NEURODIVERSITY AND THE B.C. SECONDARY SCIENCE CURRICULUM: INTERSECTIONS AND DIVERSIONS

by

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Abstract

In this graduating paper, I explore a selection of scholarly articles and curriculum documents about the theory of neurodiversity and then draw comparisons to the revised B.C. curriculum, specifically within the context science education at the Grade 9 level. Intersections between neurodiversity and the revised curriculum include the valuing of individual identity, offering various entry points for all learners into the curriculum and also how knowledge can be constructed socially. While there are various intersections between neurodiversity and curriculum, diversions can occur based on the philosophy of the individual classroom teacher. I conclude by placing emphasis on the importance of valuing neurodiversity in both the curriculum as well as in the classroom.

Lay Summary

This graduating paper explores the revised 2016 curriculum in British Columbia with a focus on science education at the Grade 9 level. The exploration is done through the lens of neurodiversity theory and seeks to analyze how the revised curriculum both supports and lacks support in this theory. It is concluded that ways in which the revised curriculum supports students of diverse needs is through providing the space to value individual identity, offering varying levels of difficulty to approach the same topic, and also providing the opportunity to discuss how knowledge can be constructed socially. It is also concluded that the philosophy of the individual classroom teacher can have a large impact on supporting the diverse student needs within the classroom. I close by placing emphasis on the importance of valuing neurodiversity in both the curriculum as well as in the classroom.
Table of Contents

Abstract and Lay Summary .................................................................................. ii
Table of Contents ................................................................................................ iii
Chapter 1: Introduction .......................................................................................... 1
  Researcher Epistemology .................................................................................. 4
Chapter 2: Literature Review on Neurodiversity ...................................................... 9
  Neurodiversity as a Theoretical Framework ...................................................... 11
  Limitations of Neurodiversity ........................................................................ 13
  Summary ........................................................................................................ 15
Chapter 3: Analysis of the Revised B.C. Curriculum ................................................ 18
  Curriculum: Core Competencies and Big Ideas ............................................. 18
  Instruction: Skill Building and Inquiry .......................................................... 20
  Assessment: For and As Learning ................................................................ 21
  Science Education: A Constructivist Curriculum .......................................... 22
Chapter 4: Intersections and Diversions between Neurodiversity and the Curriculum... 25
  The Intersections of the B.C. Curriculum and Neurodiversity ....................... 26
  The Diversions of the B.C. Curriculum and Neurodiversity ......................... 32
  Conclusion ..................................................................................................... 34
  Researcher Reflections .................................................................................. 35
References ......................................................................................................... 36
Chapter 1: Introduction and Background to the Research

Looking out at the room of young faces as I began my long-awaited ten week teaching practicum, everyone looked back at me with curiosity except one student, who appeared to be withdrawn, disengaged, and uninterested in this new student teacher standing at the front of the classroom. I would hear other teachers talk about the “handful of hard to reach” students in their class with a tone as if that will always be the case. I was told to try my best to “teach to the middle” and attempt to engage at least the majority of the students. I felt early on that even allowing a single student to be so disconnected was wrong but quickly learned that a classroom teacher had a multitude of balancing acts to accomplish each day. I knew more work needed to be done specializing in students who were having a difficult time at school. It had to start with not looking at the student as the problem but beginning to question the system. Fast forward five years, and after spending time working as a teacher in British Columbia, my continuous curiosity has led me to pursue this study, in which I will review and analyze both relevant literature and curriculum documents to better understand the system with which I work in and how it supports students who have a difficult time in school.

The purpose of this graduating paper is to review the relevant literature and curriculum documents with the aim of identifying and discussing intersections and diversions between neurodiversity theory and the revised B.C. Science Curriculum. Within B.C.’s school system, approximately one in 59 students have autism spectrum disorder and one in every 29 students has a learning disability (B.C. Teacher’s Federation, 2018). The revised curriculum places greater emphasis on themes of open-ended, flexible, and inquiry driven pedagogies (B.C.’s New Curriculum, 2018). These
themes share commonalities with the neurodiversity framework as both state that a disability, which the medical model defines as a disability, (Autism, ADHD, etc.) should be understood as a neurological difference and a divergent way of thinking and learning (Kapp, Gillespie, Lynch, Sherman, & Hutman, 2013; Masataka, 2016; Silberman, 2017). In the following paragraph I will discuss how the medical model defines disability in more detail.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) is the principal authority for psychiatric diagnoses in the United States and Canada. Financial support from the government, treatment recommendations, and guiding school supports are often determined by DSM classifications. The fifth edition, the most recent and published in 2013, categorizes neurodevelopmental disorders as a category that includes diagnoses for autism, attention-deficit/hyperactivity disorder (ADHD), developmental coordination disorder, Tourette’s disorder, and others. While the manual does specifically address autism, the main focus encompasses all neurodevelopmental disorders. The manual describes the group of neurodevelopmental disorders as “characterized by deficits that produce impairments of personal, social, academic, or occupational functioning” (American Psychiatric Association, 2013, p. 31).

Autism spectrum disorders (ASD) is defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as highly heritable neurodevelopmental disorders characterized by “persistent deficits in social communication and social interaction” as well as “restricted, repetitive patterns of behavior, interests, or activities” (American Psychiatric Association, 2013, p. 31). According to the Centres for Disease Control and Prevention (CDC), about one in 59 children have been identified with ASD in 2014, a
consistent increase in prevalence since data collection began in 2000 (Centres for Disease Control and Prevention, 2014).

The field of special education in Canada and the United States relies heavily on the DSM-5, and therefore “founded on conceptions of disability originating within scientific, psychological, and medical frameworks” (Baglieri, Valle, Connor, & Gallagher, 2011, p. 265). Within these frameworks, a dichotomy exists between “the dis and human” (Goodley, Lawthom, Liddiard & Cole, 2017, p. 497), or the able and non-able-bodied, both of which are deficit models. These kinds of prescriptive frameworks pathologize people with disabilities: “psychology has damaged disabled people…when disability is defined as a problem and when that problem is located in an individual’s body or mind, then there is only really one way we can go with disability and that is pathologisation” (Goodley et al., 2017, p. 491). As a result, special education practices have marginalized students with diverse needs due to the characterization of these students as being a problem needing solution.

Based on my experience as a high school special education teacher as well as a teacher of “core” classes, heavily adapted curricular courses for students with diverse needs, I have observed school-based administrators and educators attempting to find solutions to adapt courses for special needs’ students. Some examples include streaming students into specialized classes due to the assumption that smaller class sizes and more direct instruction can benefit students with special needs. However, I have observed these actions often further marginalize students with special needs as they are physically segregated with limited access to regular mainstream curriculum courses.
In the case of students with neurological challenges, there is a movement towards the use of the term neurodiversity, which “challenges the medical model’s interest in causation and cure, celebrating [‘neural diversity’] as an inseparable aspect of identity” (Kapp, Gillespie-Lynch, Sherman & Hutman, 2013, p. 59). Neurodiversity refers to those with neurological differences (autism spectrum, ADHD, etc.) as not having a disability, but rather having brain diversity. In British Columbia, the revised Kindergarten to Grade 12 curriculum now allows for more flexibility in terms of the amount of subject content taught with more emphasis on inquiry-based learning. This increased flexibility allows one to believe that there are more opportunities to accommodate students with diverse abilities.

In this paper, I will analyze how the revised B.C. Science curriculum, specifically for Grade 9, may align with the framework of neurodiversity as described by Kapp, Gillespie-Lynch, Sherman and Hutman (2013). I selected the Grade 9 curriculum for the topic as I currently teach this grade within the context of the revised curriculum; hence I am most familiar with this grade level and curriculum document. In the following section, “Research Epistemology,” I will further discuss my personal experiences and how those experiences led me pursue this study.

**Researcher Epistemology**

Dr. Ross Greene (2014) states, “Kids do well if they can,” which reflects my teaching philosophy. I see resistance to engage at school not as a choice/act of defiance, but rather as a signal to a deeper problem. The root cause varies, but often, I believe, it stems from not knowing what to do, either the academic task is too hard, or the process of
where to start, or how to ask for help. If students were set up in a predictable environment where they are comfortable and given a task they can accomplish independently, I believe we would see their school avoidance decrease significantly. This belief shapes the way I interact with the students I work with daily. When I see a disengaged student, I do not question them; I question the task, myself, and the teaching and learning environment.

In the late fall of my second year as a practicing teacher, a small group of Grade 8s were identified by their classroom teachers as struggling significantly despite having support blocks such as Learning Assistance. The students already had Individual Education Plans (I.E.Ps) as well as a support block, but those supports proved to be insufficient. Similar to their behaviour in the mainstream class, the students were disengaged, and both their teachers and the students themselves said that they were not learning. The school-based team which consisted of myself, the school counsellors, the district psychologist, the student’s support teachers, and the school administrator - decided to create “core” curricular/academic classes to support this group of students, and I became their Core English and Core Science teacher. Knowing that every one of these Grade 8 students wanted to graduate with a B.C. Dogwood Diploma (a B.C. Certificate of Graduation awarded to students who have successfully completed the provincial graduation requirements), I taught these students with the intention of preparing them for re-integration into mainstream curricular classes by the time they entered Grade 10. At the time, I was taking Special Education courses at UBC where I learned specific strategies such as mapping function of behaviours and designing lessons and related assessments that were accessible for a variety of learners.
As I developed a rapport with this diverse group of Grade 8 students, I observed they all had one outcome in common; they became motivated by experiencing some success at school. For the first time, they saw grades being returned that were not just a bare pass but sometimes near perfect. They were asked questions in class they knew the answer to and answered correctly. They were allowed breaks part way through classes and were not reprimanded for needing to move their bodies when thinking and learning. They were finally in a class where they did not feel constantly inferior to their peers.

Inspired by these students, I began my personal endeavor to incorporate more strength-based teachings, where I would capitalize on my students’ existing skills (such as oral assessment methods for those who were strong oral expressers) into my practice. I also had the luxury of individualizing the curriculum for my group of ten students (regular class sizes in B.C. at the time were on average a total of thirty students).

However, not everything was utopian. This group of already vulnerable Grade 8’s were now viewed by their peers as being in a different, “easier” English/Science class. Both the students and I experienced the effects of being in a segregated classroom. As we were part of a school and district with a strong vision of inclusion, for example the department of “Special Programs” became “Inclusive Learning”, the idea of adapted curricular classes was and continues to be, controversial.

These “core” classes continue to run to this day. As a teacher of these classes, I have observed that although the individual needs of students are being met, and students who traditionally struggled to access core curricular content through regular coursework are now able to do so, we are streaming and segregating students with diverse needs. The physical separation these students experience lead to further marginalization them from
their peers which leads to a situation that actively works against the model of inclusion. In an inclusive model, students of all abilities are placed in a general education classroom and engage in learning together: “students with disabilities are actively engaged in effective instruction with supports and services provided to them within their natural learning environments” (Algozzine, Anderson, & Baughan, 2016, p. 120).

These classroom experiences shared with students with diverse needs have led me to this exploration of neurodiversity and the B.C. Curriculum. My inquiry aims to explore the revised B.C. curriculum (2016) through the neurodiversity framework to identify and discuss intersections and diversions. I am guided by the overarching problem of how to enable, inspire, and inform students of all abilities to experience academic success at school. The problem specific to this paper, focuses on how educators and curriculum developers can support students with diverse needs.

The purpose of this study is to determine and discuss intersections between neurodiversity theory and the revised B.C. science 9 curriculum with the objective of providing information about ways our education system can better meet the needs of every student in our classrooms, specifically students with diverse needs, taking in to account how they learn. By conducting this research, I hope to not only improve the educational experience of students who traditionally struggle in school, but to also equip classroom teachers with more knowledge regarding the diverse body of students in their classrooms. My research was guided by the following question:

What are the intersections and diversions of the revised B.C. Science 9 curriculum and neurodiversity theory?
I began this paper with an introduction to this review, my researcher positionality, and the problem which prompted me to pursue this research. In Chapter 2, I will review the literature on neurodiversity theory, make links to students with diverse needs, and then discuss neurodiversity theory as my chosen theoretical framework. In Chapter 3, I will present and analyze the revised K-12 B.C. curriculum, specifically discussing curriculum, instruction, and assessment to reflect the neurodiversity? I will then focus on science education and a constructivist approach to teaching and learning in science. To conclude, in Chapter 4, I will analyze the intersections and diversions between neurodiversity theory, based on the framework presented and discussed in Chapter 2, and the revised B.C. science 9 curriculum.
Chapter 2: Literature Review on Neurodiversity

In this chapter, I will review the literature on neurodiversity theory and include a discussion on inclusive education. I begin by providing the background and related contexts on special needs and inclusive education. I will then discuss neurodiversity theory as a social model and compare and contrast the theory to the traditional medical model. I will then present neurodiversity theory as a theoretical framework and articulate how this theory is appropriate to my research. To conclude, I discuss the limitations of neurodiversity within the education context and provide a summary of the literature reviewed in the chapter.

The focus on increasing comprehensive testing of learners and the acquired knowledge and understanding has led to the identification of different types of diverse needs, e.g. learning disability, autism spectrum, mental illness. As a result the number of students with various diverse needs in British Columbian high schools continues to rise (BCTF Magazine, 2018). While the population of students with diverse needs increases, methods to address students’ needs can be very prescriptive and normalizing. The continuation of “pull-out/special” programs or streamed classes where teachers provide more attention and support to students with diverse needs, can lead to teachers, perhaps unintentionally, marginalizing these students (Goodley et al., 2017).

In 1986, educational researcher Susan Hart compared two approaches to support teaching which included one that focused on improving the learning of individual students through “pull-out/special” programs where students with special needs were separated from their classmates. The other method identified attempted to adapt curriculum to enhance learning for all students. Hart (1986) eventually argued against the
individual approach due to the segregation of students with learning difficulties and advocated for support teachers and fundamental curriculum reform to enhance the learning of all students (Hart, 1986, p. 26).

Hart’s (1986) recommendation aligns with an inclusive education model where students of all abilities actively engage in effective instruction (Algozzine, Anderson, & Baughan, 2016). The inclusive education model also relates directly to the focus of this paper. Curriculum reform, as Hart argued, is an essential part, and the B.C. Ministry of education recently completed revising the K-12 curriculum.

My research explores whether this curricular reform supports inclusive education. For the purpose of this paper, I define inclusive education as involving: access e.g. removing barriers, providing a variety of learning opportunities, and making individual adaptations as needed to promote learning); participation e.g. promoting engagement and a sense of belonging); and supports e.g. enacting systems-level changes to ensure education (Algozzine, Anderson, & Baughan, 2016).

In addition to providing an inclusive education, it is important to identify attitudes and perspectives as these inform the underlying philosophy of our educational system. As Kauffman, Anastasiou, Badar, Travers, and Wiley (2016) write: “positive change in the educational experiences of students with disabilities is achievable, but not without examining attitudes and philosophical perspectives” (p. 160). Attitude is dependent on whether we view and understand special education through a medical model or social model. The medical model, predominant in B.C. schools. today, states that students have a disability and are therefore at a disadvantage compared to other learners. The medical
model definition locates the problem within the student, suggesting that what requires “fixing” is within the student rather than the system.

In contrast to the medical model, the social model, called neurodiversity, recognizes those with autism, ADHD, etc. as having neurological diversity rather than a deficit. The goal is to promote autism, ADHD, etc. as a positive identity; a normal human variation rather than a pathology. The social model presents autism, ADHD, etc. as involving a brain that works in a different way rather than a problem to be remedied (Seaberg, 2015). In this perspective, problems are located in the system rather than in the individual him/herself. In the following sections, I will discuss neurodiversity as a theoretical framework, identify limitations related to neurodiversity, and finally provide a summary of the main points presented in the literature.

**Neurodiversity as a Theoretical Framework**

Neurodiversity includes a wide variety of neurological diversity related conditions, including autism and ADHD. To illustrate how disability can be perceived, those who self-identify as autistic understand autism as a positive identity which provides *homo sapiens* with behavioral variants (Kapp, Gillespie, Lynch, Sherman, & Hutman, 2013; Masataka, 2016). This definition goes against the medical model of characterizing neurological differences such as autism as a disability to be cured. Placing the medical model’s disability definition in a neurodiversity framework allows researchers and practitioners to go beyond the limitations of deficit-based models. Silberman (2017) warns against “viewing autistic people only in light of their deficits and impairments, while ignoring the special gifts conveyed by their atypical neurologies” (p. 120) and
advocates for a conversation around how to provide practical ways to support the strengths of all students, including those with neurodiversity.

Ravet (2011) discusses the recurring debates around inclusion which highlight the oppositional views of rights-based perspective and needs-based perspective and presents the alternative integrative inclusionist position. The “rights-based” perspective eliminates educational segregation and calls for the inclusion of all children in mainstream schools (Ravet, 2011). The “needs-based” perspective draws attention to the lack of research evidence to support mainstreaming learners. In this perspective attention is given to the distinctive group needs of learners and advocates for the provision of additional supports to meet those needs (Ravet, 2011).

A review of these two perspectives on inclusion reveals the rights-based perspective aligns closely with neurodiversity, which argues for equal treatment of all in an educational system that accepts diversity. Rights-based inclusionists also argue that categories of disability and the labels used to define them are not neutral but social constructions based on assumptions about ‘normality’ and are strongly influenced by socio-historical contexts (Ravet, 2011).

Additional researchers including Welsh (2003) conducted studies informed by a neurodiversity framework and used a strength-based rather than a deficit-based approach to special needs education. The authors found that in the classroom, the student response was positive and there was a decrease in problematic behaviours (Welsh, 2003) and increased class cohesion with higher levels of positive affect and engagement (Quinlan, Swain, Cameron, & Vella-Brodrick, 2015).
Other studies found that complications arose around the use of neurodiversity theory due to the absence of culture from the discussion. Harris in her 2017 article, in response to Mastaka (2016), concluded there was a need to embrace a bio-ecological perspective to the issue of neurodiversity, considering the cultural component of race, cultural perceptions, and religious beliefs.

Tincani, Travers, and Boutot (2010) recognize that autism can be seen through multiple lenses, emphasizing that culture (as well as race) must be brought into the conversation of neurodiversity in order to find successful educational interventions. This literature links to Ravet (2011) who states that categories of disability are social constructions influenced by socio-historical contexts deeply embedded in cultural mindsets (Ravet, 2011). Later on, Chun and Fisher (2014) define autism through three distinct lenses: (1) cultural and linguistic diversity, (2) the medical model, and (3) as a form of neurodiversity. The authors state that all three lenses are interwoven spheres of influence and must be considered together. In sum, the literature concludes that if our construction of what disability means is embedded in cultural mindsets, we must explore those underlying assumptions before we can break through the barriers and come to understand neurodiversity as simply diversity in neurological wiring.

Limitations of Neurodiversity

Neurodiversity presumes competence in all students, and this presumption means “the outsider regards the person labeled as [neurodiverse] as a thinking, feeling person” (Travers & Ayres, 2015, p. 372). Support for neurodiversity involves underlying assumptions of “inclusive education [is] potentially less harmful than segregated
settings,” “contextually relevant instruction [is] less harmful than artificial instruction, and “independence [is] less harmful than dependence” (Travers & Ayres, 2015, p. 371). However, Travers and Ayres (2015) are skeptical about presuming competence without empirical support and state that special education has long been “rife with fad interventions” (p. 372) but an evidence-based movement, e.g. a “reliance on reasoning coupled with responsible skepticism is the best way to ensure access to effective interventions and supports” (Travers & Ayres, 2015, p. 373). The researchers argue: rather than presuming competence, professionals instead may remain agnostic about the person’s ability until sound evidence of current functioning in specified domains gathered from formal assessment results, progress monitoring data, behavior observation data, and etc. have been collected and evaluated (Travers & Ayres, 2015, p. 377).

The literature reveals that the struggle in establishing empirical data related to research on neurodiversity lies in the expansive breadth of special education and the variety of individuals involved. The result is difficulty in collecting, summarizing conclusive data inherent to rigorous research.

Currently, there is a body of research around practical implications on teaching students with neurodiversity (Armstrong 2012; Marschark, Spencer, Adams, Sapere, 2011; Rentenbach, Prislovsky, & Gabriel, 2017). Studies on practical implications emphasize the teacher’s ability to critically reflect on their interactions with students with neurodiversity (Conn, 2017) for the purpose of becoming more effective teachers for those students.
Regarding the instruction of students with neurodiversity, while there is research on the pedagogy of strength-based teaching such as incorporating Universal Design for Learning (Tomlinson & Newman, 2017) to accept neurodiversity in the classroom, the research heavily emphasizes behavioural aspects (social-emotional) rather than differences in cognition (including processing, perceptual, and sensory differences) (Detzer, 2016). In Chapter 4 I will further elaborate on the discussions around limitations of neurodiversity in the educational setting and the relationship with teacher subjectivity and attitude.

**Summary**

In sum, the neurodiversity literature argues that the notion of disability is an idea not a thing. While *impairment* refers to “variations that exist in human behavior, appearance, functioning, sensory acuity, and cognitive processing,” *disability* is “the product of social, political, economic, and cultural practice” (Baglieri et al, 2011, p. 270). My review established that definitions of disabilities have changed over the years and also vary geographically. Changes can arise from updated and new research, new criteria as developed and advocated by the DSM (Diagnostic and Statistical Manual of Mental Disorders), and even methods of government funding. In B.C. there is current discussion about moving towards a “prevalence model”. Yet as the literature points out, this model brings the controversy and fear of having fewer assessments and diagnoses (Bacchus, 2018)).

To further complicate the notion presented in the literature of disability being impacted by social, political, economic, and cultural practices, it is important to identify
the voices behind the dominant discourse around neurodiversity theory. Currently, “the dominant discourse is still framed within the concerns of the global north” (Meekosha & Shuttleworth, 2009, p. 49). The global north includes developed countries and continents such as Canada, the United States, and Europe (Dados & Connell, 2012). As noted in this chapter, the challenge of data collection is due to the expansive breadth of special education and the variety of individuals being discussed, resulting in difficulties collecting and summarizing conclusive data. Neurodiversity theory is a multidisciplinary subject, affecting and taken on board by various applied sciences “such as architecture, design, engineering…medicine and pure science” as well as acts as an interdisciplinary frame that can be incorporated into multiple disciplines, including “women’s studies, black studies and queer studies” (Meekosha & Shuttleworth, 2009, p. 49). Hence, the current dominant voice from the global north shows an underlying hegemony present.

However, the literature shows neurodiversity theory to be relevant to a range of disciplines and open to a variety of perspectives, resulting in the limiting of any one dominant voice from a singular discipline. Although the neurodiversity theory movement can be considered a problem due to the fact it is composed of a heterogeneous collection of individuals and organizations who all state their beliefs in varying ways, those who align themselves with this theory share commonalities as articulated through the following claims:

1. Autism is a natural variation among humans, not a disease or disability,
2. Autism does not need to be (or cannot be) cured,
3. Autism is an integral part of a person’s identity,
4. Autistic persons deserve the same rights and social acceptance as anyone else, and

5. Autism, like many other conditions, is best understood through the social model of disability. (Garen, 2014)

Considering Garen’s summary of commonalities which are shared amongst those who align themselves with neurodiversity, for the purpose of this paper, I amalgamate the five claims above with the following three:

1. Neurodiversity is a fluid and natural variation among humans, not a binary dis-ability

2. Those who are neurodiverse need not be (or cannot be) cured, as it is an integral part of a person’s identity, and

3. Interactions and social settings contribute to the creation of disability

Taken together, these three points encompass all diagnoses of neurological diversities, not just autism. I will employ these three categories as a framework to analyze the B.C. curriculum in Chapter 4. In the next Chapter, I present and discuss the revised B.C curriculum within the contexts of curriculum, instruction, assessment, and science education through a constructivist approach.
Chapter 3: Analysis of the Revised B.C. Curriculum

In this section, I will explore the revised B.C. curriculum through the lens of curriculum, instruction, and assessment. I will then focus on science curriculum within the context of a constructivist approach to education. The purpose of this chapter is to review and discuss the revised B.C. curriculum and make links to the B.C. science curriculum, science education, and the constructivist curriculum. This will then provide a context for Chapter 4, where connections will be made between the revised B.C. science curriculum and neurodiversity theory.

Curriculum: Core Competencies and Big Ideas

The British Columbia (B.C.) Ministry of Education began a curriculum renewal with the elementary years in 2015 and then progressed to the secondary grades. Students who graduated after June 30, 2018 were on the revised B.C. Graduation Program. Prior to the revision, the K-12 B.C. curriculum was enacted through the Integrated Resource Package (I.R.P.) published in 2006. The package included detailed Prescribed Learning Outcomes (P.L.O.s) and extensive checklists of student achievement indicators. The 2006 curriculum P.L.O.s emphasized content knowledge, student goals, and required objectives and achievements.

In comparison to the I.R.P., the recently completed revised B.C. curriculum has a different philosophy which focuses on preparing students for a 21st Century learning in a technology-rich globalized world. The current curriculum is more student-centered and flexible for teachers in terms of what content is mandated to be covered in each subject. The document highlights three core competencies, new to B.C.’s education model. These are considered “soft-skills” or human skills (intellectual, personal, and social skills)
essential for student success in life (B.C.’s New Curriculum, 2018). The three core competencies identified as essential for all learners are:

1. Communication
2. Thinking
3. Personal and social competency

To further mirror the movement away from the P.L.O.s prescribed content knowledge, the revised curriculum is also based on a concept-based competency model of “know-do-understand.” While the 2006 curriculum emphasized the aspect of “knowing” information, the revised document emphasizes the acquisition and ability to demonstrate knowledge of skills and processes. The sheer volume of content students are expected to “know” has lessened, but the depth of understanding of certain “big ideas” has increased. For Science 9, there are only four “big ideas”: “Cells are derived from cells,” “The electron arrangement of atoms impacts their chemical nature,” “Electron current is the flow of electric charge,” and “The biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them” (B.C.’s New Curriculum, 2018). The revised curriculum focuses on the “doing,” where students engage deeply with their studies, leading to the ultimate goal of “understand.” According to the developers of the revised curriculum, the focus on understanding places an increased emphasis on personalized learning in which the instruction and assessment of curriculum can address the diverse needs and interests of all students (B.C.’s New Curriculum, 2018).

The three core competencies as well as the know-do-understand model of big ideas span K-12 courses. This movement towards competencies and away from content
allows more flexibility for both the teacher and student. Hence, the revised curriculum reflects the current philosophy of B.C.’s education system in that it is flexible and individually student-centered (B.C.’s New Curriculum, 2018).

**Instruction: Skill Building and Inquiry**

Based on my review of the literature and conversations with teachers who have been putting the revised B.C. curriculum into practice, there is a consensus that the increased flexibility allows for more methods of instruction. When the curriculum was replete with extensive lists of P.L.O.s, teachers often relied on direct instruction and textbooks in order to cover all mandated content. A comparison of the two curriculum documents reveals the 2006 curriculum is comprised of extensive checklists of P.L.O.s for each content subject area topic. The 2018 curriculum is divided into two columns placed side by side: “content” and “competencies,” with “competencies” taking up more physical document space (B.C. New Curriculum, 2018).

With the revised curriculum’s focus on skills building rather than subject content mastery, teachers are now able to practice instruction methods such as inquiry, project-based learning, and an overall more student-centered approach. An inquiry approach allows teachers to give students more control over their learning. Schwab (1962) first described the concept of different levels of inquiry. This was further developed by Herron in 1971 into three levels of openness for inquiry in science activities. Later on in 1999, Rezba, Auldridge, and Rhea developed a four-level model of inquiry instruction. These four levels are referred to as confirmation, structured, guided and lastly, open. The activities gradually give students more control over their learning, from confirmation...
activities where students are provided the question, procedure, and expected results in advance, to open, where problems, methods, and solutions are completely left to the student (Rezba, Auldridge, & Rhea, 1999). This focus on skills building and inquiry places an emphasis on the process of learning rather than the end result.

**Assessment: For and As Learning**

In both the 2006 and 2018 B.C. curriculum documents, assessment is divided into three categories: (1) assessment of learning; (2) assessment as learning; and (3) assessment for learning. Assessment of learning has traditionally been emphasized in the 2006 B.C. curriculum with a strong focus on assessing whether a student has mastered prescribed content. During assessment of learning, teachers assess student achievement according to learning goals and standards. Assessment as learning involves students in the process. They monitor and document their own progress, create and ask questions, and hone and practice skills. Assessment as learning is based on student self-assessment coupled with teacher feedback. Students then critically reflect on their own learning and make changes based on their reflections. Lastly, assessment for learning is for the teacher, and enables teachers to use information about students’ knowledge, understanding, and skills to inform their own teaching (B.C. Ministry of Education, 2013).

The revised B.C. curriculum has removed the need for standardized provincial exams, which were the traditional method of assessing whether or not students have achieved the mandated PLOs. With the removal of Grades 10-12 provincial exams, the Ministry has demonstrated that assessment of learning is no longer the main form of
assessment. Rather, there is greater emphasis with the revised curriculum on both assessment for learning and assessment as learning. The Ministry states that K-12 curriculum is now a “competency-driven curriculum” where “curriculum, instruction, and assessment are refocused on ‘doing’” (B.C. Ministry of Education, p. 1). In place of provincial exams, the Ministry now includes literacy and numeracy graduation assessments, which are strengths-based assessments and assess skill rather than assessment based on mastery of content knowledge.

Science Education: A Constructivist Curriculum

If we perceive disability as manifest in interactions among social contexts and bodies and minds – all of them unique – our work in practice is primarily to shape learning environments in ways in which all classroom and school members have access to curriculum and learning opportunities (Baglieri et al., 2011, p. 272).

Baglieri et al’s words represent the belief of an inclusive model of education where students of all abilities are able to find success in the mainstream classroom. The authors also reflect the notion of social constructivism, where the knowledge of the group is constructed socially. Constructivism is an “epistemological model of learning” where “the construction of new knowledge in science is strongly influenced by prior knowledge” (Cobern, 1994, p. 51). When thinking through the framework of constructivism, learning implies a change (replacement, addition, or modification) in prior knowledge. It is also imbedded within a context – “the construction of new knowledge takes place at a construction site consisting of existing structures standing on a foundation” (Cobern, 1994, p. 51). A constructivist way of knowing can include
perceptions towards those with diverse abilities, as well as the content being studied, e.g. science. In addition, constructivism also involves a distinct view of the student, where “students are knowing beings who construct knowledge that is personally meaningful” (Cobern, 1994, p. 53).

In science education, the term *scientific literacy* has been used since the late 1950s to describe “a desired familiarity with science on the part of the general public” (DeBoer, 2000, p. 582). In his work, DeBoer reviews the history of science education and highlights nine separate and distinct goals of science education related to the larger goal of scientific literacy. He states that “instead of defining scientific literacy in terms of specifically prescribed learning outcomes, scientific literacy should be conceptualized broadly” (DeBoer, 2000, p. 582). In another article, Bingle and Gaskell (1994) use NASA’s Galileo Mission to Jupiter as the context to contrast the positivist and social constructivist position in terms of their inherent views concerning the nature of scientific knowledge. They conclude that the positivist position relies on constitutive values which are normally inaccessible to ordinary citizens, and the social constructivist position acknowledges the importance of contextual values and is more accessible to citizens. Therefore, “the social-constructivist position is potentially more useful than the positivist for critically examining scientific knowledge” (Bingle & Gaskell, 1994, p. 186).

Although the above literature advocates for developing an open-ended curriculum that acknowledges a constructivist position towards scientific literacy and knowledge were written prior to the 2006 B.C. curriculum, the authors’ positions are now being reflected in the revised B.C. curriculum. In constructivism, a central tenet is that knowledge is primarily built from the ground-up inside the mind of each individual.
learner and not through the more traditional mode of information transfer from teacher to student (B.C. Ministry, 2018). The revised B.C. curriculum provides a glossary of curricular terms, where they define constructivism as:

*Constructivism* views learners as actively constructing their own knowledge and understanding of the world through experience and reflection, rather than passively receiving information. New information is linked to prior knowledge through experiential, inquiry-based, project-based, and other forms of active learning (B.C. Ministry of Education, 2018, p. 2).

This notion of how knowledge is gained by a group of learners will be discussed through the lens of neurodiversity in Chapter 4.

In this chapter, I explored the revised B.C. curriculum through the lens of curriculum, instruction, and assessment. In curriculum, I discussed the curriculum’s emphasis now placed on core competencies, “big ideas” and a “know-do-understand” model. In instruction, I discussed an increased flexibility as expressed by teachers and I discussed an inquiry approach in science education. In assessment, I examined the curriculum’s emphasis on competency and focus on assessment as and for learning, rather than of learning. Lastly, I looked at a constructivist curriculum for science education, reviewing the epistemological belief that knowledge is socially constructed and linking to the revised B.C. curriculum.
Chapter 4: Intersections and Diversions between Neurodiversity and the Curriculum

The curriculum I have selected for analysis in this paper is the revised B.C. Science 9 curriculum. I will focus on the six Curricular Competencies and the following sub points. This analysis will seek to examine whether or not the revised B.C. Curriculum actually provides multiple points of entry for students with diverse abilities. In addition, I seek to examine whether B.C.’s high school science students are taught to embrace a value diversity, including neurodiversity.

The revised curriculum was first implemented at the Grade 9 level during the 2016/2017 school year (September-June) across B.C. I taught this curriculum during the implementation year, which is the reason I chose to examine it for this paper. As I taught this “new” curriculum through the lends of my special education background, I would think about whether or not the content and method of instruction were creating access to those who experience difficulties learning.

Booth (1992) introduces his book, *Curricula for Diversity in Education*, by describing students who have difficulty learning as “unable or unwilling to respond to what they are expected to learn” (Booth, 1992, p.1). He then states that the concern should not be about identifying students with learning difficulties but rather about making curricula appropriate for the diversity of learners (Booth, 1992). This statement reflects my statement in Chapter 1 regarding shifting the problem focus from being about the individual struggling student to the environment where we teach our students.

In addition to the three core competencies mentioned in the previous chapter, there are curricular competencies in the revised B.C. Curriculum specific to each course
and grade level. There are six curricular competencies from Kindergarten through to Grade 12 that mirror the six steps of the scientific method, which are to (1) Make an observation, (2) Ask a question, (3) Form a hypothesis, (4) Test the hypothesis, (5) Analyze the data, and (6) Reproduce and communicate results (Bradford, 2017). The six curricular competencies are: (1) Questioning and predicting, (2) Planning and conducting, (3) Processing and analyzing data and information, (4) Evaluating, (5) Applying and innovating, and (6) Communicating” (B.C. New Curriculum, 2018).

I chose to analyze the curricular competencies rather than content or “big ideas” as my intention was to examine pedagogy and procedural knowledge (skill-based knowledge, or knowledge on how to perform certain tasks) rather than declarative knowledge (content-based, factual knowledge). Also, based on this paper’s theoretical framework of neurodiversity, I found it more relevant to my guiding question to explore the “how” of the curriculum as compared to the “what.” These six competencies are repeated each year for all grade levels with modification in the sub-points only, which suggests to me the curriculum developers’ intent was for students to focus on and improve these skills as they progressed through B.C.’s education system (B.C. New Curriculum, 2018).

I will now address this paper’s guiding question:

What are the intersections and diversions of the revised B.C. Science 9 curriculum and neurodiversity theory?

The Intersections of the B.C. Curriculum and Neurodiversity

The analysis of intersecting the revised B.C. curriculum with neurodiversity theory
will be done through the subcategories formulated at the end of Chapter 2:

1. Neurodiversity is a fluid and natural variation among humans, not a binary dis-ability
2. Those who are neurodiverse need not be (or cannot be) cured, as it is an integral part of a person’s identity, and
3. Interactions and social settings contribute to the creation of disability

Those subcategories of neurodiversity theory will be written in italics, and how the revised curriculum intersects with those subcategories will be analyzed below.

Although in this paper I discuss whether the revised curriculum supports students who are neurodiverse, the context is an inclusive education system with a curriculum for all students. The curriculum is enacted in an inclusive setting with a student body composed of diverse abilities including general education students as well as special education students.

*Neurodiversity is a fluid and natural variation among humans, not a binary [dis]ability.*

Under the core competencies, there are three main categories which include communication, thinking, and personal/social competency. These competencies remain the same from Grades K-12, and essentially educate students about how to live a democratic society as they promote interaction with others and reflection on both interactions with others and also on oneself. B.C.’s curriculum website states that B.C.’s economic and social goals require well-educated citizens who are motivated to participate actively in our democratic institutions (B.C. Ministry, 2018).
In the 21st Century in North America, there is an emphasis placed on collaborative, relational skills (B.C. Ministry, 2018). In public schooling as well as in the greater society, communication, thinking, and personal/social competency are continuously shaped by interactions and if taught well, can encourage ever increasing interactions and understandings of others.

Ideally, this can lead to a greater understanding of others, and the ever-growing social notion of diversity being a spectrum of variation. This can be placed in relation to Detzer’s (2016) study on educators’ experiences and needs regarding effective support of inclusion of students with autism. Participants reported the importance of training beyond the behavioural aspects of autism as well as differences in autistic cognition, including processing and perceptual (sensory) differences (Detzer, 2016). If we wish to embrace diversity, we must understand it instead of seeing a different “other.” Properly educating teachers will then enable and empower teachers to educate their students. This creates a climate that supports embracing diversity, which contributes to inclusive education.

Within the curricular competencies of the revised B.C. science 9 curriculum, emphasis is placed on personal interest. The section on “Questioning and Predicting,” provides ample opportunity for students to formulate personal questions and attention is given to the importance of forming multiple hypotheses on any given topic (B.C. New Curriculum, 2018). This kind of flexibility in student inquiry provides space for all in this learning environment and achieve success. I find the field of science naturally lends itself to a flexible notion of learning and mastery. There is much yet to be discovered, and scientific theory is based on the data available at the time. The beauty of the discipline lies in the wide array of possibilities, empowering learners of all abilities.
Within “Processing and Analyzing Data and Information,” students are taught to seek and analyze patterns in data and identify inconsistencies. This further supports the notion that facts and content are not dichotomous right/wrong answers, but rather fluid. I believe that being taught to identify inconsistencies can also empower a learner as it shows there can be multiple answers to a question rather than a singular correct response.

Another section in curricular competencies called “Evaluating,” focuses on encouraging, students to provide alternative explanations and conclusions (B.C. New Curriculum, 2018). This section further emphasizes the idea there is potential for multiple outcomes and perspectives which contributes to the notion of fluidity. Overall, these intersections contribute to creating an environment where diversity is embraced and opportunity is given to be inclusive.

*Those who are neurodiverse need not be (or cannot be) cured, as it is an integral part of a person’s identity*

The revised curriculum follows a framework of “know-do-understand” with an emphasis on the “doing” which contrasts with the 2006’s curriculum emphasis on “knowing” (B.C. New Curriculum, 2018). I suggest the addition of know-do-understand indicates the revised curriculum encourages depth of understanding rather than breadth of content knowledge. This, and the presence of fewer curricular competencies with more emphasis on “big ideas,” allow for more personalized learning tailored to the interests of each individual learner. This valuing of the personal and the individual respects each student’s unique identity, rather than teaching to learners as one whole group.
In addition, the whole student body may benefit from this focus on the individual learner as noted in a study by Quinlan, Swain, Cameron, and Vella-Brodrick (2015). The researchers conducted a six-session program with 9-12 year old students of diverse abilities. Participants were taught to recognize personal strengths and then practiced strengths-related goal settings. Results showed an increased sense of personal well-being among participants along with greater whole-class cohesion, relatedness, positive affect, and engagement (Quinlan et al., 2015). The study’s methodology and findings resonate with the revised curriculum’s emphasis on assessment as learning, where students are given ample opportunity to self-assess and self-reflect on their learning, as well as set personal strength-based goals. This reflects current practice in special education, where students have an I.E.P. that includes personal strength-based goals that the student is specifically working towards. These goals are derived with the student’s personal input and an emphasis is always put on the fact that it is strength-based and individualized.

The B.C. revised curriculum’s emphasis on classroom assessment rather than content-heavy standardized assessments such as examination creates more space for assessment as learning in the classroom. In assessment as learning, students have the opportunity to conduct self-assessments, peer-assessments, reflections on learning, self-regulation monitoring, etc. By engaging in these individualized assessments, students can critically reflect on their own learning process, with each student learning and progressing at their own pace. In the curricular competency section under “Questioning and Predicting,” the same argument can be made. There is a focus on the individual learner’s interest, and the valuing of multiple hypotheses and outcomes creates a learning
environment where students of diverse abilities can be successful (B.C. New Curriculum, 2018).

*Interactions and social settings contribute to the creation of disability*

If we perceive disability as manifest in interactions among social contexts and bodies and minds – all of them unique – our work in practice is primarily to shape learning environments in ways in which all classroom and school members have access to curriculum and learning opportunities (Baglieri et al., 2011, p. 272).

Socially constructed knowledge can be applied to how students with diverse needs are viewed by society. As students learn to be critical thinkers, they should be made aware that definitions of a disability are rooted in contextual and societal judgment (Goodley et al., 2017). I find this criterion to be arguably the most complex to achieve within a curriculum, and depends greatly on the educator and the type of learning environment created in the classroom. Amongst the section of “Evaluating,” the curriculum encourages students to demonstrate awareness of assumptions, question information given, and identify bias in sources and in personal work (B.C. New Curriculum, 2018). Through discussions of validity, questioning sources, and identifying bias, the educator can facilitate discussions around societal norms and question who delivers the message of there being dichotomies of right/wrong, able/unable, etc. The curriculum does not directly address this criterion, but does provide a platform where insightful discussion can occur. There is a curricular competency point under “Evaluation” that urges students to consider social, ethical, and environmental
implications of findings of others and their own (B.C. New Curriculum, 2018). This opens up the discussion around how norms are constructed by various aspects of society.

Under “Applying and Innovating,” the curriculum encourages students to contribute to care for self, others, community, and world through individual and collaborative approaches. The idea of collaborating to contribute to our world is powerful. This also provides the space and opportunity for students to understand their community and the diversity that exists within it. It promotes an understanding of the other, which can include students with diverse abilities. However, I suggest making contributions must be done through a critical lens because not doing so could be detrimental and further contribute to problems such as creating notions of disability.

Lastly, under “Communicating,” the curriculum provides students with opportunities to express and reflect on a variety of experiences, perspectives, and worldviews through connections with place. The questions that follow the word “place” lead to more critical inquiry, such as “How do the place-based experiences and stories of others affect the ways in which you communicate and collaborate?” (B.C. New Curriculum, 2018). I believe that focusing on questions such as this can foster a more critical mindset in students.

The Diversions of the B.C. Curriculum and Neurodiversity

My review of the revised B.C. curriculum strengthened my belief in the importance of thinking about which voices/stakeholders one sees; do we see voices of students, parents, teachers, businesses, the government, etc.? We must also question whether the curriculum is designed for a smoother flowing democratic society or for
allowing individual diversity to flourish. The critical lens is necessary, but the main problem lies in how the curriculum is enacted in the classroom.

The principal arguments I make in this paper regarding the revised B.C. curriculum through the lens of neurodiversity theory indicate the curriculum is now more flexible and open-ended for the teacher with a focus on a constructivist approach to gaining knowledge. In both cases, teacher attitude and how the teacher decides to apply the curriculum have a large impact. John Robison (2015), an author and person who classifies himself as neurodiverse, discusses the frustrations he feels as well as sees in others regarding his autism. He states there is frustration in disappointing others by not being able to abide by the norms of society as easily as others seem to do. He states that those who have autism and engage in destructive behavior is possibly due to frustration, abuse, and sensory issues. Robison’s key point, however, is while the issues around sensory require further research, frustration and abuse can be changed by a societal shift in attitude (Robison, 2015).

Students spend much of their impressionable, belief-forming years in classrooms with teachers facilitating the attitude and tone of the class. I suggest, the responsibility of allowing the curriculum to shift to become more aligned with neurodiversity theory remains with the teacher. Providing professional development for teachers that includes learning about specific frameworks of teaching and guidelines for support teaching, such as models of team teaching, curriculum planning that employs Universal Design for Learning (“designing an educational environment that can accommodate a wide range of learning differences” (Armstrong, 2012, p.18)), etc. will inform teachers on how and in what ways they can support students who are neurodiverse.
As I reflect on the reason why I pursued this study, the specialized “core” classes designed for students who struggle in mainstream classes continue to exist at my school today. Even though the revised curriculum is in full implementation, there are still students who cannot be included in mainstream classes and are being treated differently. I believe that the flexibility and acceptance of diversity in the revised curriculum is providing the impetus for education in B.C. to go forward in the direction of full inclusion. Yet, there is still much work to do.

Conclusion

Through my analysis of the revised B.C. curriculum using the lens of neurodiversity theory, I conclude a number of commonalities exist between the two. The flexible, skills-based, individualized curriculum allows students of diverse abilities to experience individual success. Nevertheless, the curriculum enacted in the classroom (what Ted Aoki calls “the lived curriculum”) is through the practicing teacher, who is a human being carrying their own attitudes, judgements, and biases. Those variations may have an equal impact as curriculum on whether or not a student who is a neurodiverse can succeed in a classroom.

Looking at the world through my biologist lens, I see ecosystems around the world comprised of various species, and I conclude there is no ecological setting that does not benefit from diversity. This is also true regarding diversity amongst humans, including neurodiversity. I believe diversity provides resilience; a system without diversity has no resilience against change and growth.
In B.C.’s Labour Market Outlook (2018), it is projected that by 2028, only 3% of jobs will be for those without a high school Dogwood diploma. Students who struggle in school need educators to move away from thinking students with a disability do less than their peers and to question the validity of what I label the “victimizing” term disabled. My wish is for educators to move towards what I call an asset-based pedagogy and create a classroom culture that promotes and makes it possible for every student to feel academic success.

**Researcher Reflections**

Throughout the process of pursuing this study and completing this paper, I have delved deeper into notions of disability and the complexities around the impact the label has on students. It is both encouraging to see the possibility of intersections between the revised B.C. curriculum and neurodiversity theory and disheartening to know that it depends so greatly on teacher attitude. It seems to ultimately come down to individual teacher attitude and perspective to really change the environment for the student. As with many things, then, I believe that having conversations and opening up possible new perspectives will increase the chances of creating environments that allow all learners to thrive.
References


