patton, 1990; Yin, 2011). Overall, data collection processes began in the Fall 2017 semester and

ended in Winter 2018 semester. Data were then analyzed using MAXQDA software to generate themes about the research questions and literature.

6.1.2 Statement of the problem. This study attempted to explore the perspectives and practices of high school science teachers in the Avalon region of the English School District in the Newfoundland and Labrador province on inclusive pedagogy. Specifically, the study endeavoured to address the following research questions:

1. What are high school science teachers' conceptions of inclusive pedagogy?
2. How do high school science teachers describe their instructional planning processes when designing lessons appropriate for the diversity in their classrooms?
3. What specific inclusive pedagogical strategies do high school science teachers use to respond to the diverse learning needs of students?

6.1.3 Summary of the findings. Based on the gathered, analyzed, and interpreted data, the following findings emerged in accordance with the above research questions:

1. High school science teachers involved in the current study held multiple conceptions of inclusion. They conceptualized inclusion within the context of acceptance, belongingness, recognition of individual differences, respect for diversity, right to education, and equal opportunity and treatment for all children in inclusive classrooms. Recognition of individual differences and respect for diversity dominated participants' descriptions of inclusion. Also, of the four teachers interviewed, three of them conceptualized inclusion in terms of belongingness, acceptance, and creating equal opportunity for all children to learn and succeed through the adoption of teaching approaches that address the needs of

all children. Additionally, the findings indicated that classroom experiences influenced participants understanding and attitude toward inclusion. Although all participating teachers indicated that they had inclusive education policy documents from the Department of Education, three of the participants felt that they get a much better understanding of inclusion and a sense to adopt inclusive practices based on their experiences with students and the enormity of diverse needs they are confronted with in the classroom.

2. On the instructional planning process, it emerged that all participants planned their instructions by first targeting students with special education needs in the classroom. They then differentiate their instruction and scaffold the instructional activities to create multiple pathways to support and give all students the opportunity to succeed. Also, the result indicated that a variety of factors influenced participants' selection of instructional methods and strategies when planning for inclusion. These factors included the abilities and interests of students, availability of time, learner variability, and the content of the curriculum. Furthermore, participants indicated that collaboration with professional peers is one of the best approaches to meet the diverse needs in inclusive classrooms. While two participating teachers affirmatively indicated that they usually collaborate with the instructional resource teachers in their schools (where available), another teacher expressed the interest that in collaborating with the instructional resource teachers if only roles are explicitly defined.

3. On the adoption of specific inclusive pedagogies used to address students' diverse needs in the classroom, it emerged that teachers in this study adopt multiple instructional strategies to represent information to students, engage and sustain the interests of students, and to provide students with opportunities to express their knowledge and what they have learned. Particularly, among the essential instructional practices and strategies used by participants to represent information to students included the use of inquiry-based learning; articulating the learning goals to students at the beginning of each lesson; and the utilizing multiple media such as technology, graphics, and videos to demonstrate instruction and support student learning. Participants felt that using videos and graphics coupled with the explanation of learning goals to students create a medium that allows them to connect the new information to students' background knowledge. Moreover, participants relied on technology, videos, and games to sustain and engage students. Their instructional practices mainly focused on students engagement and addressing individual learning needs. The adoption of multiple instructional strategies to represent information and engage students corroborates the finding that participants' instructional planning is centred on meeting the diverse learning needs of students. Of concern in the findings were the numerous challenges faced by teachers in this study. Several barriers impacted their efforts toward inclusion. Among these barriers were inflexible or rigid curriculum, inadequate or a lack of professional development, inadequate or a lack of instructional resource teachers, large class size, extra workload and limited time, over-reliance on standardized

testing, a lack of monitoring by the department and the school board to ascertain their instructional needs and challenges in the classroom, and a perceived lack of collaboration among general education and special education teachers. They also expressed concern about a lack of pedagogical efficacy in addressing most of the special learning needs in their classroom, suggesting a need for more training and professional development.

6.1 Conclusion

This study sought to provide insights into the perspectives and practices of high school science teachers on inclusive pedagogy. The research outcomes and the researcher's insight demonstrated that there was no unified definition of inclusive education based on participants' conceptions. Participants in this study conceptualized inclusion as an educational system that is focused on acceptance, belongingness, rights, respect for diversity, and equal opportunity for all. These conceptions agree with the Newfoundland and Labrador Education and Early Childhood and Development's (2018) notion of what constitutes an inclusive education. Further, teachers' perspectives and attitude toward inclusion were influenced by contextual factors such as classroom experiences including students need and availability of support. Primarily, participants in this study, albeit encounter several challenges and limitations in their classroom, had a positive attitude toward inclusion and felt that all children should be educated in inclusive classrooms.

Further, the outcome suggested that high school science teachers in inclusive classrooms perceived collaboration among professional peers as a vital tool in addressing the diverse needs of students in inclusive settings. Also, when deciding on instructional approaches and strategies appropriate for inclusion, teachers considered the abilities and interests of students, learner

variability, time availability, and content of the curriculum. Teachers in this study ensured that their instructional planning was centred on students with the most learning needs in order to make the curriculum accessible to all students in an inclusive environment.

With regards to instructional planning and practices, teachers in this study utilized multiple instructional methods and strategies including inquiry-based learning approach, provision of positive feedback and multiple ways of asking questions as well as the use of videos, games, and technology to represent information and engage students. To create opportunities for students that enable them to express their knowledge, teachers in this study diversified their assessment strategies which provided students with the autonomy to use oral presentation, PowerPoint presentation, peer-based assessment, or drawing (in the case of biology). They differentiated the quizzes and midterm tests to reflect students' learning profiles, abilities, and interest to ensure the inclusion and success of every learner. However, several barriers appear to impede the efforts of the participants toward inclusion. These barriers were numerous, but the most frequent ones highlighted by the participants include a lack of instructional resource teachers, a perceived tension between general and special education teachers with regards to collaboration, inadequate or a lack of professional development aimed at equipping teachers on how to adopt and implement inclusive teaching practices, increasing workload and limited time, inflexible curriculum, and the over-reliance on standardized testing. These barriers suggest that more efforts, in addition to the existing and on-going support by the government and department of education, is required

6.3 Recommendation

This study sought to fill a gap in and enrich the existing literature on teachers' perspectives and practices of inclusion. Additionally, the aim was to open new avenues for future research and provide suggestions for policy formulation and program development in the areas of teacher education and training. Based on the findings and conclusion cited in the current study; the researcher makes the following recommendations:

1. Teacher education programs should be directed at providing enough opportunities for pre-service teachers to spend more time with children with special education needs in inclusive environments as the findings in this study showed that increased exposure, experiences, and time with children with special education needs influence teachers' perspectives, practices, and attitudes toward inclusion. Further, to enable teachers to address the needs of children with exceptionalities effectively, the researcher proposes an enactment or legislative instrument across provincial and territorial jurisdictions to limit the class size to 20 or less as proposed by Scruggs and Mastropieri (1996).
2. Departments of education and school boards should ensure that the roles and responsibilities of general education and special education teachers (instructional resource teachers) in the classroom are explicitly clarified to avoid confusion and lack of clarity during collaboration. Effective collaboration requires a great deal of time for the planning and execution of roles and responsibilities. At the beginning of the school year, school administrators and principals should create enough time for teachers when planning programs and schedule for the year to enable teachers to meet and plan together. Also, efforts should be made toward the development of programs with a focus on equipping

teachers with team building and developing their interpersonal skills to enhance collaboration.

3. Professional development programs should be directed at equipping teachers with specific skills and knowledge in implementing inclusive instructional practices in the classroom. Precisely, such professional learning should be aligned with supporting and building teachers' pedagogical proficiency in the areas of integrating technology including inclusionary practices and frameworks such as the use of UDL and differentiation effectively in science lessons to improve achievement and active participation in class.
4. General education pre-service teachers should not only have an opportunity to learn about types of exceptionalities in the classroom but should be exposed to the methodologies and practices needed to handle such challenges. To this end, the researcher suggests that faculties of education make Universal Design for Learning a major teaching course or program for all pre-service teachers as it is known to be a flexible and effective instructional model for inclusive classrooms.
5. An in-depth comparative study should be done in NL with a focus on examining the self-efficacy beliefs and concerns of novice and experienced science teachers in teaching science to students with special needs in an inclusive setting. Such studies will help to determine the effectiveness of teacher education programs and professional development support given to teachers. Also, new studies should be carried out to examine how teachers at other grade levels adopt the framework of UDL to make the curriculum accessible to diverse students in the classroom.

References

Acedo, C., Amadio, M., Opertti, R., & Brady, J. (Eds.). (2009). Defining an inclusive education agenda: Reflections around the 48th session of the international conference on education. (pp. 1-128). Geneva: UNESCO.

Advisory Board on Education. (2006). *Special education: Issues of inclusion and integration in the classroom.* Retrieved from http://www.education.gouv.qc.ca/fileadmin/site_web/documents/autres/organismes/CELA_avis-adaptation-scolaire_a.pdf

Ainscow, M. (2005). Developing inclusive education systems: What are the levers for change? *Journal of Educational Change, 6*(2), 109-124. https://doi.org/10.1007/s10833-005-1298-4

Ainscow, M., Booth, T., & Dyson, A. (2004). Understanding and developing inclusive practices in schools: A collaborative action research network. *International Journal of Inclusive Education*, *8*(2), 125-139. https://doi.org/10.1080/1360311032000158015

Ajuwon, P. M. (2008). Inclusive education for students with disabilities in Nigeria: Benefits, challenges and policy implications. *International Journal of Special Education*, *23*(3), 11-16. Retrieved from https://files.eric.ed.gov/fulltext/EJ833673.pdf

Alberta Education. (2018, December 20). *The principles of inclusion.* Retrieved from Education in Alberta: https://education.alberta.ca/inclusive-education/what-is-inclusion/

Ali, M. M., Mustapha, R., & Jelas, Z. M. (2006). An Empirical study on teachers' perceptions towards inclusive education in Malaysia. *International Journal of Special Education, 21*(3), 36-44. Retrieved from https://files.eric.ed.gov/fulltext/EJ843618.pdf

Alvermann, D. E., Smith, L. C., & Readence, J. E. (1985). Prior knowledge activation and the comprehension of compatible and incompatible text. *Reading Research Quarterly,* 420-436. Retrieved from https://www.jstor.org/stable/747852

Ambrose, S. (2010). *How learning works: Seven research-based principles for smart teaching.* San Francisco, CA: Jossey-Bass.

American Institute for Research. (2017). *Inclusion: The pros and cons*. Retrieved from American Institue for Research: http://www.sedl.org/change/issues/issues43/definition_inclusion.html

Andrews, J., & Lupart, J. L. (2000). *The inclusive classroom: Educating exceptional children. Nelson Canada.* Nelson Thomson Learning.

Au, K. H. (1998). Social constructivism and the school literacy learning of students of diverse backgrounds. *Journal of Literacy Research, 30*(2), 297-319. http://journals.sagepub.com/doi/abs/10.1080/10862969809548000

Austin, V. L. (2001). Teachers' beliefs about co-teaching. *Remedial and Special Education, 22*(4), 245-255. https://doi.org/10.1177/074193250102200408

Avramidis, E., & Kalyva, E. (2007). The influence of teaching experience and professional development on Greek teachers' attitudes towards inclusion. *European Journal of Special Needs Education*, 367-389. https://doi.org/10.1080/08856250701649989

Avramidis, E., Bayliss, P., & Burden, R. (2000). A survey into mainstream teachers' attitudes towards the inclusion of children with special educational needs in the ordinary school in one local education authority. *Educational Psychology, 20*(2), 191-211. https://doi.org/10.1080/713663717

Ballard, K. (2000). *Inclusive education: International voices on disability and justice.* New York: Routledge.

Banks, L. M., & Zuurmond, M. (2015). *Barriers and enablers to inclusion in education for children with disabilities in Malawi.* Oslo, Norway: Norwegian Association of Disabled. Retrieved from http://disabilitycentre.lshtm.ac.uk/files/2014/07/Report-on-inclusion-in-education-for-children-with-disabilities-in-Malawi_FINAL_large-print_1.pdf

Barksdale-Ladd, M. A., & Thomas, K. F. (2000). What's at stake in high-stakes testing: Teachers and parents speak out. *Journal of Teacher Education, 51*(5), 384–397. https://doi.org/10.1177/0022487100051005006

Barney, L. (1971). *The teaching act applied to science.* Dubuque, Iowa: Kendall/Hunt Pub.

Barrington, G. (1995). *Supporting integration: Work in progress in Albert (Final Report).* Edmonton: Alberta Dept. of Education. Retrieved from https://eric.ed.gov/?id=ED392225

Barton, L. (1997). Inclusive education: romantic, subversive or realistic? *International journal of inclusive education, 1*(3), 231-242. https://doi.org/10.1080/1360311970010301

Baurhoo, N., & Asghar, A. (2014). Using universal design for learning to construct inclusive science classrooms for diverse learners. *LEARNing Landscapes, 7*(2), 59-81. Retrieved from https://www.learninglandscapes.ca/index.php/learnland/article/view/651

Beaton, M. C., & Black-Hawkins, K. (2014). Editorial changing legislation on inclusive and special education: Perspectives across the four nations of the UK. *British Journal of Special Education, 41*(4), 340-343. https://doi.org/10.1111/1467-8578.12084

Beaudoin, J. (2013). *Introduction to inclusive teaching practices.* Ottawa: Centre for University Teaching. Retrieved from https://www.uottawa.ca/respect/sites/www.uottawa.ca.respect/files/accessibility-inclusion-guide-2013-10-30.pdf

Beres, C. J. (2001). *Challenges for inclusive education (Master's Thesis).* Lethbridge, Alta: University of Lethbridge. Retrieved from http://hdl.handle.net/10133/891

Best, K. W. (2016). *Understanding the impact of a global universal design for learning (UDL) virtual classroom on Jamaican educators through the lens of how people learn (HPL) (Doctoral Dissertation).* Virginia Commonwealth University. Retrieved from https://scholarscompass.vcu.edu/etd/4105

Bhatnagar, N, & Das, A. (2014). Regular school teachers' concerns and perceived barriers to implementing inclusive education in New Delhi, India. *International Journal of Instruction, 7*(2), 89-102. Retrieved from https://eric.ed.gov/?id=EJ1085257

Bondy, E., & Brownell, M. T. (1997). Overcoming barriers to collaboration among partners-in-teaching. *Intervention in School & Clinic, 33*(2), 112-115. https://doi-org.qe2a-proxy.mun.ca/10.1177/105345129703300207

Brigham, F. J., Scruggs, T. E., & Mastropieri, M. A. (2011). Brigham, F. J., Scruggs, T. E., & Mastropieri, M. A. (2011). Science education and students with learning disabilities. *Learning Disabilities Research & Practice, 26*(4), 223-232. https://doi.org/10.1111/j.1540-5826.2011.00343.x

British Columbia Ministry of Education. (2016). *Special education services: A manual of policies, procedures and guidelines.* Victoria: BC Ministry of Education.

Browder, D. M., Mims, P. J., Spooner, F., Ahlgrim-Delzell, L., & Lee, A. (2008). Teaching elementary students with multiple disabilities to participate in shared stories. *Research and Practice for Persons with Severe Disabilities, 33*(1–2), 3–12. https://doi.org/10.2511/rpsd.33.1-2.3

Brownlee, K., Rawana, E. P., & MacArtthur, J. (2012). Implementation of a strengths-based approach to teaching in an elementary School. *Journal of Teaching and Learning, 8*(1), 1-12. http://doi.org/10.22329/JTL.V8I1.3069

Burgstahler, S. (2008). *Equal access: Universal design of instruction.* Washington, DC: University of Washington.

Burgstahler, S. (2011). Universal design: Implications for computing education. *AMC Transactions on Computing Education, 11*(3). doi: 10.1145/2037276.2037283

Campbell, C., Osmond-Johnson, P., Faubert, B., Zeichner, K., & Hobbs-Johnson, A. (2016). *The state of educators' professional learning in Canada.* Oxford, OH: Learning Forward.

Carver, L. B. (2016). Teacher perception of barriers and benefits in K-12 technology usage. *Turkish Online Journal of Educational Technology-TOJET, 15*(1), 110-116.

CAST. (2011, February 1). *Universal design for learning (UDL) guidelines: Full-text representation version 2.0.* Retrieved from Center for Applied Special Technology: http://www.udlresource.com/uploads/1/2/1/2/12126894/udl_guidelines_version_2.0_final_3.pdf

CAST. (2015). *Making science more inviting and effective for all students*. Retrieved from Center for Applied Special Technology: http://www.cast.org/our-work/research-development/projects/science-learning-minority-students.html#.XBj1svZFzIU

CAST. (2016). *Top 5 UDL tips for reducing stereotype threat.* Retrieved from CAST Professional Leaning: http://castprofessionallearning.org/project/top-5-udl-tips-for-reducing-stereotype-threat/

CAST. (2018, March 8). *Universal design for learning.* Retrieved from Universal Design for Learning Guidelines: http://udlguidelines.cast.org

Chamberlin, M., & Powers, R. (2010). The promise of differentiated instruction for enhancing the mathematical understandings of college students. *Teaching Mathematics and Its Applications: An International Journal of the IMA, 29*(3), 113-139. https://doi.org/10.1093/teamat/hrq006

Cimer, A. (2007). Effective teaching in science: A review of literature. *Journal of Turkish Science Education, 4*(1), 20-44. Retrieved from http://www.tused.org/internet/tufed/arsiv/v4/i1/metin/tufedv4i1s3.pdf

Cole, B. A. (2005). Mission impossible? Special educational needs, inclusion and the re-conceptualization of the role of the SENCO in England and Wales. *European Journal of Special Needs Education, 20*(3). https://doi.org/10.1080/08856250500156020

Collins, A., Philpott, D., Fushell, M., & Wakeham, M. (2017). *The premier's task force on improving educational outcomes.* St. John's: Government of Newfoundland and Labrador.

Courey, S. J., Tappe, P., Siker, J., & LePage, P. (2013). Improved lesson planning with universal design for learning (UDL). *Teacher Education and Special Education, 36*(1), 7-27. https://journals.sagepub.com/doi/pdf/10.1177/0888406412446178

Coyne, P., Pisha, B., Dalton, B., Zeph, L. A., & Smith, N. C. (2012). Literacy by Design: A universal design for learning approach for students with significant intellectual disabilities. *Remedial and Special Education, 33*(3), 162–172. https://doi.org/10.1177/0741932510381651

Crawford, C. (2005). *Scoping inclusive education for Canadian students with intellectual and other disabilities.* Toronto: Roeher Institute.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Boston, MA: Pearson Education, Inc.

Crotty, M. (1998). *The foundation of social research: Meaning and perspective in the research process.* London: SAGE Publications.

Cunha, T. B. (2011). *Teaching science in culturally diverse classrooms: The relevance of multicultural coursework on novice teachers' instructional choice (Doctoral Dissertation).* Retrieved from https://search.proquest.com/docview/1140130764?accountid=12378

Curry, C., Cohen, L., & Lightbody, N. (2006). Universal design in science learning. *Science Teacher, 73*(3), 32–37. Retrieved from https://search.proquest.com/docview/214615446?accountid=12378

Czerniak, C., & Chiarelott, L. (1990). Teacher education for effective science instruction — A social cognitive perspective. *Journal of Teacher Education, 41*(1), 49–58. https://doi.org/10.1177%2F002248719004100107

Daniel, K. S. (2011). *Identifying the gaps towards an inclusive educational system within Quebec: Collectively examining the perceptions of different groups of educators (Doctoral dissertation).* Montreal: McGill University Library. Retrieved from http://digitool.library.mcgill.ca/R/?func=dbin-jump-full&object_id=103546

Davis, B., Sumara, D. J., & Luce-Kapler, R. (2013). *Engaging minds: Changing teaching in complex times.* New York: Routledge.

Deboer, G. E. (2002). Student-centered teaching in a standards-based world: Finding a sensible balance. *Science & Education, 11*(4), 405-417. https://doi.org/10.1023/A:1016075805155

Delaney, A. (2017, February 11). *Not just a nice idea': The importance of inclusion in and beyond the classroom*. Retrieved from CBC News: https://www.cbc.ca/news/canada/newfoundland-labrador/inclusion-education-importance-1.3977102

Department of Education (England). (2011). *Support and aspiration: A new approach to special educational needs and disability.* London: The Stationery Office Limited.

Department of Education (England). (2015, May 8). *2010 to 2015 government policy: Special educational needs and disability (SEND).* Retrieved from: https://www.gov.uk/government/publications/2010-to-2015-government-policy-special-educational-needs-and-disability-send/2010-to-2015-government-policy-special-educational-needs-and-disability-send

DeSimone, J. R., & Parmar, R. S. (2006). Issues and challenges for middle school mathematics teachers in inclusion classrooms. *School Science and Mathematics, 106*(8), 338-348. https://doi.org/10.1111/j.1949-8594.2006.tb17754.x

Dewey, J. (1986). Experience and Education. *The Educational Forum, 50*(3), 241-252. https://doi-org.qe2a-proxy.mun.ca/10.1080/00131728609335764

Donohue, D., & Bornman, J. (2014). The challenges of realising inclusive education in South Africa. *South African Journal of Education, 34*(2), 1-14. http://dx.doi.org/10.15700/201412071114

Ekins, A. (2010). *An exploration of inclusive practices in schools: Case studies of two primary schools (Ed. D. Dissertation).* University of Kent, Kent. Retrieved from http://create.canterbury.ac.uk/12115/

Engelbrecht, P. (2006). The implementation of inclusive education in South Africa after ten years of democracy. *European Journal of Psychology of Education, 21*(3), 253-264. https://doi.org/10.1007/BF03173414

Engelbrecht, P., Nel, M., Nel, N., & Tlale, D. (2015). Enacting understanding of inclusion in complex contexts: Classroom practices of South African teachers. *South African Journal of Education, 35(3),* 1-10. http://dx.doi.org/10.15700/saje.v35n3a1074

Erlandson, R. (2002). *Universal design for learning: Curriculum, technology, and accessibility.* Norfolk, VA: Association for the Advancement of Computing in Education (AACE).

Erten, O. (2014). *Effective inclusive classrooms: Examining the relationship between perceptions of inclusion, effective teaching and student outcomes (Doctoral dissertation).* McGill University Libraries. Retrieved from http://digitool.library.mcgill.ca/webclient/StreamGate?folder_id=0&dvs=1546900440489~273

Erten, O., & Savage, R. S. (2012). Moving forward in inclusive education research. *International Journal of Inclusive Education, 16*(2), 221-233. https://doi.org/10.1080/13603111003777496

Fan, S., & Fielding-Wells, J. (2016). *What is next in educational research?* Boston: Sense Publishers.

Farrell, P. (2016). Promoting inclusive education in India: A framework for research and practice. *Journal of the Indian Academy of Applied Psychology, 42*(1), 18-29. Retrieved from https://search.proquest.com/docview/1779873805?accountid=12378

Finnegan, L. (2013). *Examining the effect f the universal design for learning-expression principle on students with learning disabilities in science (Doctoral dissertation).* Florida: University of Central Florida.

Florian, L. (2015). Inclusive pedagogy: A transformative approach to individual differences but can it help reduce educational inequalities. *Scottish Educational Review, 47*(1), 5-14.

Florian, L. (2016). *Education from early years to 18: Research and practice contributing to policy.* Retrieved from The University of Edinburgh: https://www.ed.ac.uk/education/election-briefings/inclusive-pedagogy

Florian, L., & Black-Hawkins, K. (2011). Exploring inclusive pedagogy. *British Educational Research Journal, 37*(5), 813-828. https://doi.org/10.1080/01411926.2010.501096

Forlin, C., & Chambers, D. (2011). Teacher preparation for inclusive education: Increasing knowledge but raising concerns. *Asia-Pacific Journal of Teacher Education, 39*(1), 17-32. https://doi.org/10.1080/1359866X.2010.540850

Freire, P. (2018). *Pedagogy of the oppressed.* New York: Bloomsbury Publishing Inc.

Friend, M., Hutchinson, N., & Bursuck, W. (1998). *Including exceptional students: A practical guide for classroom teachers (Canadian ed.).* Scarborough, Ont.: Allyn & Bacon.

Fuchs, W. W. (2010). Examining teachers' perceived barriers associated with inclusion. *RATE Journal, 19*(1), 30-35. Retrieved from https://search-proquest-com.qe2a-proxy.mun.ca/docview/964176705?accountid=12378

Fyssa, A., Vlachou, A., & Avramidis, E. (2014). Early childhood teachers' understanding of inclusive education and associated practices: Reflections from Greece. *International Journal of Early Years Education, 22*(2), 223-237. https://doi.org/10.1080/09669760.2014.909309

Fyssa, A., Vlachou, A., & Avramidis, E. (2014). Early childhood teachers' understanding of inclusive education and associated practices: Reflections from Greece. *International Journal of Early Years Education, 22*(2), 223-237. https://doi.org/10.1080/09669760.2014.909309

García-Campos, M. D., Canabal, C., & Alba-Pastor, C. (2018). Executive functions in universal design for learning: moving towards inclusive education. *International Journal of Inclusive Education*, 1-15. https://doi.org/10.1080/13603116.2018.1474955

Gayle, J. (2013). *Elementary teachers' perspectives on teaching science to socio-culturally diverse students (Doctoral Dissertation).* Toronto: University of Toronto. Retrieved from http://hdl.handle.net/1807/35556

Gee, J. (2012, January 20). *Importance of prior knowledge to learning*. Retrieved from Illinois State University News: https://news.illinoisstate.edu/2012/01/importance-of-prior-knowledge-to-learning/

Gilroy, G. (2005). *Retention and integration of immigrants in Newfoundland and Labrador—Are we ready?* Retrieved from http://s3.amazonaws.com/zanran_storage/www.hrle.gov.nl.ca/ContentPages/17356402.pdf

Glesne, C. (2015). *Becoming qualitative researchers: An introduction.* New York: Longman.

Goodnough, K. (2010). Investigating pre-service science teachers' developing professional knowledge through the lens of differentiated instruction. *Research in Science Education, 40*(2), 239-265. https://doi.org/10.1007/s11165-009-9120-6

Gordon, D. T., Gravel, J. W., & Schifter, L. A. (2009). *A policy reader in universal design for learning.* Cambridge, MA: Harvard Education Press.

Government of Newfoundland and Labrador. (2018). *Education action plan.* Retrieved from https://www.ed.gov.nl.ca/edu/EAP-report.pdf

Grant, C., & Osanloo, A. (2014). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house." *Administrative Issues Journal, 4*(2), 12-26. Retrieved from https://dc.swosu.edu/aij/vol4/iss2/4

Greenlees, L. O. (2015). *Teachers' perspectives on inclusion: The impact on instructional practices (Doctoral dissertation).* Texas: Texas Tech University. Retrieved from https://ttu-ir.tdl.org/ttu-ir/bitstream/handle/2346/66177/GREENLEES-DISSERTATION.pdf?sequence=3

Grumbine, R., & Alden, P. B. (2006). Teaching science to students with learning disabilities. *The Science Teacher, 73*(3), 26-31. https://search.proquest.com/docview/214615506?accountid=12378

Hall, T. E., Cohen, N., Vue, G., & Ganley, P. (2015). Addressing learning disabilities with UDL and technology: Strategic reader. *Learning Disability Quarterly, 38*(2), 72-83. https://doi.org/10.1177/0731948714544375

Hall, T., Strangman, N., & Meyer, A. (2003). Differentiated instruction and implications for UDL implementation. *Preventing School Failure, 52*(2), 21-30. Retrieved from http://aem.cast.org/about/publications/2003/ncac-differentiated-instruction-udl.html

Hammond, W. (2016). *Principles of strength-based practice.* Retrieved from http://www.ayscbc.org/Principles%20of%20Strength-2.pdf

Harlen, W. (1999). *Effective teaching of science: A review of research.* Edinburgh: Scottish Council for Research in Education.

Hart, S., Dixon, A., & Drummond, M. J. (2006). *Learning without limits.* New York City, NY: McGraw-Hill Education.

Haskell, D. H. (2000). Building bridges between science and special education: Inclusion in the science classroom. *Electronic Journal of Science Education, 4*(3). Retrieved from http://ejse.southwestern.edu/article/view/7631

Hein, G. (1991). Constructivist learning theory. Institute for Inquiry. *CECA (International Committee of Museum Educators) Conference.* Jerusalem, Israel. Retrieved from /http://www. exploratorium. edu/ifi/resources/constructivistlearning. htmlS.

Hemmings, B., & Woodcock, S. (2011). Preservice teachers' views of inclusive education: A content analysis. *Australasian Journal of Special Education, 35*(2), 103-116. https://doi.org/10.1375/ajse.35.2.103

Hilton, J. L. & von Hippel, W. (1996). Stereotypes. *Annual review of psychology, 47*(1), 237-271. https://doi.org/10.1146/annurev.psych.47.1.237

Hodkinson, A. (2006). Conceptions and misconceptions of inclusive education—One year on: A critical analysis of newly qualified teachers' knowledge and understanding of inclusion. *Research in Education, 76*(1), 43-55. https://doi.org/10.7227/RIE.76.4

Hodkinson, A., & Devarakonda, C. (2009). Conceptions of inclusion and inclusive education: A critical examination of the perspectives and practices of teachers in India. *Research in Education, 82*(1), 85-99. https://doi.org/10.7227/RIE.82.7

Horne, P. E., & Timmons, V. (2009). Making it work: Teachers' perspectives on inclusion. *International Journal of Inclusive Education, 13*(3), 273-286. https://doi.org/10.1080/13603110701433964

Hunt, P. (2007). *Implementation of general assembly resolution 60/251 of 15 March 2006 entitled "Human Rights Council": Report of the special rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health, A/HRC/4/28.* Geneva: Office of the United Nations High Commissioner for Human Rights.

Hutchinson, N. L. (2013). *Inclusion of exceptional learners in Canadian schools: A practical handbook for teachers.* London: Pearson.

Hwang, Y., & Evans, D. (2010). Attitudes towards inclusion: Gaps between beliefs and practice. *International Journal of Special Education, 26*(1), 136-146. Retrieved from https://eprints.qut.edu.au/34074/

Johnson, L. J., & Pugach, M. C. (1996). The emerging third wave of collaboration: Beyond problem solving. In W. &. Stainback, *Controversial Issues Confronting Special Education: Divergent Perspectives, 2nd Edition* (pp. 197-204). Boston: Pearson.

Johnson-Harris, K. M. (2014). *The effect of universal design for learning on the academic engagement of middle school students (Dissertations. Paper 827).* Southern Illinois University Carbondale.

Johnson-Harris, K. M., & Mundschenk, N. A. (2014). Working effectively with students with BD in a general education classroom: The case for universal design for learning. *Clearing House, 87*(4), 168–174. https://doi.org/10.1080/00098655.2014.897927

Jordan, A., Glenn, C., & McGhie-Richmond, D. (2010). The supporting effective teaching (SET) project: The relationship of inclusive teaching practices to teachers' beliefs about disability and ability, and about their roles as teachers. *Teaching and Teacher Education, 26*(2), 259-266. https://doi.org/10.1016/j.tate.2009.03.005

Jordan, A., Schwartz, E., & McGhie-Richmond, D. (2009). Preparing teachers for inclusive classrooms. *Teaching and Teacher Education, 25*(4), 535-542. https://doi.org/10.1016/j.tate.2009.02.010

Juriševič, M., Vrtačnik, M., Kwiatkowski, M., & Gros, N. (2012). The interplay of students' motivational orientations, their chemistry achievements and their perception of learning within the hands-on approach to visible spectrometry. *Chemistry Education Research and Practice, 13*(3), 237-247. Retrieved from https://pubs.rsc.org/en/content/articlehtml/2012/rp/c2rp20004j

Karge, B. D., McClure, M., & Patton, P. L. (1995). The success of collaboration resource programs for students with disabilities in grades 6 through 8. *Remedial and Special Education, 16*(2), 79–89. https://doi.org/10.1177/074193259501600203

Katz, J. (2012). *Teaching to diversity: The three-block model of universal design for learning.* Winnipeg: Portage & Main Press.

Katz, J. (2013). The three block model of universal design for learning (UDL): Engaging students in inclusive education. *Canadian Journal of Education, 36*(1), 153-194. Retrieved from http://search.proquest.com/docview/1440186282?accountid=12378

Katz, J. (2015). Implementing the three block model of universal design for learning: Effects on teachers' self-efficacy, stress, and job satisfaction in inclusive classrooms K-12. *International Journal of Inclusive Education, 19*(1), 1-20. https://doi.org/10.1080/13603116.2014.881569

Katz, J., & Sugden, R. (2013). The three-block model of universal design for learning Implementation in a high school. *Canadian Journal of Educational Administration and Policy, 141*, 1-28. Retrieved from https://journalhosting.ucalgary.ca/index.php/cjeap/article/view/42841

Kavale, K. A. (2004). *Inclusion: Rhetoric and reality surrounding the integration of students with disabilities.* Des Moines: FINE Foundation.

Kearney, A. (2009). *Barriers to school inclusion: An investigation into the exclusion of disabled students from and within New Zealand schools (Doctoral dissertation).* Palmerston North: Massey University. Retrieved from https://mro.massey.ac.nz/handle/10179/876

Khader, F. R. (2012). Teachers' pedagogical beliefs and actual classroom practices in social studies instruction. *American International Journal of Contemporary Research*, 73-92. Retrieved from http://aijcrnet.com/journals/Vol_2_No_1_January_2012/9.pdf

Khan, T. A. (2012). Secondary school teachers' perceptions of inclusive education in Bangladesh. *Critical Literacy: Theories and Practices, 6* (2), 102-118. Retrieved from http://criticalliteracy.freehostia.com/index.php?journal=criticalliteracy&page=article&op=viewArticle&path%5B%5D=128

King, K., Shumow, L., & Lietz, S. (2001). Science education in an urban elementary school: Case studies of teacher beliefs and classroom practices. *Science Education, 85*(2), 89-110. https://doi.org/10.1002/1098-237X(200103)85:2<89::AID-SCE10>3.0.CO;2-H

King-Sears, M. (2009). Universal design for learning: Technology and pedagogy. *Learning Disability Quarterly, 32*(4), 199-201. https://doi.org/10.2307/27740372

King-Sears, M. E. (1997). Best academic practices for inclusive classrooms. *Focus on exceptional children, 29*(7), 1-22. https://doi.org/10.17161/foec.v29i7.6753

King-Sears, M. E., Johnson, T. M., Berkeley, S., Weiss, M. P., Peters-Burton, E. E., Evmenova, A. S., ... & Hursh, J. C. (2015). An exploratory study of universal design for teaching chemistry to students with and without disabilities. *Learning Disability Quarterly*, *38*(2), 84-96. https://doi.org/10.1177/0731948714564575

Kirch, S. A., Bargerhuff, M. E., Turner, H., & Wheatly, M. (2005). Inclusive science education: Classroom teacher and science educator experiences in CLASS workshops. *School Science and Mathematics, 105*(4), 175-196. https://doi.org/10.1111/j.1949-8594.2005.tb18157.x

Koeze, P. A. (2007). *Differentiated instruction: The effect on student achievement in an elementary school (Doctoral Dissertation).* Retrieved from http://commons.emich.edu/theses/31

Kothari, C. R. (2004). *Research methodology methods & techniques.* New Delhi: New Age International P Ltd., Publishers.

Landever, G. S. (2010). *Collaboration among general and special education teachers (Doctoral dissertation).* Baldwin City, Kansas: Baker University. Retrieved from https://www.bakeru.edu/images/pdf/SOE/EdD_Theses/Landever_Gwen.pdf

Laswell, R. (2016, December 14). Universal design for learning and learner variability: Removing barriers in the learning environment. Retrieved from *ODYSSEY* 2018: https://www.theodysseyonline.com/life-of-science-health-major-as-told-by-the-cast-of-greys-anatomy

Leavy, P. (2017). *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches.* New York: The Guilford Press.

Lipsky, D. K., & Gartner, A. (1997). *Inclusion and school reform: Transforming America's classrooms.* Baltimore, Maryland: Paul H. Brookes Publishing Co.

Lloyd, C. (2008). Removing barriers to achievement: A strategy for inclusion or exclusion? *International Journal of Inclusive Education, 12*(2), 221-236. https://doi.org/10.1080/13603110600871413

Lobosco, A. F., & Newman, D. L. (1992). Teaching special needs populations and teacher job satisfaction: Implications for teacher education and staff development. *Urban Education, 27*(1), 21-31. https://doi.org/10.1177/0042085992027001003

Lopez, S. J. (2004). Naming, nurturing, and navigating: Capitalizing on strengths in daily life. *National Conference on Building a Strengths-Based Campus: Best Practices in Maximizing Student Performance.* Omaha, NE.

Lopez, S. J., & Louis, M. C. (2009). The principles of strengths-based education. *Journal of College and Character, 10*(4), 1-8. https://doi.org/10.2202/1940-1639.1041

Loreman, T. (2014). Measuring inclusive education outcomes in Alberta, Canada. *International Journal of Inclusive Education, 18*(5), 459-483. https://doi.org/10.1080/13603116.2013.788223

Louis, M. C. (2008). *A comparative analysis of the effectiveness of strengths-based curricula in promoting first-year college student success (Doctoral dissertation).* Azusa Pacific University.

Love, T. (2002). Multiple theoretical perspectives in the long thesis PhD: A foundation problem in PhD education. *HERDSA, Australia,* 409-416.

Lupart, J., & Webber, C. (2012). Canadian schools in transition: Moving from dual education systems to inclusive schools. *Exceptionality Education International, 22,* 8-37. Retrieved from https://ir.lib.uwo.ca/eei/vol22/iss2/4

MacKay, A. W. (1984). *Education law in Canada.* Toronto: Emond-Montgomery.

MacKay, A. W., & Burt-Gerrans, J. (2004). The lighthouse of equality: Clues to the meaning and substance of "inclusive schooling." *CACL National Summit on Inclusive Education,* (pp. 24-26). Ottawa.

Mackey, M. (2014). Inclusive education in the United States: Middle school general education teachers' approaches to inclusion. *International Journal of Instruction, 7*(2), 5-20. Retrieved from https://files.eric.ed.gov/fulltext/EJ1085271.pdf

MacSuga-Gage, A. S., Simonsen, B., & Briere, D. E. (2012). Effective teaching practices: effective teaching practices that promote a positive classroom environment. *Beyond Behavior, 22*(1), 14-22. https://journals.sagepub.com/doi/pdf/10.1177/107429561202200104

Maeng, J. L., & Bell, R. L. (2015). Differentiating science instruction: Secondary science teachers' practices. *International Journal of Science Education, 37*(13), 2065-2090. https://doi.org/10.1080/09500693.2015.1064553

Makoelle, T. (2014). Pedagogy of inclusion: A quest for inclusive teaching and learning. *Mediterranean Journal of Social Sciences, 5*(20), 1259-1267. Retrieved from http://nur.nu.edu.kz/handle/123456789/1878

Mallory, B. L., & New, R. S. (1994). Social constructivist theory and principles of inclusion: Challenges for early childhood special education. *The Journal of Special Education, 28*(3), 322-337. https://doi.org/10.1177/002246699402800307

Marino, M. T. (2010). Defining a technology research agenda for elementary and secondary students with learning and other high-incidence disabilities in inclusive science classrooms. *Journal of Special Education Technology, 25*(1), 1–27. https://doi.org/10.1177/016264341002500101

Marino, M. T., Gotch, C. M., Israel, M., Vasquez, E., Basham, J. D., & Becht, K. (2014). UDL in the middle school science classroom: Can video games and alternative text heighten engagement and learning for students with learning disabilities? *Learning Disability Quarterly, 37*(2), 87–99. https://doi.org/10.1177/0731948713503963

Mason, J. (2017). *Qualitative researching.* Los Angeles: SAGE Publication.

Mastropieri, M. A., & Scruggs, T. E. (2010). *The inclusive classroom: Strategies for effective differentiated instruction.* Upper Saddle River, N J: Merrill.

Mastropieri, M. A., Scruggs, T. E., Norland, J. J., Berkeley, S., McDuffie, K., Tornquist, E. H., & Connors, N. (2006). Differentiated curriculum enhancement in inclusive middle school science: Effects on classroom and high-stakes tests. *The Journal of Special Education, 40*(3), 130–137. https://doi.org/10.1177/00224669060400030101

MAXQDA. (2019). *Professional software for qualitative and mixed methods research*. Retrieved from MAXQDA – The Art of Data Analysis: https://www.maxqda.com/what-is-maxqda

McCrimmon, A. W. (2015). Inclusive education in Canada: Issues in teacher preparation. *Intervention in School and Clinic, 50*(4), 234-237. https://doi.org/10.1177/1053451214546402

McGhie-Richmond, D., Irvine, A., Loreman, T., Cizman, J. L., & Lupart, J. (2013). Teacher perspectives on inclusive education in rural Alberta, Canada. *Canadian Journal of Education, 36*(1), 195–239. Retrieved from http://www.jstor.org/stable/canajeducrevucan.36.1.195

McGinnis, J. R., & Stefanich, G. P. (2007). Special needs and talents in science learning. In S. A. (Eds), *Handbook of research on science education*, (pp. 287-317). Mahwah, NJ: Erlbaum.

McGuire, J. M., & Scott, S. S. (2006). Universal design for instruction: Extending the universal design paradigm to college instruction. *Journal of Postsecondary Education and Disability, 19*(2), 124-134. Retrieved from https://eric.ed.gov/?id=EJ844629

Meier, B. (2013). *Strategies that teachers implement to help students access the general education curriculum: Investigating the instructional strategies of universal design for learning.* Michigan: Michigan State University.

Meltzer, L. (Ed.). (2018). *Executive function in education: From theory to practice*. New York: Guilford Publications.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation.* New Jersey: Jossey Bass.

Meyer, A. (2006). *A practical reader in universal design for learning.* Cambridge, MA: Harvard Education Press.

Meyer, A., Rose, D.H., & Gordon, D. (2014). *Universal design for learning: Theory and practice.* Wakefield MA: CAST.

Millet, S. (2004). *Inclusion or exclusion: the special education dilemma in Quebec public high schools (Doctoral Dissertation).* Montreal: Concordia University.

Minke, K. M., Bear, G. G., Deemer, S. A., & Griffin, S. M. (1996). Teachers' experiences with inclusive classrooms: Implications for special education reform. *The Journal of Special Education*, 152-186. https://doi.org/10.1177/002246699603000203

Mitchell, D. (2014). *What really works in special and inclusive education: Using evidence-based teaching strategies.* London: Routledge.

Mitchell, D. (2015). Inclusive education is a multi-faceted concept. *Center for Educational Policy Studies Journal, 5*(1), 9-30. Retrieved from https://ojs.cepsj.si/index.php/cepsj/article/view/151

Moon, N. W., Todd, R. L., Morton, D. L., & Ivey, E. (2012). *Accommodating students with disabilities in science, technology, engineering, and mathematics (STEM).* Atlanta, GA: Center for Assistive Technology and Environmental Access, Georgia Institute of Technology.

Moriarty, M. A. (2007). Inclusive pedagogy: Teaching methodologies to reach diverse learners in science instruction. *Equity & Excellence in Education, 40*(3), 252-265. https://doi.org/10.1080/10665680701434353

Mugambi, M. M. (2017). Approaches to inclusive education and implications for curriculum theory and practice. *International Journal of Humanities Social Sciences and Education, 4*(10), 92-109. http://dx.doi.org/10.20431/2349-0381.0410013

Mujawamariya, D., Hujaleh, F., & Lima-Kerckhoff, A. (2014). A reexamination of Ontario's science curriculum: Toward a more inclusive multicultural science education? *Canadian Journal of Science, Mathematics and Technology Education, 14*(3), 269-283. https://doi.org/10.1080/14926156.2014.874618

Mumba, F., Banda, A., & Chabalengula, V. M. (2015). Chemistry teachers' perceived benefits and challenges of inquiry-based instruction in inclusive chemistry classrooms. *Science Education International, 26*(1), 180-194. Retrieved from https://eric.ed.gov/?id=EJ1064034

National Research Council. (1996). *National science education standards.* Washington, DC: National Academies Press.

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

Nelson, L. L., & Rose, D. H. . (2014). *Design and deliver: Planning and teaching using universal design for learning.* Baltimore, MD: Brookes Publishing.

Neuman, W. L. (2013). *Social research methods: Qualitative and quantitative approaches.* Pearson Education. Retrieved from http://lib.hpu.edu.vn/handle/123456789/28691

New Brunswick Association for Community Living (NBAC). (2007). *Brief on systemic barriers to implementing inclusive education in New Brunswick.* Retrieved from https://nbacl.nb.ca/wp-content/uploads/2017/01/Brief-on-Systemic-Barriers-and-Inclusive-Education.pdf

New Brunswick Department of Education and Early Ch. (2013). *Policy 322: Inclusive education.* Retrieved from https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/policies-politiques/e/322A.pdf

New Zealand Ministry of Education. (2017). *Inclusive education.* Retrieved from EDUCATION.govt.nz: http://www.education.govt.nz/school/running-a-school/inclusive-education/

Newfoundland and Labrador Department of Education. (2018, February 28). *Inclusive schools*. Retrieved from Education and Early Childhood Development: https://www.ed.gov.nl.ca/edu/k12/inclusion.html

Niemeyer, J. A. & Proctor, R. (2002). The influence of experience on student teachers' beliefs about inclusion. *Journal of Early Childhood Teacher Education, 23*(1), 49-57. https://doi.org/10.1080/1090102020230109

Norman, K., Caseau, D., & Stefanich, G. P. (1998). Teaching students with disabilities in inclusive science classrooms: Survey results. *Science Education, 82*(2), 127-146. https://doi.org/10.1002/(SICI)1098-237X(199804)82:2<127::AID-SCE1>3.0.CO;2-G

Novak, K. (2014). *UDL Now!: A teacher's Monday-morning guide to implementing common core standards using universal design for learning.* Wakefield, MA: CAST Professional Publishing.

NRC. (2000). *Inquiry in the national science education standards: A guide for teaching and learning.* Washington, DC: The National Academies Press.

Okolo, C. M. (2006). Using video to teach content-area information: How can the web help teacher. 48-51. *Journal of Special Education Technology, 21*(3), Journal of Special Education Technology, 21(3). Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/016264340602100306

Oliveira, A. W., Wilcox, K. C., Angelis, J., Applebee, A. N., Amodeo, V., & Snyder, M. A. (2013). Best practice in middle-school science. *Journal of Science Teacher Education, 24*(2), 297-322. https://doi.org/10.1007/s10972-012-9293-0

Ontario Ministry of Education. (2014). *Equity and inclusive education in Ontario schools: Guidelines for policy development and implementation.* Ontario: Ministry of Education. Retrieved from http://www.edu.gov.on.ca/eng/policyfunding/inclusiveguide.pdf

Opertti, R., Brady, J., & Duncombe, L. (2009). Moving forward: Inclusive education as the core of education for all. *Prospects, 39*(3), 205-214. https://doi.org/10.1007/s11125-009-9112-3

Papadouris, N., Hadjigeorgiou, A., & Constantinou, C. P. (Eds.). (2015). *Insights from research in science teaching and learning: Selected papers from the ESERA 2013 conference (Vol. 2).* Switzerland: Springer. https://doi.org/10.1007/978-3-319-20074-3

Patton, M. (1990). *Qualitative evaluation and research methods.* Newbury Park: SAGE Publications.

Peterson, K. (2011). *A qualitative study of instructional strategies used by elementary general education teachers in inclusive classrooms (Doctor's Dissertation). Paper 448.* Retrieved from https://scholarworks.wmich.edu/dissertations/448/.

Petty, L. L., & Narayan, R. (2012). Investigating secondary science teachers' beliefs about multiculturalism and its implementation in the classroom. *Multicultural Perspectives, 14*(4), 212-219. https://doi.org/10.1080/15210960.2012.725327

Philpott, D. (2007). *Assessing without labels inclusive education in the Canadian context.* Thunder Bay, Ont.: Centre of Excellence for Children and Adolescents with Special Needs. Retrieved from https://www-deslibris-ca.qe2a-proxy.mun.ca/ID/223965

Philpott, D. F., & Dibbon, D. (2008). The evolution of disability studies amidst school reform in Newfoundland and Labrador. *The Morning Watch, 36,* 1-27.

Pilgrim, J., & Ward, A. K. (2017). Universal design for learning: A framework for supporting effective literacy instruction. In *Handbook of Research on Classroom Diversity and Inclusive Education Practice* (pp. 282-310). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-2520-2.ch012

Poirier, D., Goguen, L., & Leslie, P. T. (1988). *Education rights of exceptional children in Canada: A national study of multi-level commitments.* Toronto: Carswell.

Porter, G. L. (2004). Meeting the challenge: Inclusion and diversity in Canadian schools. *Education Canada, 44*(1), 48-51. Retrieved from https://www.edcan.ca/wp-content/uploads/EdCan-2004-v44-n1-Porter.pdf

Porter, G. L. (2008). Making Canadian schools inclusive: A call to action. *Education Canada, 48*(2), 62-64. Retrieved from https://www.edcan.ca/wp-content/uploads/EdCan-2008-v48-n2-Porter.pdf

Porter, G. L., & Richler, D. (1991). *Changing Canadian schools: Perspectives on disability and inclusion.* North York, Ontario: The Roeher Institute.

Powell, K. C., & Kalina, C. J. (2009). Cognitive and social constructivism: Developing tools for an effective classroom. *Education, 130*(2), 241-250. Retrieved from https://docdrop.org/static/drop-pdf/ConstructivismDay1-ln36v.pdf

Office of the Premier (News Release-Education). (2006, November 28). *New Brunswick receives national recognition for inclusive education system*. Retrieved from Communications New Brunswick: https://www.gnb.ca/cnb/news/edu/2006e1463ed.htm

Rao, K., Ok, M. W., & Bryant, B. R. (2014). A Review of research on universal design educational models. *Remedial and Special Education, 35*(3), 153-166. http://journals.sagepub.com.qe2a-proxy.mun.ca/doi/pdf/10.1177/074193251351898

Rao, K., Smith, S. J., & Lowrey, K. A. (2017). UDL and intellectual disability: What do we know and where do we go? *Intellectual and Developmental Disabilities, 55*(1), 37-47. http://dx.doi.org/10.1352/1934-9556-55.1.37.

Rawana, E., & Brownlee, K. (2009). Making the possible probable: A strength-based assessment and intervention framework for clinical work with parents, children and adolescents. *Families in Society: The Journal of Contemporary Social Services, 90*(3), 255-260.

American Institute for Research. (2015, January 1). *Issues about Change*. Retrieved from http://www.sedl.org/change/issues/issues43/definition_inclusion.html

Resiliency Initiative. (2011). *Embracing a strength-based perspective and practice in education.* Retrieved from http://www.ayscbc.org/Strengths-Based%20School%20Culture%20and%20Practice.pdf

Rieser, R. (2012). *Implementing inclusive education: A Commonwealth guide to implementing Article 24 of the UN Convention on the Rights of Persons with Disabilities.* London: Commonwealth Secretariat.

Roberts, J. L., & Inman, T. F. (2009). *Assessing differentiated student products: A protocol for development and evaluation.* Waco, TX: Prufrock Press.

Rose, D. H., & Meyer. (2002). *Teaching every student in the digital age: Universal design for learning.* Alexandria, VA: Association for Supervision and Curriculum Development.

Rose, D., & Meyer, A. (2009). *A practical reader in universal design for learning.* Cambridge: MA: Harvard Education Press.

Rose, R. (2001). Primary school teacher perceptions of the conditions required to include pupils with special educational needs. *Educational Review, 53*(2), 147-156. https://doi.org/10.1080/00131910120055570

Rosen-Webb, S. M. (2011). Nobody tells you how to be a SENCo. *British Journal of Special Education, 38*(4), 159–168. https://doi-org.qe2a-proxy.mun.ca/10.1111/j.1467-8578.2011.00524.x

Roth, W. M., & Lee, S. (2004). Science education as/for participation in the community. *Science Education, 88*(2), 263-291. https://doi.org/10.1002/sce.10113

Roy, A., Guay, F., & Valois, P. (2013). Teaching to address diverse learning needs: Development and validation of a differentiated instruction scale. *International Journal of Inclusive Education, 17*(11), 1186-1204. https://doi.org/10.1080/13603116.2012.743604

Ruggs, E., & Hebl, M. (2012). Literature overview: Diversity, inclusion, and cultural awareness for classroom and outreach education. *Apply Research to Practice (ARP) Resources,* 1-16. Retrieved from http://www.engr.psu.edu/AWE/ARPResources.aspx

Runswick-Cole, K. (2011). Time to end the bias towards inclusive education? *British Journal of Special Education, 38*(3), 112-119. https://doi.org/10.1111/j.1467-8578.2011.00514.x

Rutherford, F. J., & Ahlgren, A. (1991). *Science for all Americans.* Oxford, England: Oxford University Press.

Salend, S. J., & Duhaney, L. M. G. (1999). The impact of inclusion on students with and without disabilities and their educators. *Remedial and Special Education, 20*(2), 114-126. https://doi.org/10.1177/074193259902000209

Salend, S. J., & Whittaker, C. R. (2017). UDL: A blueprint for learning success. *Educational Leadership, 74*(7), 59–63.

Saloviita, T., & Schaffus, T. (2016). Teacher attitudes towards inclusive education in Finland and Brandenburg, Germany and the issue of extra work. *European Journal of Special Needs Education, 31*(4), 458-471. https://doi.org/10.1080/08856257.2016.1194569

Sargeant, J. (2012). Qualitative research part II: Participants, analysis, and quality assurance. *Journal of Graduate Medical Education,* 1-3. doi:https://doi.org/10.4300/JGME-D-11-00307.1

Saunders, S., E., R., & Debeer, Y. (2007). A brief introduction to inclusion, inclusive schools and barriers to inclusion. Toronto. Retrieved from http://www.oise.utoronto.ca/cld/userfiles/file/briefintrotoinclusioninclusiveschoolsandbarrierstoinclusion.pdf.

Saunders, W. L. (1992). The constructivist perspective: Implications and teaching strategies for science. *School Science and Mathematics, 92*(3), 136-141. https://doi.org/10.1111/j.1949-8594.1992.tb12159.x

Savolainen, H., Engelbrecht, P., Nel, M., & Malinen, O. (2012). Understanding teachers' attitudes and self-efficacy in inclusive education: Implications for preservice and in-service teacher education. *European Journal of Special Needs Education, 27*(1), 51-68. doi:10.1080/08856257.2011.613603

Schumm, J. S., & Vaughn, S. (1995). Getting ready for inclusion: Is the stage set? *Learning Disabilities Research & Practice, 10*(3), 169-17.

Schumm, J. S., Vaughn, S., & Leavell, A. G. (1994). (1994). Planning pyramid: A framework for planning for diverse student needs during content area instruction. *The Reading Teacher, 47*(8), 608-615. Retrieved from https://www.jstor.org/stable/20201330

Schweitzer, L., & Stephenson, M. (2008). Charting the challenges and paradoxes of constructivism: A view from professional education. *Teaching in Higher Education, 13(5),* 583–593. https://doi-org.qe2a-proxy.mun.ca/10.1080/13562510802334947

Science Council of Canada. (1984). *Science for every student: Educating Canadians for tomorrow's world (Report 36).* Ottawa: Canadian Government Publishing Centre.

Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching, 5*(9), 9-16. http://dx.doi.org/10.5539/elt.v5n9p9

Scott, T. P., Schroeder, C., Tolson, H., & Bentz, A. (2006). *Effective K-12 science instruction: Elements of research-based science education.* Texas: Center for Mathematics and Science Education.

Scruggs, T. E., & Mastropieri, M. A. (1996). Teacher perceptions of mainstreaming/inclusion, 1958–1995: A research synthesis. *Exceptional Children, 63*(1), 59-74. https://doi.org/10.1177/001440299606300106

Sharma, U. (2001). *The attitudes and concerns of school principals and teachers regarding the integration of students with disabilities into regular schools in Delhi, India (Doctoral Dissertation).* Melbourne.: Faculty of Education, The University of Melbourne. Retrieved from http://hdl.handle.net/11343/37802

Sharma, U., & Sokal, L. (2015). The impact of a teacher education course on pre-service teachers' beliefs about inclusion: An international comparison. *Journal of Research in Special Educational Needs, 15*(4), 276-284. https://doi.org/10.1111/1471-3802.12043

Sheppard, B., & Anderson, K. (2016). *Better together: The final report of the panel on the status of public education in Newfoundland and Labrador 2015-16.* St. John's: Newfoundland and Labrador Teachers' Association.

Shore, L. M., Randel, A. E., Chung, B. G., Dean, M. A., Ehrhart, K. H., & Singh, G. (2011). Inclusion and diversity in work groups: A review and model for future research. *Journal of Management, 37*(4), 1262–1289. https://doi.org/10.1177%2F0149206310385943

Singal, N. (2008). Working towards inclusion: Reflections from the classroom. *Teaching and Teacher Education, 24*(6), 1516-1529. https://doi.org/10.1016/j.tate.2008.01.008

Singletary, S.L., Ruggs, E.N., Hebl, M.R., & Davies, P.G. (2009). Literature overview: Stereotype threat: Causes, effects, and remedies. Retrieved from https://www.engr.psu.edu/awe/misc/arps/arp_stereotypethreat_overview_31909.pdf

Smith, T. E., Polloway, E. A., Patton, J. R., & Dowdy, C. A. (2009). *Teaching students with special needs in inclusive settings (Vol. 6).* Upper Saddle River, NJ: Pearson.

Smith, T., Polloway, E. A., Patton, J. R., & Dowdy, C. A. (2004). *Teaching students with special needs in inclusive settings (4th ed.)*. Boston: Pearson.

Smith, W. J., & Foster, W. F. (1996). *Equal educational opportunity for students with disabilities in Canada: 1996 Legislative Update.* Montreal: Office of Research on Educational Policy, McGill University.

Sokal, L., & Katz, J. (2015). Oh, Canada: Bridges and barriers to inclusion in Canadian schools. *Support for Learning, 30*(1), 42-54. https://doi.org/10.1111/1467-9604.12078

Soodak, L. C., Podell, D. M., & Lehman, L. R. (1998). Teacher, student, and school attributes as predictors of teachers' responses toiInclusion. *The Journal of Special Education, 31*(4), 480–497. https://doi.org/10.1177/002246699803100405

Southerland, S., Gallard, A., & Callihan, L. (2011). Examining teachers' hurdles to 'science for all.' *International Journal of Science Education, 33*(16), 2183-2213. https://doi.org/10.1080/09500693.2010.530698

Specht, J. (2016). Pre-service teachers and the meaning of inclusion. *Journal of Research in Special Educational Needs, 16,* 894-895. https://doi.org/10.1111/1471-3802.1_12347

Specht, J., McGhie-Richmond, D., Loreman, T., Mirenda, P., Bennett, S., Gallagher, T., ... & Lyons, W. (2016). Teaching in inclusive classrooms: Efficacy and beliefs of Canadian preservice teachers. *International Journal of Inclusive Education, 20*(1), 1-15. https://doi.org/10.1080/13603116.2015.1059501

Spektor-Levy, O. & Granot-Gilat, Y. (2012). The impact of learning with laptops in 1:1 classes on the development of learning skills and information literacy among middle school students. *Interdisciplinary Journal of E-Learning and Learning Objects, 8*(1), 83-96. Retrieved from https://www.learntechlib.org/p/44763/.

Spencer, S. A. (2011). Universal design for learning: Assistance for teachers in today's inclusive classrooms. *Interdisciplinary Journal of Teaching and Learning, 1*(1), 10-22. Retrieved from https://files.eric.ed.gov/fulltext/EJ1055639.pdf

Sposaro, S. A., & Lensink, J. M. (1998). Barriers to implementing inclusion practices (Master's Thesis). Retrieved from http://scholarworks.gvsu.edu/theses/372

Spratt, J., & Florian, L. (2013). Applying the principles of inclusive pedagogy in initial teacher education: From university based course to classroom action. *Revista de InvestigaciÓn en EducaciÓn, 11*(3), 133-140. Retrieved from http://webs.uvigo.es/reined/

Statistics Canada. (2005, March 22). *Population projections of visible minority groups, Canada, provinces and regions - ARCHIVED (Catalogue number 91-541-XIE)*. Retrieved from https://www150.statcan.gc.ca/n1/daily-quotidien/050322/dq050322b-eng.htm

Steele, M. M. (2007). Methods and strategies: Science success for students with special needs. *Science & Children, 45*(2), 48-51. Retrieved from http://www.nsta.org/publications/browse_journals.aspx?action=issue&id=10.2505/3/sc07_045_02

Stefanich, G. P. (2001a). *Science teaching in inclusive classrooms: Models & applications.* Iowa: Woolverton Printing Company.

Stefanich, G. P. (2001b). *Science teaching in inclusive classrooms: Theory and foundations.* Cedar Falls: University of Northern Iowa.

Subban, P. (2006). Differentiated instruction: A research basis. *International Education Journal, 7*(7), 935-947. Retrieved from https://eric.ed.gov/?id=EJ854351

Superfine, A. M. (2009). Planning for mathematics instruction: A model of experienced teachers' planning processes in the context of reform mathematics curriculum. *The Mathematics Educator*, 11-12. Retrieved from http://tme.journals.libs.uga.edu/index.php/tme/article/viewFile/198/185

Tan, Q. (2015). *Examining the barriers to inclusive education for students with special education needs: A case study for two primary schools in Mainland China (Doctoral Dissertation).* Barcelona: Universitat Autònoma de Barcelona. Retrieved from https://ddd.uab.cat/pub/tesis/2014/hdl_10803_285411/qt1de1.pdf

Thakur, K. (2014). Differentiated instruction in the inclusive classroom. *Research Journal of Educational Sciences, 2*(7), 10-14. Retrieved from http://www.isca.in/EDU_SCI/Archive/v2/i7/2.%20ISCA-RJEduS-2014-025.pdf

Tomlinson, C. A. (2003). *Fulfilling the promise of the differentiated classroom: Strategies and tools for responsive teaching.* Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Tomlinson, C. A., & Imbeau, M. B. (2010). *Leading and managing a differentiated classroom.* Alexandria: ASCD.

Towle, H. (2015). *Disability and inclusion in Canadian education: Policy, procedure, and practice.* Ottawa: Canadian Centre for Policy Alternatives.

Turville, J. (2013). *Differentiating by student learning preferences: Strategies and lesson plans.* Larchmont, NY: Routledge.

U. S. Department of Education. (2008). *Education and inclusion in the United States: An overview.* Retrieved from https://www2.ed.gov/about/offices/list/osers/osep/index.html

U.S. Department of Education. (2002). *No child left behind: A desktop reference.* Washington, D.C.: Office of Elementary and Secondary Education. Retrieved from https://www2.ed.gov/admins/lead/account/nclbreference/reference.pdf

U.S. Department of Education. (2017, December 19). *Every student succeeds act (ESSA).* Retrieved from Laws & Guidance.: https://www2.ed.gov/policy/elsec/leg/essa/index.html

UDL-IRN. (2018, April 11). *Critical elements of UDL in instruction.* Retrieved from The Universal Design for Learning Implementation and Research Network: https://udl-irn.org/critical-elements/

UNESCO. (1994). *The Salamanca statement and framework for action on special needs education: Adopted by the world conference on special needs education; Access and Quality.* Paris: Unesco. Retrieved from http://www.unesco.org/education/information/nfsunesco/pdf/SALAMA_E.PDF

UNESCO. (2000). *World education forum: Final report.* Paris: UNESCO.

UNESCO. (2005). *Guidelines for inclusion: Ensuring access to education for all.* Paris: United Nations Educational, Scientific and Cultural Organization. Retrieved December 12, 2018, http://www.ibe.unesco.org/sites/default/files/Guidelines_for_Inclusion_UNESCO_2006.pdf

UNESCO. (2009). *48th session of the international conference on education* (pp. 1-128). Geneva, Switzerland: International Bureau of Education.

Van Garderen, D. & Whittaker, C. (2006). Planning differentiated, multicultural instruction for secondary inclusive classrooms. *Teaching Exceptional Children*, 12-21. Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/004005990603800302

Vaughn, S. (1994). Teachers' views of inclusion: " I'd rather pump gas." *ERIC*, 3-34. Retrieved from https://files.eric.ed.gov/fulltext/ED370928.pdf

Villa, R. A., Thousand, J. S., Nevin, A. I., & Malgeri, C. (1996). Instilling collaboration for inclusive schooling as a way of doing business in public schools. *Remedial and Special Education, 17*(3), 169–181. https://doi.org/10.1177/074193259601700306

Von Glasersfeld, E. (1995). *Radical constructivism: A way of knowing and learning.* Bristol: Taylor & Francis Inc.

Von Secker, C. E., & Lissitz, R. W. (1999). Estimating the impact of instructional practices on student achievement in science. *Journal of Research in Science Teaching, 36*(10), 1110-1126. https://doi.org/10.1002/(SICI)1098-2736(199912)36:10<1110::AID-TEA4>3.0.CO;2-T

Vrtačnik, M., & Gros, N. (2013). The impact of a hands-on approach to learning visible spectrometry upon students' performance, motivation, and attitudes. *Acta Chimica Slovenica, 60*(1), 209-220.
Retrieved from https://journals.matheo.si/index.php/ACSi/article/view/44/33

Vrtačnik, M., Juriševič, M., & Gros, N. (2012). Impact of the hands-on approach in teaching and learning visible spectrometry on students' achievements and its relation with students' motivational orientations and study programs. Retrieved from https://www.semanticscholar.org/paper/Impact-of-the-hands-on-approach-in-teaching-and-on-Vrta-Nik/c744f02891add86ef9fdd0ea48e50133d4904d47#references

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (2012). *Thought and language.* Cambridge: MIT Press.

Wade, S. E. (2000). *Inclusive education: A casebook and readings for prospective and practicing teachers.* New York: Routledge.

Walther-Thomas, C. (2000). *Collaboration for inclusive education: Developing successful programs.* Toronto: Allyn and Bacon.

Watson, S., & Houtz, L. E. (1998). Modifying science instruction: One strategy for achieving success and equity in inclusive settings. *Journal of Science Education for Students with Disabilities,* 24-37.

Watson, S., & Houtz, L. (2002). Teaching science: Meeting the academic needs of culturally and linguistically diverse students. *Intervention in School and Clinic, 37*(5), 267. https://search-proquest-com.qe2a-proxy.mun.ca/docview/211747772?accountid=12378

Weinberg, D. (2002). *Qualitative research methods.* Malden: Blackwell Publishing.

Wiggins, C. (2012). *High school teachers' perceptions of inclusion (Doctoral Dissertations).* Virginia: Liberty University. https://digitalcommons.liberty.edu/doctoral/608/

Williams, P. J., Nguyen, N., & Mangan, J. (2017). Using technology to support science inquiry learning. *JOTSE, 7*(1), 26-57. https://doi.org/10.3926/jotse.234

Windschitl, M., Thompson, J., Braaten, M., & Stroupe, D. (2012). Proposing a core set of instructional practices and tools for teachers of science. *Science Education, 96*(5), 878-903. doi:https://doi.org/10.1002/sce.21027

Winter, S. M. (1997). SMART" Planning for inclusion. *Childhood Education, 73*(4), 212-218. doi:10.1080/00094056.1997.10521095

Woodcock, S., & Hardy, I. (2017). Beyond the binary: Rethinking teachers' understandings of and engagement with inclusion. *International Journal of Inclusive Education, 21*(6), 667-686. doi:10.1080/13603116.2016.1251501

Workman, E. (2012). Teacher expectations of students: A self-fulfilling prophecy. *The Progress of Education Reform, 13*(6), 1-7.

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report*, 134-152. Retrieved from https://nsuworks.nova.edu/tqr/vol20/iss2/12

Yin, R. K. (2011). *Qualitative research from start to finish.* New York: Guilford Publication.

York, J., & Tundidor, M. (1995). Issues raised in the name of inclusion: Perspectives of educators, parents, and students. *Journal of the Association for Persons with Severe Handicaps, 20*(1), 31-44. https://doi.org/10.1177/154079699502000104

Yukon Department of Education. (2015, November 30). *Student support services manual.* Retrieved from Yukon Government: http://www.education.gov.yk.ca/pdf/schools/SSS_Manual_H_New_Referral_to_Student_Support_Services.pdf

Zigmond, N. (1995). An exploration of the meaning and practice of special education in the context of full inclusion of students with learning disabilities. *The Journal of Special Education, 29*(2), 109-115. https://doi-org.qe2a-proxy.mun.ca/10.1177/002246699502900201

Appendices

Appendix A: Study Invitation

MEMORIAL UNIVERSITY

Study Invitation

Hi! My name is Simon Adu-Boateng, and I am a graduate student in the Faculty of Education at the Memorial University of Newfoundland. I am conducting a research project called "**Examining the perspectives and practices of high school science teachers on inclusive pedagogy**" for my master's degree under the supervision of Dr. Karen Goodnough, a professor of science education.

Purpose of the study

The purpose of the study is to explore the conceptions of high school science teachers on inclusive pedagogy and how they adopt inclusive practices to create inclusive learning environments to make the science curriculum accessible to all learners.
I am contacting you to invite you to participate in this study.

What you will do in this study

If you agree to take part in this study, you would be required to avail yourself for interviews and also allow me into your classroom for observations. Approximately, there will be two interviews and three classroom observations. The first and second interviews will take place at your school at a time of your convenience. During the first interview, I will ask you to share your understanding and experiences on inclusive pedagogy. This will be followed by two to four classroom observations to gather more information from you based on our discussions from the first interview. Each observation will last about 45 minutes. The second interview will occur after the observations to provide you with the opportunity to reflect on your experiences during the study and share these thoughts with me. Participating in the interview will require 45-60 minutes of your time.

To participate in this, you must be a high school science teacher who adopts inclusionary practices in your classroom. If you are interested in participating in this study, please contact me at sab021@mun.ca (709 746 7744) to arrange a meeting time. If you agree to participate, I will ask you to review and sign a consent form that will be provided to you enclosed in an envelope during our meeting.

If you have any questions about me or my project, please contact me by email at sab021@mun.ca or by phone at 709 746 7744.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as your rights as a participant, you may contact the Chairperson of the ICEHR at icehr.chair@mun.ca or by telephone at 709-864-2861.

Thank you in advance for considering my request.

Simon

Appendix B: Informed Consent

MEMORIAL UNIVERSITY

Informed Consent Form

Title:	Examining the Perspectives and Practices of High School Science Teachers on Inclusive Pedagogy.
Researcher(s):	Simon Adu-Boateng, Faculty of Education, Memorial University of Newfoundland, sab021@mun.ca (709 746 7744).
Supervisor(s):	Dr. Karen Goodnough, Faculty of Education, Memorial University of Newfoundland, kareng@mun.ca.

You are invited to take part in a research project entitled "Examining the Perspectives and Practices of High School Science Teachers on Inclusive Pedagogy."

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, Simon Adu-Boateng, if you have any questions about the study or would like more information before you consent.

Participation in this project is not a requirement of the NLESD and/or school principals. Also, for participants pursuing a program at MUN, your participation in this project is not a requirement of your degree or program at MUN, as such, the decision to participate or not will not be reported to anyone.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction:

I am Simon Adu-Boateng, a master's student at the Faculty of Education at the Memorial University of Newfoundland. As part of my Master's thesis, I am conducting research under the supervision of Dr. Karen Goodnough, a professor of science education.

Purpose of Study:

The purpose of the study is to explore high school science teachers' conceptions of inclusive pedagogy and how they create inclusive learning environments to make the science curriculum accessible to all learners.

What You Will Do in this Study:

Participating in this study involves being available for interviews and classroom observations. The first and second interviews will take place in your school at a time of your convenience. The first interview will be open-ended with

you sharing your understanding and experiences on inclusive pedagogy. There will be two to four classroom observations after this to gather more information from you based on your responses from the first interview. This will be followed by a second interview to find out more about your pedagogical approaches in the classroom. You will also be asked to provide general information about yourself, such as your level of education, teaching experiences, and classroom demographics. The general outline of the interview and observation are attached for your review. After the interview, I will give you a hard copy of the transcripts of each of your interview sessions. You will have the opportunity to make any modifications or changes to ensure the essence of your understanding and experiences on inclusive pedagogy were captured accurately.

Length of Time:

Each interview will last45-60. Each of the classroom observations should last about 45 minutes.

Withdrawal from the Study:

You are free to withdraw from the study at any time up until May 5, 2018, without penalty. I will be in the final stage of the writing process at this point. As such, it will be difficult to take out specific quotations from the document. Also, you are free not to answer any questions or respond to any research situations, if you so choose.

Possible Benefits:

Although there are no monetary incentives for being part of this study, you will have an opportunity to reflect on your experiences in teaching diverse students in inclusive science classrooms. Moreover, by taking part in this study, you and your school will advance awareness of current successful teaching practices and strategies being used in addressing the learning needs of diverse students in inclusive science classrooms. Additionally, this study will help identify science teachers and schools that may serve as resources for teacher collaboration and preparation in the English School District. The outcome of the study will also draw attention to the challenges that science teachers encounter in inclusive classrooms when serving a diverse group of learners.

Possible Risks:

There are no risks of any physical danger. However, as in all research, there may be unforeseen risks to the participants. One potential risk of this project is that you may become stressed or troubled when sharing your understanding and experiences on inclusive pedagogy. You may discontinue your participation or quit at any time during the study without prejudice.

In the event that you become upset or experience any form of emotional distress during the study, you may be referred to the following contacts for assistance:

For participants who are Memorial University students: Memorial University's Student Wellness and Counselling Centre (UC5000): (709) 864-8874

For participants other than Memorial University students: Mental Health Crisis Line, 24-hour Toll-Free: 1-888-737-4668.

Confidentiality:

The ethical duty of confidentiality includes safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure.

To protect your privacy and confidentiality, all the information collected will remain confidential. At no point, will the interview *transcripts* be seen by anyone other than my supervisor, the individual participants, and me. The interview transcripts and all other data will be alphanumerically coded, and the names of participants and their affiliated schools would be replaced with pseudonyms. Once the data are collected and analyzed, all the remaining

data will be encrypted and retained for a minimum of five years on a securely password-protected laptop, not accessible to any individual outside the study.

Anonymity:

Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance.

The data from this research project may be published and presented at conferences; however, your identity will be kept confidential. Although I will report direct quotations from the interview, you will be given a pseudonym, and all identifying information such as the name of your school, your position in the school, or a name of any of your students that comes up in the interview process will be removed from the report.

As well, this study will take place in a school setting, as such; there is a possibility that other teachers or staff may identify participants who take part in this project. To safeguard participants' anonymity, I will ensure that all identifiable data provided by participants remain anonymous. In the event that the data from this project is published and/or presented at conferences; your identity as a participant will be kept anonymous. Additionally, if direct quotations from the interview are cited in my report, all participants will be given pseudonyms to hide or protect their identities. Further, all identifying information such as the names of participants' affiliated schools, positions held by participants in the schools, and the name of any of their students that come up in the interview or data collection process will be replaced with pseudonyms to protect the identity of participants and their affiliated schools.

Every reasonable effort will be made to ensure your anonymity. You will not be identified in publications without your explicit permission.

Recording of Data:

As indicated above, all interview sessions will be audiotape recorded. Only the interviews, not the classroom observations, will be audiotaped. Tape recorders will be placed in plain view for all participants to see. At no point in the study will a video recorder be used. You have every right to agree or disagree with the use of an audio recorder.

Use, Access, Ownership, and Storage of Data:

The results from this study will be shared with my thesis supervisor and the thesis committee at the School of Graduate Studies at MUN.
Data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

Reporting of Results:

Upon completion, my thesis will be available at Memorial University's Queen Elizabeth II library and can be accessed online at http://collections.mun.ca/cdm/search/collection/theses. Part of the thesis may contain direct quotes from participants if permission is granted.

Sharing of Results with Participants:

A copy of the findings will also be made available to participants, the Newfoundland and Labrador's English School District and the participating schools in the form of a report. Further, the outcome of the study will be published in academic journals. The publication will be shared with participants through emails.

Questions:

You are welcome to ask questions before, during, or after your participation in this research. If you would like more information about this study, please contact Simon Adu-Boateng at sab021@mun.ca (709 746 7744). You may also reach my supervisor, Dr. Karen Goodnough, at karen@mun.ca.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Consent:

Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw participation in the study without having to give a reason and that doing so will not affect you now or in the future.
- You understand that if you choose to end participation **during** data collection, any data collected from you up to that **point will be destroyed**.
- You understand that if you choose to withdraw **after** data collection has ended, your data can be removed from the study up to **December 4, 2017**.

I agree to be audio-recorded	☐ Yes ☐ No
I agree with the use of direct quotations	☐ Yes ☐ No
I agree that you may observe my classroom and take notes	☐ Yes ☐ No
I agree to share my lesson plans and other teaching artifacts	☐ Yes ☐ No

By signing this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your Signature Confirms:

☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions, and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.

☐ A copy of this Informed Consent Form has been given to me for my records.

Signature of Participant _____ Date _____

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____

Signature of Principal Investigator Date

Appendix C: Ethics Approval

MEMORIAL UNIVERSITY

Interdisciplinary Committee on Ethics in Human Research (ICEHR)

St. John's, NL Canada A1C 5S7
Tel: 709 864-2561 icehr@mun.ca
www.mun.ca/research/ethics/humans/icehr

ICEHR Number:	**20180743-ED**
Approval Period:	September 19, 2017 – September 13, 2018
Funding Source:	Not funded
Responsible Faculty:	Dr. Karen Goodnough Faculty of Education
Title of Project:	*Examining the Perspectives and Practices of High School Science Teachers on Inclusive Pedagogy*

September 19, 2017

Mr. Simon Adu-Boateng
Faculty of Education
Memorial University of Newfoundland

Dear Mr. Adu-Boateng:

Thank you for your correspondence of September 7 and 15, 2017 addressing the issues raised by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) concerning the above-named research project.

ICEHR has re-examined the proposal with the clarification and revisions submitted, and is satisfied that the concerns raised by the Committee have been adequately addressed. In accordance with the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans (TCPS2)*, the project has been granted *full ethics clearance* to September 30, 2018. ICEHR approval applies to the ethical acceptability of the research, as per Article 6.3 of the *TCPS2*. Researchers are responsible for adherence to any other relevant University policies and/or funded or non-funded agreements that may be associated with the project.

If you need to make changes during the project, which may raise ethical concerns, please submit an amendment request with a description of these changes for the Committee's consideration. In addition, the *TCPS2* requires that you submit an annual update to ICEHR before September 30, 2018. If you plan to continue the project, you need to request renewal of your ethics clearance, and include a brief summary on the progress of your research. When the project no longer involves contact with human participants, is completed and/or terminated, you are required to provide the annual update with a final brief summary, and your file will be closed.
Annual updates and amendment requests can be submitted from your Researcher Portal account by clicking the *Applications: Post-Review* link on your Portal homepage.

We wish you success with your research.

Yours sincerely,

Kelly Blidook, Ph.D.
Vice-Chair, Interdisciplinary Committee on
Ethics in Human Research

KB/lw

cc: Supervisor – Dr. Karen Goodnough, Faculty of Education
Associate Dean, Graduate Programs, Faculty of Education

Appendix D: Request for Approval (NLESD)

MEMORIAL UNIVERSITY

Memorial University of Newfoundland
P .O Box 17, Battery Facility
St. John's
A1B 3P7

September 20, 2017

Senior Education Officer
95 Elizabeth Avenue
St. John's, NL
A1B 1R6 · Canada

REQUEST FOR ASSISTANCE TO RECRUIT PARTICIPANTS

Dear Ms. Deborah Toope:

I am Simon Adu-Boateng, a master's student at Faculty of Education at Memorial University of Newfoundland (MUN). As part of my Master's thesis, I am conducting research on the topic: "**Examining the perspectives and practices of high school science teachers on inclusive pedagogy**". This project is under the supervision of Dr. Karen Goodnough, a professor of science education at MUN.

The purpose of the study is to explore high school science teachers' conceptions of inclusive pedagogy and how they create inclusive learning environments to make the science curriculum accessible to all learners in their class. The research will be conducted within the English School District in St. John's.

I hereby write to request your approval to enable me contact high schools in your district to invite science teachers who might be interested to participate in this study. As indicated in the attached consent form, teachers who agree to participate in this study will be available for interviews and classroom observations.

Although there are no monetary incentives or compensations for teachers who voluntarily take part in this project, participants would have an opportunity to reflect on their experiences in teaching diverse students in inclusive science classrooms. Moreover, by taking part in this study, participants and their affiliated schools will be contributing toward knowledge on effective inclusive pedagogy and strategies for addressing the learning needs of diverse students in regular education classrooms.

The proposal for this research has been reviewed by the Interdisciplinary Committee on

Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have any ethical concerns about this research, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

For any enquiries or clarifications about this study, please do not hesitate to contact the researcher at 709 746 7744 (sab021@mun.ca). You may also contact my thesis supervisor, Dr. Karen Goodnough, at karen@mun.ca for further information.

Thank you for your time and consideration in this matter.

Yours sincerely,

Simon Adu-Boateng

Appendix E: Request for Permission from Principals

Simon Adu-Boateng
Faculty of Education, Memorial University of Newfoundland
P .O Box 17, Battery Facility
St. John's
A1B 3P7

September 25, 2017

Request for Permission to Carry Out Research in Your School

Dear Principal:

I am Simon Adu-Boateng, a master's student at Faculty of Education, Memorial University of Newfoundland (MUN). As part of my master's thesis, I am conducting research on the topic: "Examining the perspectives and practices of high school science teachers on inclusive pedagogy." This project is under the supervision of Dr. Karen Goodnough, a professor of science education at MUN.

Purpose of the Study

The purpose of the study is to explore high school science teachers' conceptions of inclusive pedagogy and how they create inclusive learning environments to make the science curriculum accessible to all learners in their class.

I am writing to seek your permission to enable me to work with one of your science teachers, Amanda Craig, who has freely consented to participate in this project. I will interview Amanda about her perspectives and practices of inclusive pedagogy and observe her briefly in her classrooms during lessons. My role as a researcher in the observation process will be a non-participant observer. As such, my presence in her classroom will not interrupt the regular teaching hours. I will ensure that my presence and all research activities to be carried out in your school will conform to the decisions and wishes of your school and the staff. Based on this, I will work around the classroom schedules to respect the routines and minimize any interruptions that may be caused by my presence in the class/classes and school as well.

Benefits of the Study

Although there are no monetary incentives or compensations for teachers and schools involved in this project, your school's participation in this study will help to advance awareness of current

successful teaching practices and strategies being used in addressing the learning needs of diverse students in inclusive science classrooms. Moreover, this study will help identify science teachers and schools that may serve as resources for teacher collaboration and preparation in the English School District. Further, the outcome of the study will draw attention to the challenges that science teachers encounter in inclusive classroom environments when serving a diverse group of learners.

Confidentiality and Anonymity

In accordance with the core principles of ethical conduct for research involving humans, all responses provided by participants would remain anonymous and only I, my supervisor, and the individual participants will have access to the information provided by the participants. Also, the names of teachers who have consented to be part of the project, their affiliated schools, and their responses will not be linked in any way. The results from this study will not identify individual participants or their schools' name. Any data from this study that appears in academic journals will always be presented in an anonymous form, in order to ensure the confidentiality and anonymity of the data. Thus, **every reasonable effort** will be made to ensure the anonymity of participants, their affiliated schools, and their research data.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. As such, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861 if you have any ethical concerns about this research.

Further, this project has been reviewed and approved by the Newfoundland and Labrador English School District.

Please do not hesitate to contact the researcher at 709 746 7744 (sab021@mun.ca) if you have any questions or concerns about this study. You may also contact my thesis supervisor, Dr. Karen Goodnough, at karen@mun.ca for further information or clarifications.

Thank you for your time and consideration in this matter.

Yours sincerely,

Simon Adu-Boateng

Appendix F: Approval from NLESD

Newfoundland & Labrador English School District

Office of the Senior Education Officer (Human Resources)
Deborah Toope (709) 758-2391

Chairperson: Goronwy Price
CEO/Director of Education: Anthony Stack

Research Approval Conditions

Research Title & Investigator(s): Examining Perspectives and Practices High School Science Teachers Inclusion Simon Adu-Boa

Your request to conduct this research is NOT approved: _____

Your request to conduct research in our district is approved subject to the conditions/requirements checked below:

1. A list of selected schools must be forwarded to my office before the research can begin. ☑
   1a. The list of targeted schools has been received
2. Final approval to conduct this study will rest with the principal of each targeted school and the targeted group of teachers/students/parents where applicable. ☑
3. Conducting the research will in no way negatively impact instructional time for students and teachers. ☑
4. Conducting this research must not put any burden of responsibility on our school administrators or other staff unless they specifically agree to it. Such agreement must not negatively impact instructional time. ☑
5. Participation in the study will be voluntary and participants will be able to opt out at any time without prejudice. This must be clearly communicated to the participants at the outset. ☑
6. For students under 19 years of age, the researcher(s) must secure parental consent and confirm such consent with the principal before the research proceeds. Students 19 years of age and older must provide their own consent. Regardless of age, youth must be clearly informed from the outset that they may refuse to participate, even if their parents consented to their participation. ☑
7. Anonymity of participants must be ensured. ☑
8. Before the research project can begin, it must receive final approval from your university's Research Ethics Committee and a copy of this approval must be sent to the Senior Education Officer (HR) as per the contact information listed below. 8a. Ethics Committee approval letter has been received ☑ 8b. Not applicable ☐
9. Given the inherent potential risk in this research project that some participants may relive a traumatic experience which can cause emotional or psychological stress, counseling services and other appropriate supports must be available during and subsequent to the data collection process. Researchers are responsible for providing such supports. This service will not be provided by the NLESD. ☑
10. A copy of the research findings and resulting papers/reports must be directed to the Senior Education Officer (HR) and to the regional Assistant Directors of Education (Programs) where applicable. ☑
11. Research results must be made available to the schools involved and the individual participants who request them. ☑
12. The Newfoundland and Labrador English School District takes no responsibility in conducting this research, and will not be held liable for any negative impacts relating to this research effort. The full responsibility to organize & conduct this research rests with the researcher(s). ☑

Recommended by: Deborah Toope — Senior Education Officer — Date: Oct 6, 2017

Signature of Approval: _____ — Associate Director of Education — Date: Oct 6, 2017.

Signature of Compliance: _____ — Researcher — Date: October 6, 2017

A signed copy of this form MUST be returned to the address below and to the target schools before research can begin:

Attention: Senior Education Officer (HR)
Newfoundland and Labrador English School District
95 Elizabeth Avenue
St. John's, NL
A1B 1R6

Appendix G: Interview Protocol

Individual Interview Protocol

Interviewer: Simon Adu-Boateng

Informant ID (Coded): ……..

Date: …….

Time: …….

Location: …….

Preamble: This interview seeks to elicit your views on inclusive education. I will ask you to share your thoughts on inclusive pedagogy and describe the teaching pedagogies and strategies you adopt in your science lessons to make the science curriculum accessible to all the students in your class. Please be reminded that you are not obliged to answer all the questions during the interview. You are free to skip any question that you do not wish to answer.

1. How long have you been teaching as a high school science teacher? May I know your age?
2. Could you share your educational background with me? What is your highest qualification as a teacher?
3. What is your understanding of inclusive education?

   The researcher may probe further for elaboration or clarification. Probing questions may differ for each participant.
4. Would you say you adopt inclusionary practices in your lessons?
5. Describe specific inclusionary practices that you use in your lessons to make the science curriculum accessible to your students.

   The researcher may probe further for elaboration or more in-depth understanding. Probing questions may differ for each participant.

6. (a) Does inclusive education present any form of challenge in your classroom?

   (b) If yes, what are some of the challenges?

7. Describe how you plan your lessons to meet diversity in your classroom.

   Guiding questions:

   (a) What specific instructional strategies and practices do you use in your science lessons to address the diverse learning needs of students? And why do you use those particular instructional strategies and practices?

   (b) What are the effects of those instructional strategies and practices on your students' academic achievement?

   The researcher may probe further for elaboration or more in-depth understanding. Probing questions may differ for each participant.

   (c) Does your school adopt particular inclusive policies or practices based on the Department of Education's current policy? If yes, please describe these policies.

   (d) Do you collaborate with other teachers such as the instructional resource teachers (IRTs) when planning your lessons? If yes, please describe how.

   The researcher may probe further for elaboration or more in-depth understanding. Probing questions may differ for each participant.

8. How do you know if students are successful in your lessons?

9. Describe the forms of assessment criteria you use to evaluate whether or not students are successful in your lessons.

   The researcher may probe further for elaboration or deeper understanding. Probing questions may differ for each participant.

10. Describe what informs your understanding of how to create inclusive learning environments.

    The researcher may probe further for elaboration or deeper understanding. Probing questions may differ for each participant.

Appendix H: Follow-Up Interview Protocol

Follow-up Individual Interview Protocol

Preamble: During our individual interview sessions, we discussed your understanding of inclusive pedagogy. You also described your instructional planning processes when designing lessons to meet diversity in your classroom. This was followed up with observing your classroom practices to elicit a deeper understanding about how you address diverse learning needs of your students in an inclusive setting. Reflecting on those experiences, I would like you to talk about your understanding of inclusion and inclusive pedagogy, as well as the adoption and implementation of your teaching pedagogies and strategies, and how they have been influenced by your involvement in this study.

Guiding Questions:

1) If you had to describe inclusive pedagogy to a colleague, what would be your description?
2) Based on our discussions from the first interview and your classroom observations:
   a. What pedagogies do you feel are ineffective in responding to the learning needs of diverse learners in inclusive science classrooms?

   The researcher may probe further for elaboration or clarification based on the initial interview. Probing questions may differ for each participant.

   b. What pedagogies do you feel are effective in making the science curriculum accessible to ALL learners?

   The researcher may probe further for elaboration or clarification based on the initial interview. Probing questions may differ for each participant.
3) a. What are some of the barriers to addressing the learning needs of students in an inclusive classroom?

b. What support do you think will be beneficial to help you respond to the learning needs of students in inclusive science classrooms?

4) What are the types of things you would like to change to make your classroom more inclusive?

The researcher may probe further for elaboration or clarification. Probing questions may differ for each participant

5) Do you receive periodic professional developments on inclusion? If yes, how would you describe the effect of these supports in teaching science to diverse students?

The researcher may probe further for elaboration or clarification. Probing questions may differ for each participant

SCIENCE TEACHERS' PERSPECTIVES AND PRACTICES ON INCUSION

Appendix I: Observation Guidelines

Observation Checklist for the Adoption of Inclusive Practices

Date of Classroom Visit_____ Name of Teacher _____

School Name_____ Observation Number_____

Principles of Universal Design for Learning	**Evidence of UDL to Look-for in the Classroom**	**Notes**
I. Provide multiple means of representation	**Examples of Evidence of Inclusive Practice Observed in the Classroom**	
Example: • Teacher provides options for language and symbols (e.g. using multiple media for illustrations, decoding text, mathematical notations, and symbols). • Teacher provides options for perception using a ***variety of formats***. • Teacher provides students with ***options for methods to acquire knowledge and skills*** that tap into different learning profiles. • Teacher provides ***options for comprehension*** (e.g. by activating the background knowledge of students, maximizing generalization and information transfer, highlighting patterns, big ideas, and critical features). • Teachers activate or supply opportunities to build ***background knowledge***.	• Evidence of the use of multiple media to present the content of the lesson to students (e.g., video clips, online resources, audio/visual files, manipulatives, and interactive white board). • Availability of a variety of materials related to the content (e.g., text books, magazines, articles, literature, and online content). • The use of technology in the lesson to help students visualize, learn, and practice concepts being taught. • The teacher uses concept maps, graphic organizers, diagrams, charts, and models in the classroom. • The teacher uses graphics (drawing or images) in paper handouts, digital materials, and presentations to complement text and whole group instruction. • Students have options with the use of technology and other materials to learn concepts and skills.	
II. Provide multiple means of action and expression	**Examples of Evidence of Inclusive Practice Observed in the Classroom**	Notes
Example: • Teacher provides students with options for executive functions (e.g. enhancing capacity for monitoring, guiding appropriate goal setting).	• Teacher displays student products such as written work samples and posters in the classroom. • Teacher diversifies assessment strategies. • Teacher posts rubrics in the classroom and provides choices to students for instructional activities including	

Observation Checklist for the Adoption of Inclusive Practices

• Teacher provides students options for expressing and communicating what they know or have learned (e.g. using multiple media for communication, varying options for students to complete assignments). • Teacher provides students ***options to construct, compose and share their learning with peers***, in small groups and/or with the whole class. • Teacher provides students ***options for physical action and response*** to communicate their learning. • Teacher ensures that **available learning tools are accessible to all** students. • Students have the ***opportunity to extend their knowledge*** beyond the scope of the initial lesson.	physical manipulatives, choral response, and movement. • Availability of alternative methods for interacting with instructional materials (e.g., joy stick, adaptive keyboard, and switch etc.). • Teacher uses small and whole group activities. • Students use multiple media to construct and compose (e.g. speech-to-text software, translators, sentence starters, Google forms, Google Classroom, web applications such as wikis, and animation).	
III. Provide multiple means of engagement	**Examples of Evidence of Inclusive Practice Observed in the Classroom**	
Example: • Teacher provides students options for self-regulation. (E.g. encourages students to reflect and assess their own learning, promotes expectations, and beliefs that optimize motivation). • Students are provided opportunities for varied levels of teacher support to ***sustain effort and optimize challenging content*** knowledge. (e.g. fostering collaboration and team work among students, reminding students about or asking them to restate lesson's standards or objectives). • Teacher provides feedback to students very often throughout the lesson. • Teacher provides options for recruiting interest (e.g. by minimizing threats and distraction-safe	• Teacher ensures that the learning goals or objectives are posted in student-friendly language and students can articulate them. • Availability of books, textbooks, and other written resources in the classroom that are linked to the learning objectives and are written at a variety of reading levels. • There is active engagement of all students are engaged (e.g. they actively listen to the teacher or a peer during lessons or presentation, writing, using iPads or other technology or are engaged in a project or activity alone or with a peer). • Students are able to demonstrate reasonable independence in gathering and using available materials for evaluation of work. • Teachers provides students opportunities to practice skills being taught. • Teacher provides students opportunities for reflection.	

Observation Checklist for the Adoption of Inclusive Practices

classroom climate, optimizing individual choice and autonomy etc.). • Teacher ensures the classroom or physical environment is easily accessible to all students and all styles of learning •	• There are various forms of assessment (e.g., exit tickets, non-verbal cues, oral assessment, quizzes etc.). • Teacher gives constructive feedback to students. • The classroom environment is organized to facilitate whole group and small group instruction and activities. • Students record their work using multiple media such as notebooks, journals, Google classroom, iPads and other digital devices).	

Source: Adapted from the New Jersey Department of Education and modified based on CAST (2018) and UDL-IRN (2018)

SECTION F: Copyright and Trademark Limitation

The State of New Jersey has made the content of these pages available to the public and anyone may view, copy or distribute State information found here without obligation to the State, unless otherwise stated on particular material or information to which a restriction on free use may apply.

Source: https://www.nj.gov/nj/legal.html

Appendix J: Critical Elements of UDL

Critical Elements of UDL in Instruction

Universal Design for Learning (UDL) represents a paradigm shift in education that has the potential to improve outcomes for a broad range of learners. The UDL-IRN working with the Michigan Integrated Technology Supports (MITS) and in collaboration with CAST has identified four critical elements intended to serve as a foundation for UDL implementation and research. Educators aligning instruction to UDL must minimally include each of the four critical elements shown below.

Element 1: Clear Goals

- Goals and desired outcomes of the lesson/unit are aligned to the established content standards.
- Goals are clearly defined and separate from means. They allow multiple paths/ options for achievement.
- Teachers have a clear understanding of the goal(s) of the lesson and specific learner outcomes.
- Goals address the needs of every learner, are communicated in ways that are understandable to each learner, and can be expressed by them.

Element 2: Intentional Planning for Learner Variability

- Intentional proactive planning that recognizes every learner is unique and that meeting the needs of learners in the margins- from challenged to most advanced- will likely benefit everyone.
  - Addressing learner strengths and weaknesses, considering variables such as perceptual ability, language ability, background knowledge, cognitive strategies, and motivation.
  - Anticipates the need for options, methods, materials, and other resources- including personnel- to provide adequate support and scaffolding.
  - Maintains the rigor of the lesson- for all learners- by planing efforts (1) that embed necessary supports and (2) reduce unnecessary barriers.

Element 3: Flexible Methods and Materials

- Teachers use a variety of media and methods to present information and content
- A variety of methods are used to engage learners (e.g., provide choice, address student interest) and promote their ability to monitor their own learning (e.g., goal setting, self-assessment, and reflection).
- Learners use a variety of media and methods to demonstrate their knowledge.

Element 4: Timely Progress Monitoring

- Formative assessments are frequent and timely enough to plan/redirect instruction and support intended outcomes.
- A variety of formative and summative assessments (e.g., projects, oral tests, written tests) are used by the learner to demonstrate knowledge and skill.
- Frequent opportunities exist for teacher reflection and new understandings.

UDL IRN
IMPLEMENTATION & RESEARCH NETWORK
http://udl-irn.org

Suggested Citation:
UDL-IRN (2011) Critical Elements of UDL in Instruction (Version 1.2). Lawrence, KS: Author.
The original MITS Critical Elements are located at http://mits.cenmi.org/