The Use of Assistive Technology in the School-Based Instruction for Children with Specific Learning Disorders: The Case of Cameroon and Canada.

By

© Blessed Mbu Molua Yonge

A thesis submitted to the School of Graduate Studies

In partial fulfillment of the requirements for the degree of

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Approved:

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Dean of the School of Graduate Studies

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Dedication

This work is dedicated to my beloved mother, Dr. Mrs. Yonge Grace Eneke Mbu

Abstract

Children with specific learning disorders (SLD) face numerous challenges in their education. Various forms of support and accommodations are needed to help them. One of such support is the use of assistive technology (AT). AT helps them to carry out certain tasks which they could not do before. It is against this background that this study was aimed at critically exploring and comparing the use of AT in the school-based instruction of children with SLD in Cameroon and Canada. The qualitative comparative case study design was used for the study. The two geopolitical locales were selected using critical case purposive sampling. Twenty-four documents were selected and analyzed with ten emergent themes using document analysis leading to a comparison of both countries in terms of the use of AT. The results of the study show that AT is available for use in both countries with unmet needs and that there exist laws, policies, and legislations in both countries to control access and provision of AT. However, some differences were found in terms of the availability of assistive devices programs and funding sources amongst others. Recommendations were given such as increase of funding in provision of AT and constantly revising and improving the implementation of the existing laws, policies, and legislations for AT access and provision. Implications for practice and further research were also proposed.

Keywords: Assistive Technology, Comparative Study, Inclusive Classroom, Specific Learning Disorder.

General Summary

Children with specific learning disorders (SLD) encounter many problems in their education and so they need support and accommodations to help them succeed. One support to help them is the use of assistive technology (AT). AT helps them to do what they could not do easily. So, this study is to critically explore and compare the use of AT in the school-based instruction of children with SLD in Cameroon and Canada. The study used the qualitative comparative case study design with a critical case purposive sampling to select the two countries. Twenty-four documents were selected and analyzed with ten themes using document analysis method to compare both countries. The results of this study show that AT is available for use in schools although not for every child and that both countries have laws, policies, and legislations that govern how AT is used in schools. Some differences were found in terms of the availability of assistive devices programs and funding sources amongst others. Recommendations and implications for practice and further research are proposed.

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviation	Explanation
APA	American Psychiatric Association
AT	Assistive Technology
CAST	Centre for Applied Special Technology
CBCHS	Cameroon Baptist Convention Health Service
CLA	Canadian Library Association
CMEC	Council of Ministers of Education, Canada.
COVID-19	Coronavirus Disease 2019
CRPD	Convention on the Rights of Persons with Disabilities
DSM-5	Diagnostic and Statistical Manual of Mental Disorders Fifth Edition
ETIT	Engagement and Technology Integration Theory
FEAT	Functional Evaluation for Assistive Technology
GATE	Global Cooperation on Assistive Technology
ICED	International Centre for Evidence in Disability
ICF	International Classification of Functioning Disability and Health
IEP	Individualized Educational Plan
LD	Learning Disabilities
MINAS	Ministry of Social Affairs
MPT	Matching Person and Technology
NGO	Non-Governmental Organization
PWD	People with Disabilities
RAT	Replacement, Amplification and Transformation
SAMR	Substitution, Augmentation, Modification and Redefinition.
SDG	Sustainable Development Goal
SEEPD	Socio-Economic Empowerment of Persons with Disabilities
SETT	Student, Environments, Tasks and Tools
SLD	Specific Learning Disorders
TPACK	Technological Pedagogical Content Knowledge
UDL	Universal Design for Learning
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNO	United Nations Organization
WCAG	Web Content Accessibility Guidelines
WHO	World Health Organization

List of Appendices

Chapter 1: Introduction

1.0 Introduction

Technology is integral to many inclusive strategies used to enhance children's learning (Chambers, 2020), with a wide range of technological resources and educational experiences available to improve the inclusion opportunities for children with disabilities (Fachal et al., 2019; Olugu, 2020). Over one billion people need one or more assistive technology (AT) with a projected two billion in need by 2050; only 5-15 % of AT needs are currently met due to high costs of AT, limited availability, lack of awareness, lack of suitably trained personnel, lack of governance, inadequate financing of AT and inadequate assessments (Rohwerder, 2018; World Health Organization [WHO], 2018). Many countries have enacted laws, policies, and legislations that give children with specific learning disorders (SLD) the right to be educated with their peers in inclusive classrooms (Alasim, 2019). Technology is often viewed as a promising intervention for diverse students to: "gain access to the curriculum, foster engagement, and improve educational outcomes" (Edyburn et al., 2017, p. 357). Two common approaches associated with technology for diverse students are AT and universal design for learning (UDL) (Edyburn et al., 2017).

The use of technologies in various educational contexts will contribute to the development of learning environments, new teaching methodologies and strategies, taking into account the heterogeneity of the children and working from the basis of inclusive education (Hersh, 2017). In an inclusive classroom, the teacher has to teach all the children with and without SLD. In this case, the teacher has to be competent in using technology (AT) in the teaching and learning process. This introductory chapter presents the background of the study, statement of the problem, significance of the study, purpose of the study, research questions,

background contexts, theoretical background, conceptualization of the study, operational definition of terms and the organization of the thesis.

1.1 Background of the Study

According to the United Nations International Children's Emergency Fund [UNICEF] (2021), of the nearly 240 million children who currently have disabilities, only 1 in 10 are estimated to have access to AT that they need. There are many types of assistive products, so, to assist in prioritization, the World Health Organization has published a list of the fifty most needed assistive products (WHO, 2017). The World Health Organization has also provided guidance on the necessary steps in assistive product provision, including selecting the appropriate products through screening and assessment, fitting or providing the product, training the person on how to use the product, and follow up for review and maintenance (WHO, 2017). Children with SLD have the right to affordable AT as the United Nations Convention of the Rights of People with Disabilities (CRPD) (articles 4, 20, 26 and 32), commits States to "ensuring access to assistive technology at an affordable cost and to foster international cooperation in order to achieve this goal" (WHO, 2016, p. 1). AT products maintain or improve an individual's functioning and independence thereby promoting their well-being (WHO, 2018).

Furthermore, the World Health Organization is coordinating the Global Cooperation on Assistive Technology (GATE) which exists to improve access to high-quality affordable AT for everyone, everywhere (WHO, 2018). The GATE initiative is developing four practical tools to support countries to address the challenges of policy, products, provision, and personnel which they face (WHO, 2018) and is also actively working towards access to AT for all (Desmond et al., 2018). With ATscale, the global partnership for assistive technology, UNICEF is contributing to the ambitious goal of providing 500 million people with disabilities with assistive

technology by 2030 (UNICEF, 2021). UNICEF is introducing 24 new assistive products, plus

accessories, into the supply catalogue, including child-sized active wheelchairs and hearing aids

(UNICEF, 2021). The introduction of the new products to the supply catalogue will help

UNICEF and partners to reduce the number of children with SLD needing AT. Through global

tenders, UNICEF and WHO have been able to negotiate low-cost prices which will ensure these

highly technical and specialized pieces of equipment can be quickly and easily ordered by field

teams, partners, and governments (UNICEF, 2021).

Formerly, it was believed that AT was used only by children with SLD in special

education centres but with the current technological innovations, teachers and children all use

AT to support the teaching and learning process following the universal design for learning

(UDL) perspective. Some AT are used to provide children with SLD with educational

opportunities while bringing out the cognitive potential in them, while some are used to enable

curricula and teachers to achieve their objectives while the children are active participants in the

learning process (Chukwuemeka & Samila, 2019). Thus, the extent of the use of AT in the

classroom is determined by the attitude, experience and quality of teachers (Onivehu et al., 2017).

Also, the provision of AT should include the design, production and supply of products and

delivery of resources.

According to WHO (2015a), making AT "available, accessible, affordable, adaptable,

acceptable" and of appropriate quality requires efficient use of the often limited resources which

are often interrelated and include people, materials, manufacturing methods and service delivery

systems (p. 24).Van and Tönsing (2015) argued that the availability of financial resources and

formalized support are only two of the factors to consider when providing appropriate AT to

people with disabilities including children with SLD. Advancement in today's technology helps

to support children with SLD and the place of AT cannot be over-emphasized in the education of children with SLD as AT helps even the teachers teaching children with SLD in carrying out some classroom functions like assessment, lesson planning, lesson presentation, record keeping and classroom management (Liman et al., 2015). Lessons designed to meet UDL specifications often incorporate easily with AT.

1.2 Statement of the Problem

In the era of inclusive education, all children with SLD need to be educated in the same neighborhood school as their peers with the same curriculum. Inclusive classrooms are made up of diverse learners coming from varying social status, age, gender and having various learning needs. Children with SLD who are educated in inclusive classrooms often experience difficulties in the classroom settings in comparison to their peers (Ahmed, 2018; Wood et al., 2017) as they experience challenges to learning like visual, hearing, mathematics, language, reading, writing and communication. In order to support them, an individualized education plan (IEP) or a similar document is typically developed for each child by an IEP team to provide internal supports, modifications, accommodations and interventions within the classroom and one of such support is the use of AT. Many of the challenges faced by children with SLD in the classroom can be reduced to a minimal level through the "effective use of AT as AT can aid children with SLD in bypassing their learning challenges" (Ahmed, 2018, p.130).

Research has demonstrated that AT can greatly enhance and improve the academic achievement of children with SLD and they would excel in reading, writing, mathematics and language in an inclusive classroom (Abu Alghayth, 2020; Liman et al., 2015). AT has great potential in providing access for all children (including children with SLD) to the general education curriculum (Ahmed, 2015) and effective integration of AT into the inclusive

4

classroom would give children with SLD multiple means to complete their work with greater independence in performing tasks that they were formerly unable to accomplish or could accomplish with great difficulty (Ahmed, 2015).

There is little research on comparative studies on the use of AT in inclusive schools between countries worldwide as many studies (Abu Alghayth, 2020; Ahmed, 2018; Liman et al., 2015) present only single jurisdiction research on AT. Therefore, in this comparative study, I would like to critically explore and compare the use of AT in the school-based instruction of children with SLD in Cameroon and Canada. AT is considered one of the key elements to advancing inclusion of children with SLD together with additional supports in the inclusive classroom (Liman et al., 2015; WHO, 2015a). Thus, all children with SLD would typically benefit from available and affordable AT. This study is also inspired by my own interests in supporting AT use in teaching children with SLD and the reality that empirical comparative research on AT in inclusive classrooms are limited.

1.3 Purpose of the Study

The purpose of this comparative qualitative case study is to critically explore and compare the use of assistive technology in the school-based instruction for children with SLD in Cameroon and Canada.

1.4 Research Questions

My central research question is: What are the similarities and differences in the use of AT in the school-based instruction for children with SLD in Cameroon and Canada? The specific research questions are:

1) What are the assistive technologies that are used for school-based instruction for children with SLD?

2) What laws, policies, and legislations have been enacted to control AT access and provision for children with SLD?

1.5 Significance of the Study

This study may help policymakers to know and solve issues or even inform government policies especially those related to the education of children with SLD in schools in Cameroon and Canada in the area of the access and provision of AT. The study could be useful in informing the various Ministries of Education in both countries about the availability and use of AT in instruction for children with SLD. This study will help teachers to enable children with SLD to actively participate in activities in the inclusive classroom as they will be motivated to learn using the AT to be at the same level with their non-disabled peers.

Suggestions on how teachers could integrate technology (AT) and diversify instruction given to children with SLD in schools are provided in this study. The results of this study will help to identify some ways through which the governments and other stakeholders in AT provision could make high quality, low cost and affordable AT available for children with SLD in order to improve on their academic performance in schools. Finally, the study will add to the body of knowledge on the teaching and learning of children with SLD in inclusive schools in Cameroon and Canada forming a basis for further research in international comparative studies in AT between countries.

1.6 Background Contexts: Cameroon and Canada

This section offers a brief description of the countries under study such as each country's demography, history, government, structures, and educational system amongst others.

1.6.1 Cameroon: General Background

Cameroon is officially called the Republic of Cameroon (République du Cameroun) with the shape of an elongated triangle acting as a bridge between West and Central Africa on the

hinge of Africa with two official languages namely English and French got from the colonial masters (Britain and France) (Ngwa & Mekolle, 2020). It shares boundary with Nigeria in the West, Chad and Central African Republic to the East and Central African Republic, the Republic of Congo and Gabon in the South (Delancey & Benneh, 2020). Cameroon is a developing country in the Global South with its capital in Yaoundé (World Population Review, 2020). Cameroon lies between latitudes 1° and 13° N and longitudes 8° and 17° E (Ngwa & Mekolle, 2020). Cameroon has a total surface area of 475,442 square kilometers with a population of 26,545,864 inhabitants (World Population Review, 2020) with more than 286 local languages and many of them are not written (Lewis et al., 2014).

Cameroon has a president and a prime minister to run the government. Cameroon is a bilingual country and a unitary decentralized state divided into ten regions---eight French-speaking and two English-speaking (Ngwa & Mekolle, 2020)---and is a multi-party republic with two legislative houses (the Senate and National Assembly) (Delaney & Benneh, 2020). Cameroon is often called Africa in miniature because it exhibits all major climates and vegetations of the continent (Njung et al., 2003). Cameroon is also a member of many organizations like United Nations Organization (UNO), African Union, Economic Community of Central African States, Francophonie, and British Commonwealth amongst others (Ngwa & Mekolle, 2020). Figure 1 shows the map of Cameroon.

Figure 1

Map of Cameroon

1.6.2 Cameroon: Educational Background

In Cameroon, there are two main sub-systems of education practiced all over the country which are the English and French sub-systems of education with each of these systems having its institutions, structures, curricula and examination requirements (Ngalim, 2014; Tatangang, 2011). Each subsystem has its primary, secondary and higher education controlled by various ministries namely the Ministries of Basic, Secondary and Higher Education respectively (Nsolly &

Charlotte, 2016). There is a legal framework for a compulsory free primary education through the public system (Tchombe et al., 2014). Once a student completes secondary and high school, they apply to enter either a professional school or a university, or be employed or self-employed, amongst others.

1.6.3 Cameroon: Children with Disabilities and Assistive Technology policy

Cameroon has signed legislations and policy documents with international organizations like the United Nations convention on the right of people with disabilities (CRPD) which deals with people with disabilities on the 1st October 2008 (United Nations [UN], 2015) and is also working on the development of the Sustainable Development Goals (SDGs) especially SDG4. SDG4 deals with ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all children (UN, 2015). The UN 2030 agenda for sustainable development calls for countries to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (UN, 2015). The number of people with disabilities in Cameroon is unclear as no complete survey has been done but the World Disability Report suggest 15% worldwide disability prevalence rate of disabilities by international assessment (WHO, 2011). So, there should be currently approximately 3.9 million people with disabilities in Cameroon.

The education of children with disabilities in the 1800 to 1974 was carried out by parents, families and religious groups and later in special education centres which were created in Yaounde, Bamenda and Buea with very few children with disabilities attending the schools (Arrah & Swain, 2014). The government created a ministry to take care of persons with disabilities called the Cameroon Ministry of Social Affairs (MINAS) by Decree No. 75/467 of 28th June 1975 (Cameroon, 1975). A department of national solidarity was also created. This department works together with the ministries of education to promote the use of special

9

education facilities in the education of children with disabilities in inclusive schools (Cameroon, 1975). Another decree was signed in 1977 (Decree No. 77/495 of 7 December 1977) outlining the official categorization of disabilities in Cameroon and making provision for social welfare services and specialized institutions to support persons with disabilities in Cameroon (Cameroon, 1977; MINAS, 2005).

Thus, the persons with disabilities were given the right accommodations and other supports when they enrolled in the school making those special schools very expensive for a child from a low socio-economic background with a disability (Shey, 2018). At that time, there was no policy or law yet to define disability or to inform more around AT services, devices and provision (Shey, 2018). Disability was conceptualized in Cameroon using the international classification of functioning disability and health (ICF) (Shey, 2018). To better understand disability, the ICF framework was used and this classification is based on the biopsychosocial model which is a synthesis of the medical model and the social model (WHO, 2001). The medical model considers a disability as a person's feature requiring a medical intervention or treatment while for the social model, it is a problem socially created needing political responses (WHO, 2001). Disability in Cameroon was viewed like how the ICF saw disability which is as the intersection of impairment of body structure or function; limitations in engagement in activities, and /or participation in social life (WHO, 2001).

The first legislation for Cameroon on disability was *Law No. 83 / 013 of the 21st July 1983* on the protection of persons with disabilities (Cameroon, 1984) and its enabling *Decree No. 90 / 1516 of 26th November 1990* laying down the conditions for implementation (Cameroon, 1990). According to the 1983 law, children with disabilities were expected to be educated in normal schools and centres. These two documents formed the policy towards the education of

persons with disabilities in Cameroon at that time. Article 3 of the 1983 law gave three major provisions for children with disabilities which were: either integration of children in ordinary schools or admission in special classes or admission into specialized institutions (Cameroon, 1984). As a follow-up, another law was passed in 1990 enforcing the 1983 law (Cameroon, 1990). This legislation contained provisions for various grants and supports for special education students amongst others. There were many other laws introduced by the Ministries concerned with children with disabilities to enforce the 1983 law on disability.

As of 2003, only 10 institutions existed in Cameroon that served the needs of persons with disabilities; out of the ten, only two were government institutions (Arrah & Swain, 2014). Furthermore, another law was enacted by the President on the protection and promotion of persons with disabilities which was *Law No. 2010/002 of 13th April 2010* (Cameroon, 2010a). This 2010 law relating to education of people with disabilities stated that the education of persons with disabilities shall be subsidized with the acquisition of teaching aids to be used in their training by the state (Cameroon, 2010a). Also, persons with disabilities were now granted access to education and vocational training including provision for their financial need, material and pedagogic support, persons with sensory impairment like blind, deaf, partially sighted and partially hearing loss were considered persons with special needs who required AT devices to enhance their learning in a neighborhood school (Cameroon, 2010a). But a critical look at the special education facilities like self-contained classrooms, new centres, resource rooms and specialized equipment (AT) found out that such facilities were lacking in most inclusive schools (Tohnain & Tamajong, 2014) due to high costs. The cost for an AT is usually borne by municipalities or person with the disability or partial/full help from non-governmental organizations (NGOs) to subsidize the cost of the AT (Disability & Rehabilitation Team, 2002).

In 2018, the text of application (document to grant its application) for the 2010 disability

law on the protection of persons with disabilities in Cameroon came into effect by decree No.

2018/5233/PM of 26th July 2018 (Cameroon, 2018). As defined by the Cameroon's constitution

of 1996, the 2010 disability law and its text of application of 26th July 2018, the state offers

protection and support in health, social welfare and educational services to people with different

categories of special needs in Cameroon (Cameroon, 1996, 2010a, 2018). Few private

organizations give support to children with disabilities like NGOs and their foreign partners

(Socio-Economic Empowerment of Persons with Disabilities [SEEPD], 2011; Cameroon Baptist

Convention Health Service [CBCHS], 2016; Shey, 2018). For example, the SEEPD programme

of the CBCHS which has strategic partnership with the Liliane Foundation has since 2009 been

helping to make education inclusive for children with SLD in Bamenda, North West Region of

Cameroon in 17 pilot government schools (CBCHS, 2016). SEEPD (2011) also urges the

government to ensure all children with disabilities have equal access to education in any

neighborhood government school not special schools. Thus, if children with disabilities are

placed at the centre of their instruction and services are provided to facilitate their learning with

AT, they could perform like normal children. Cameroon operates a national strategy to help all

the children with disabilities with enacted laws on persons living with disabilities. The creation

of the Ministry of Social Affairs to handle the affairs of children with disabilities working in

synergy with the various Ministries of Education to increase inclusive education and promote the

access to AT needed in their education is a welcome initiative.

The United Nation's Educational, Scientific and Cultural Organization (UNESCO), 1995

argued that there is no administrative structure in place in Cameroon to deal with issues of

children with disabilities. All these legislations and policies on the education of children with

disabilities lacked reinforcement to help the children with disabilities especially those with learning disabilities (UNESCO, 1995). With the advent of inclusive education, the government has provided some necessary accommodations, supports, products and services needed for children with disabilities but much still needs to be done as awareness of and access to rehabilitation services and AT is low with 5% actually receiving AT services and devices (International Centre for Evidence in Disability [ICED], 2014). Most schools do not have the AT needed by the students (Eboutane, 2010; Tani & Nformi, 2016) but only a few denominational and lay-private schools have managed to accommodate a very limited number of students with mild to moderate SLD in inclusive settings with basic resources (Eboutane, 2010; SEEPD, 2011; Tani & Nformi, 2016).

Cameroon has not ratified the CRPD convention and so its obligation to provide AT to all the Cameroonian children in need is low (5%) and still unmet needs for AT due to many factors such as high costs of AT devices and services, lack of government funding, lack of training for teachers and children in using AT in the classrooms, lack of resources amongst others (ICED, 2014). There are some policies and laws in place but their implementation is slow without effective follow-up (Tukov, 2008) as children with SLD in Cameroon are neither registered nor categorized as having a disability (UNESCO, 1995). Thus, the government should continue to provide funding and production of low cost high quality AT devices for all children with SLD to enable them to continue their education and live independently (WHO, 2018). There should also be a follow-up committee to oversee that all the children with SLD are catered for in their neighbourhood schools in all parts of the nation and not only children with mobility, visual or auditory impairment (Shey, 2018; Tukov, 2008). Teachers should be trained on ways to integrate technology (AT) into the teaching and learning process.

1.6.4 Canada: General Background

Canada is the second-largest country in the world from the Global North (World Population Review, 2020), a developed country with its capital city in Ottawa within the province of Ontario. Canada stretches across 9,984,670 square kilometers of land from the Atlantic to the Pacific Ocean, on the Northern half of North America with a population of 38,008,005 inhabitants (Statistics Canada, 2020). It is composed of 10 provinces and 3 territories (Statistics Canada, 2019) making 13 jurisdictions as can be seen in Figure 2. Canada is the native land of many Indigenous people with a long history of immigration and continues to have a large scale of global immigrants (Statistics Canada, 2019) with its provincial nominee programs. It is one of the most ethnically diverse and multicultural nation in the world with two official languages namely English and French (Statistics Canada, 2019). Canada is a bilingual country and supports religious pluralism- even-in some school systems-even though it is formally a secular nation (Statistics Canada, 2019). The year 2021 marks 154 years, since Canada's confederation was obtained on July 1, 1867 (Dowding & Patrick, 2014). Today, Canada is governed by the federal system of parliamentary democracy and a constitutional monarch (Dowding & Patrick, 2014). Canada has a multi-party system with all Canadians citizens eligible to vote as from 18 years old or older.

Figure 2

Map of Canada

1.6.5 Canada: Educational Background

Education in Canada is both in English and French like in Cameroon. The Canadian

educational system is arguably the most decentralized among industrialized democracies with

Canadian provinces closely resembling independent countries rather than dependent provinces

(Lykins & Heyneman, 2008). The education of children in Canada is slowly morphing towards

one continuum of planning and development, from the early years through to high school

graduation (Philpott et al., 2017). Canada has no central ministry or department of education;

rather each jurisdiction has its own ministry of education in charge of its educational needs even

though the funds come from the federal, provincial and local levels (Lykins & Heyneman, 2008).

15

Education in Canada, while influenced by federal and municipal policies, remains, for the most part, a provincial or territorial jurisdiction (Philpott et al., 2017). Additionally, the federal government is also responsible for the education of Indigenous peoples (Council of Ministers of Education, Canada [CMEC], 2008; Canadian Education Association, 2007). Despite the lack of a national ministry or department of education, coordination between the federal government and the jurisdictions is made possible through the Council of Ministers of Education, Canada (CMEC, 2008). CMEC sets priorities for nationwide cooperation in education.

1.6.6 Canada: Children with Disabilities and Assistive Technology policy

Though definitions of disability vary within Canadian legislation and policy, the Government of Canada (2014) advises the use of the definition set out by the CRPD (UN, 2006). According to the CRPD, disability is viewed as dynamic and "results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others" (UN, 2006, p. 1). So, people with disabilities include those who have long-term physical, mental, intellectual, or sensory impairments, which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others (UN, 2006).

In Canada, jurisdictions control the delivery of educational services and establish their own systems of services and supports for people with disability are provided by the federal, provincial and municipal governments and also by not-for-profit organizations (McColl et al., 2017). In Canada, with respect to education, the federal government mandates that children must receive education and that public education must be accessible to all children (Statistics Canada, 2008a). Based on these guidelines, each jurisdiction is left to implement its own system. To date, as exemplified in the Canadian context, variations and inequities in access to AT are evident; for

example, the development of legislation, policies, and programs has not kept up with the increasing use of AT (Durocher et al., 2019).

Canada ratified the CRPD in 2010 (Councils of Canadians with Disabilities, 2010) and its Optional Protocol in 2018 (United Nations Treaty Collection, 2019). Thus, Canada has the obligation to make AT accessible and available to all (Government of Canada, 2014), meaning access to AT, AT services, and information has to be affordable and physically available to all Canadians (WHO, 2017). The 2017 response from the committee on the rights of persons with disabilities on the initial report from Canada recognized the barriers related to accessibility and, in particular, the lack of information communication for persons with disabilities (article 9); however, the response from the committee did not outline a specific mechanism for any jurisdiction to take action on improving equitable access to assistive technologies (UN, 2017). Moreover, Canada does not have federal legislation that enables universal access to AT (Schreiber et al., 2017). Where AT is referenced in Canadian legislation, definitions of AT, AT services and what is mandated in relation to AT are vague, leading to a lack of consistency and accountability in the provision of AT (Schreiber et al., 2017).

On a national level, legislation relating to the protection of the rights of people with disabilities can be found in the Canadian Charter of Rights and Freedoms (Canadian Library Association [CLA], 2016). Within provinces and territories, the rights of people with disabilities are protected under various human rights legislation (CLA, 2016). Legislative advances, like the Quebec's Act to Secure Handicapped Persons in the Exercise of their Rights (2004), Accessibility for Ontarians with Disabilities Act (2005), Accessibility for Manitobans Act (2013), Nova Scotia's Accessibility Act (2017), Accessible Canada Act (2019), Accessible British Columbia Act (2021) (Doyle, 2021) and the new legislation-Newfoundland and Labrador's

Accessibility Act (2021) (Newfoundland and Labrador Ministry of Children, Seniors and Social Development, 2021) seek to systematically remove barriers to access for people with disabilities in both the public and private spheres including the education of children with SLD. These legislations are focused on advancing accessibility and inclusion throughout the provinces.

The Government of Canada issued the first report on the Convention of the Rights of Persons with Disabilities, which outlines federal, provincial, and territorial policies and programs (including the provision of assistive technologies) to protect rights and support full participation of persons with disabilities (Government of Canada, 2014). Furthermore, information on AT services in education is clearly identified in some Canadian provinces and territories (CLA, 2016). Without federal legislation, funding or national standards addressing AT entitlement for students with disabilities in Canada, the implementation of AT in education can be inconsistent. As a result, there are extensive differences in how AT is funded and provided across Canada, as well as in the eligibility criteria for accessing publicly funded programs, and the costs that parents of students with SLD have to cover themselves to obtain or use AT and related services (Durocher et al., 2017). Current federal provisions apply to only a small number of Canadians and are unavailable to the rest of the population with similar needs, who have to rely on highly variable provincial and territorial AT programs, thus leading to inequities in access (Durocher et al., 2017).

From the above analysis of the current access to AT, it shows that Canada does not adequately fulfill its obligation to the CRPD due to restricted and underfunded AT programs across Canada. Innovations in AT enhance opportunities for many individuals to participate in society and the need for AT will continue to increase due to rises in the number of people who have disabilities (McMaster Health Forum, 2017). Despite the increased number of mainstream

AT and AT innovations available in Canada , current Canadian policies have not responded to AT progress and growing user demand leading to inconsistencies in which some cases results in unmet needs (Mattison et al., 2017, 2020; McMaster, 2017). The expense, lack of federal legislation and policies, and a lack of concrete and comprehensive definitions of AT, creates barriers to access and further amplifies inequalities (Durocher et al., 2017; Schreiber et al., 2017). Canada needs to align AT programs and services with the societal values of Canadians to improve AT access through policy implementation (Durocher et al., 2019) and using a comprehensive approach for addressing the problem (Mattison et al., 2017).

1.7 Theoretical Background

Three theoretical frameworks will be discussed which will be used to show how teachers can integrate technology into their classrooms during lesson delivery. Technology integration in education refers to the meaningful use of technology to achieve learning goals (Kimmons, 2018). Also, integration of technology in the classroom means the use of technology in the classroom to improve children's learning experience (Hammrich, n.d.). Thus, teachers have to create AT-infused lesson plans and the following theoretical frameworks can assist them in the process of integration of technologies in their classrooms such as: Mishra and Koehler's Technological Pedagogical Content Knowledge model (2006), Puentedura's Substitution, Augmentation, Modification and Redefinition model (2006) and Gunuc's Engagement and Technology Integration Theory (2017).

1.7.1 **Mishra and Koehler's Technological Pedagogical Content Knowledge model (2006)**

Mishra and Koehler's technological pedagogical content knowledge (TPACK) (2006) model is a framework for understanding how teachers incorporate content and pedagogical knowledge during technology implementation in the classroom. TPACK stands for

Technological Pedagogical Content Knowledge which refers to a representation of the complex interactions among the types of essential knowledge for successful teaching with technology (Mishra & Koehler, 2006). This model combined the content knowledge, pedagogic knowledge and technological knowledge as well as their intersection to produce a successful level of technology implementation. Any effective implementation of technology in the classroom requires acknowledgement of the dynamic, transactional relationship among content, pedagogy and the incoming technology all within the unique contexts of different schools, classrooms, and cultures (Mishra & Koehler, 2006). The innovative, transformational TPACK model (Mishra & Koehler, 2006) represents the knowledge that teachers need to know to effectively integrate technology into the teaching and learning process. Furthermore, the TPACK model represents the conceptualization of teachers' technology integration knowledge in a coherent framework and consists of seven components: technology knowledge, pedagogical knowledge, content knowledge, technological pedagogical knowledge, technological content knowledge, pedagogical content knowledge and technological, pedagogical content knowledge (Mishra & Koehler, 2006).

According to the TPACK framework, Mishra and Koehler (2006) posit that a teacher depends on three domains of knowledge for effective integration of technology (AT) into teaching and learning which are content knowledge, pedagogical knowledge and technological knowledge. Mishra and Koehler (2006) defined content knowledge as knowledge about the actual subject matter that is to be learned or taught. Mishra and Koehler observed that a teacher must know and understand the subject that he/she teaches, including knowledge of central facts, concepts, theories, and procedures if the teacher is to integrate technology into teaching and learning process. Mishra and Koehler (2006) defined pedagogic knowledge as the deep

knowledge about the processes or methods of teaching and learning (e.g. values and aims, classroom management, lesson planning, and student evaluation). They argued that a teacher with deep pedagogic knowledge is likely to integrate technology in his or her teaching considering how children can best learn in a given classroom context and nature of learners.

Mishra and Koehler (2006) defined technological knowledge as knowledge about standard technologies, such as books, chalkboard, and more advanced technologies such as the Internet and digital video and how to operate those technologies. They asserted that a teacher with technological knowledge has good knowledge of operating systems and computer hardware, the ability to use standard sets of software tools (e.g. word processors, spreadsheets, browsers, e-mail) and how to install and remove peripheral devices, install and remove programmes, create and archive documents, and how to use various AT to teach children with SLD among others. Mishra and Koehler (2006) also observed that the interaction of these three knowledge domains (content knowledge, pedagogical knowledge and technological knowledge) gives rise to three paired knowledge domains namely pedagogical content knowledge (PCK) , technological content knowledge (TCK) and technological pedagogical knowledge (TPK).

Mishra and Koehler (2006) also defined PCK as the knowledge of pedagogy that is applicable to the teaching of specific content such as knowing what teaching approaches fit content, and likewise, knowing how elements of the content can be arranged for better teaching. Mishra and Koehler (2006) further defined TCK as the knowledge about the manner in which technology and content are reciprocally related. They further asserted that a teacher needs to know not just the subject matter he/she teaches but also the manner in which the subject matter can be changed by the application of technology. Mishra and Koehler (2006) defined TPK as knowledge of the existence, components and capabilities of various technologies as they are used

in teaching and learning settings and conversely, knowing how teaching might change as the result of using particular technology. So, TPACK is the intersection of all the three bodies of knowledge and the authors argued that the development of TPACK by teachers is central for effective teaching with technology because understanding TPACK is above and beyond understanding technology, content, or pedagogy in isolation, but rather how these forms of knowledge interact with each other.

The TPACK framework is most recognized by the TPACK diagram—three interlocking circles (TK, CK, and PK) with an outer dotted circle (contexts) (Mishra, 2019). This image has evolved and there have been attempts to revise, reimagine, and redesign the existing model. Mishra (2019) renamed the outer dotted circle from "contexts" to "Contextual Knowledge" (i.e., the teacher's knowledge of the context). This "Contextual Knowledge" (XK) would be everything from teachers' awareness of available technologies, to knowledge of the school, district, state, or national policies they operate within (Mishra, 2019). Mishra argued that there is an added benefit to this move to Contextual Knowledge and this makes the outer circle another knowledge domain that teachers must possess to integrate technology in teaching. This model, in turn, implies that contextual knowledge is something that we (as teacher educators) can act on, change, and help teachers develop (Mishra, 2019). Just as we seek to develop teachers' knowledge types and overall TPACK, it becomes clear that we ought to work towards increasing their contextual knowledge as well (Mishra, 2019). Contextual knowledge becomes of critical importance to teachers, and a lack of it limits the effectiveness and success of any TPACK development, or a teacher's attempts at technology integration (Mishra, 2019). The addition of XK to the TPACK diagram has another benefit which is to highlight the organizational and situational constraints that teachers work within (Mishra, 2019). According to Mishra (2019), the

success of teachers' efforts depends not as much on their knowledge of technology, pedagogy, content, and its overlaps, but rather on their knowledge of the context and this allows us to go beyond seeing teachers as designers of curriculum within their classrooms but rather as *intrapreneurs*—knowing how their organization functions, and how levers of power and influence can effect sustainable change. This is XK—Contextual Knowledge.

The TPACK theoretical framework was deemed necessary for this study because TPACK is essential to enabling teachers to implement AT in their teaching and the learning of children with SLD in their classrooms. TPACK helps teachers to select and use hardware and software, identify the affordances (or lack thereof) of specific features and use these AT devices in pedagogically appropriate and effective ways to ensure all the children in the classroom benefits using the UDL perspective not just only children with SLD. The experiences of teachers are crucial for shaping their AT integration attitudes, skills and habits in order to use the kinds of learning opportunities that will develop the TPACK needed to optimally serve the children with SLD. TPACK is a useful technology integration framework that identifies four types of knowledge (technological, pedagogical, content and contextual knowledge) that teachers need to combine for successful integration of AT in the classroom. So, if teachers follow this framework effectively, we would be sure that AT would be well implemented in their lessons to the benefit of children with SLD in the classroom. So, TPACK provides more of a map for teachers to help them in understanding how to integrate technology into the classroom effectively.

TPACK shows us that there is a relationship between technology, content, context and pedagogy, and the purposeful blending of them is very necessary. Also, the mere presence of digital tools (AT) in a lesson will not improve the learning of children with SLD. Technology (AT) use must be planned to benefit from its potential. TPACK also paves the way for teachers

to engage children in collaborative learning and to develop the concept of digital pedagogies. Digital pedagogies may be the concept that can encompass all: teaching approach, children's attitudes and desired learning outcomes. TPACK helps teachers in technology integration in the classroom and also for collaborations and co-planning and the pedagogic and instructional strategy component is key in finding what works to get children to learn. It is important for the teacher to be completely up to date and knowledgeable with the curriculum and the components of TPACK to effectively incorporate it into their lessons. Finally, TPACK provides teachers with a chance to develop professional development and competence as well as it is useful for lessons to be more interactive and student-centered and provides support in covering 21st century skills.

1.7.2 Puentedura's Substitution, Augmentation, Modification and Redefinition model (2006)

The Substitution, Augmentation, Modification, and Redefinition (SAMR) model of technological integration relates directly to children's learning in the classroom. The SAMR model is a framework created by Dr. Ruben Puentedura in 2006 that categorizes four different degrees of classroom technology integration which are Substitution, Augmentation, Modification, and Redefinition and can be used to classify and evaluate learning activities (Puentedura, 2006). Learning activities that fall within the substitution and augmentation classifications are said to enhance learning, while learning activities that fall within the modification and redefinition classifications are said to transform learning (Puentedura, 2013). The purpose of the SAMR model is to assist teachers with determining the level of technology integration in the learning environment. The teacher must first decide to incorporate technology into the planned curriculum, and then determine if the technology is enhancing or transforming the learning (Puentedura, 2013). The goal is to introduce technology tools that redefine the learning space, which is accomplished by replacing traditional teaching methods with alternate learning environments. SAMR is a model which supports and enables teachers to design, develop, and

24

infuse digital learning experiences that utilize technology. For example, in Substitution (Technology acts as a direct substitute with no functional cane), Augmentation (Technology acts as a direct substitute with functional improvement), Modification (Technology allows for significant task redesign) and Redefinition (Technology allows for the creation of new tasks previously inconceivable). The Enhancement levels involve Substitution and Augmentation while the Transformation levels deal with Modification and Redefinition.

The SAMR model was linked to Bloom's taxonomy by Puentedura in 2014. By linking Bloom's taxonomy to SAMR, tasks will be created with specific objectives linked to curricula that deeply embedded technology and are enhanced by its use rather than using technology for the sake of it. The goal for the teacher is to construct a simple SAMR ladder that is coupled to Bloom's Revised Taxonomy, that is, as the task moves from lower to upper levels of the taxonomy, it also moves from lower to upper levels of SAMR (Puentedura, 2014). The two Enhancement levels of SAMR (Substitution, Augmentation) are associated with the three lower levels of Bloom (Remember, Understand, Apply), while the two Transformation levels of SAMR (Modification, Redefinition) are associated with the upper levels of Bloom (Analyze, Evaluate, Create) (Puentedura, 2014).

The SAMR model was deemed necessary for this study because it helped teachers to infuse technology (AT) into their teaching and assess how they incorporated the said technology into their teaching practices using the four levels (Substitution, Augmentation, Modification, and Redefinition). Teachers in the substitution and augmentation phase will often use technology to accomplish traditional tasks. At the next two levels, (modification and redefinition), teachers change the tasks and the tasks extend from the confines of the classroom. Teachers should always consider whether the technology will improve the learning process, and amplify the

learning experience when using the SAMR model. With this model, teachers are encouraged to reflect on their own technology use and make transformations in the implementation of technology into their practice to take teaching and learning to the next level using the SAMR model.

The SAMR model is designed to help teachers get a clear idea and assess their current level of curriculum technology integration, what their goals are for the integration, and the specific outcomes the technology can provide. Using the SAMR model, teachers have the opportunity to take small steps towards their evolution of technology integration. They can start small by doing what they already do, and incorporate tools when comfortable, incorporating elements, modifications, and eventually redefining their tasks (Puentedura, 2014). Using SAMR as a guide in their technology-infused lessons can help teachers develop learners who are fluent in 21st century skills which include the 4Cs: communication, collaboration, critical thinking, and creativity. The SAMR model can also help teachers reflect on their technological infusion and use technology to teach these critical learning and innovation skills to all children in their classrooms including children with SLD.

1.7.3 Gunuc's Engagement and Technology Integration Theory (2017)

The Engagement and Technology Integration Theory (ETIT) was developed by Selim Gunuc in 2017. In this theory, technology integration is discussed at the micro level. In-class and out-of-class teaching and learning activities have been designed. Both the teacher and the student form the basis of the theory. The basic idea of the theory is to explain that student engagement and technology integration are related to student success and effective learning. Gunuc expresses student engagement as follows: "Student engagement is the quality and quantity of the student's psychological, cognitive, affective, behavioural responses and energies to participate in the learning process, academic and social activities inside/outside the classroom to achieve

successful learning outcomes" (2017, p. 22). In this theory, first of all, it is necessary to emphasize the feelings of value and belonging of students. After these steps are fulfilled, activities should be done in order to create cognitive, affective and behavioural commitment. These should be accomplished by providing practical technology integration. As a result, feelings of commitment will be combined with technology integration, and effective learning outcomes will be created. This process can be used continuously in educational environments as a cycle.

This engagement and technology integration theory was deemed necessary for this study because when teachers plan AT-infused lessons with meaningful, authentic, challenging yet achievable tasks, and well-prepared educational contents which ensure children's engagement; this will increase the cognitive, affective and behavioural responses of the children and positively affect their academic achievement. So, it is imperative that teachers must be trained on ways to integrate AT in their classrooms for the school-based instruction of children with SLD. With this theory, teachers in their planning of lessons, have to make sure that they choose enriching and challenging activities to sustain the children's attention to become active in the teaching and learning process. Thus, teachers are to use various strategies to promote children's engagement such as by giving stimulating activities to generate interest of the children in tasks, providing them with a sense of ownership and choice, using learner-centred teaching methods, providing activities which provoke curiosity, communicating realistic goals and objectives with prompt constructive feedback, organizing group work, establishing good teacher-child and child-child relationships, and interactions in the classroom amongst others. When the children are engaged with the challenging learning activities/tasks through the interactions with others and the step by step introduction of technology, the technology used would help to facilitate children's

engagement in ways not possible using any other means. This technology integration would then lead to successful children outcomes since effective learning has taken place.

1.7.4 The Unified framework of Technology Integration

These three models of technology integration (TPACK, ETIT and SAMR) were combined by the researcher to form a unified framework of technology integration as shown in Figure 3.

Figure 3

Unified framework of Technology Integration

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┌─────────────────────────┐
│ TPACK MODEL             │
│                         │        ┌──────────────┐      ┌──────────────┐      ┌──────────────┐
│ Technological knowledge │        │ ETIT         │      │ SAMR         │      │              │
│ Content knowledge       │        │ MODEL        │      │ MODEL        │      │ Competent    │
│ Pedagogical knowledge   │        │              │      │              │      │ Users of     │
│ Technological           │───────▶│ Affective    │─────▶│ Substitution │─────▶│ AT           │
│ pedagogical knowledge   │        │ Behavioural  │      │ Augmentation │      │              │
│ Pedagogical content     │        │ Cognitive    │      │ Modification │      │              │
│ knowledge               │        │              │      │ Redefinition │      │              │
│ Technological content   │        │              │      │              │      │              │
│ knowledge               │        └──────────────┘      └──────────────┘      └──────────────┘
│ Contextual knowledge    │
└─────────────────────────┘
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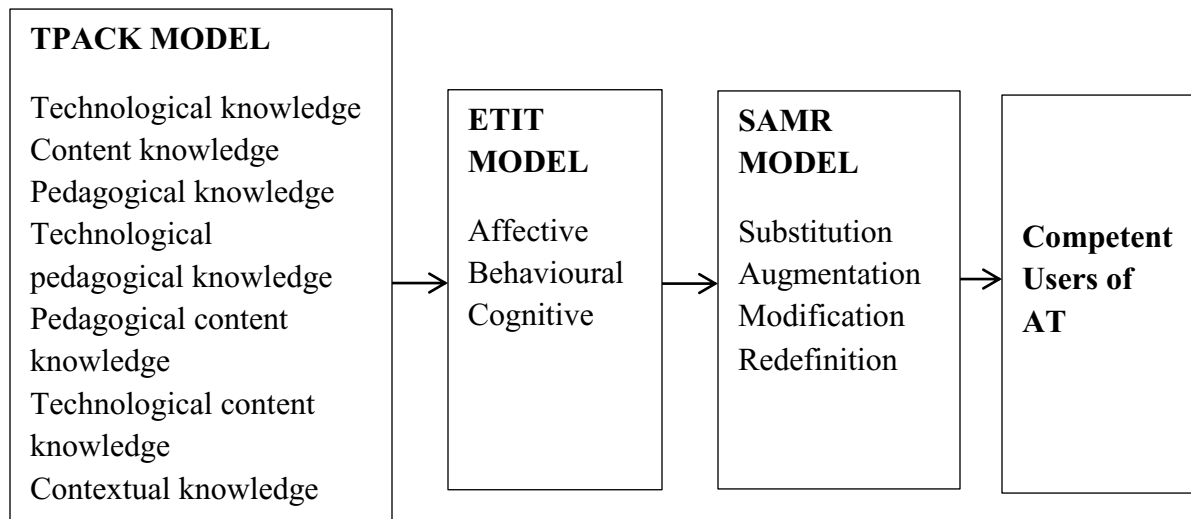
Figure 3 shows the unified framework of technology integration formulated by the researcher whereby the teachers need to acquire all the kinds of knowledge for the successful integration of technology (AT) in the teaching and learning process of children with SLD using the TPACK model as TPACK is the heart of good teaching and describes the kinds of knowledge needed by a teacher for effective technology integration (Zhang & Tang, 2021). When the teacher is well grounded with sound technological pedagogical content knowledge (Mishra & Koehler, 2006; Mishra, 2019) to use in the school-based instruction of children with SLD using the various types of AT, after the careful selection of the suitable AT for each lesson, provision

is made for the children to be engaged in the lesson using the ETIT model by ensuring their affective or emotional, behavioural, and cognitive engagements (Gunuc, 2017). The teacher should have a learner-centered focus and uses various measures to ensure that the children with SLD are fully engaged in the lesson. In any lesson, the teacher introduces the technology gradually following the SAMR model through the substitution, augmentation, modification and redefinition steps (Puentedura, 2006). With all the knowledge that the teacher possesses on technological instruction, the teacher directly substitutes or replaces the traditional tools/methods with technology (AT) with significant enhancements to the children's learning experiences. The teacher also verifies if the technology increases or augments the children's productivity and potential in some way. Further, instead of only replacement or enhancement, the teacher actually change or modify the lesson's design and its learning outcome using the selected AT for the lesson (Puentedura, 2006).

Lastly, the teacher creates a novel experience for the children with SLD with the use of the AT to transform or redefine a traditional learning task in a way that would not have been possible without AT leading to competent children with SLD (users) using AT to bypass their area of difficulty when learning in the classroom. Thus, this unified framework of technology integration informs teachers on how to systematically introduce any subject matter with a suitable AT while considering the UDL perspective to ensure effective learning for all children including children with SLD with a learner-centered focus. AT will help to bridge the gap between the child with and without SLD in an inclusive classroom laying emphasis on the fact that the teachers and the children need to be well trained and proficient in the use of AT in the classroom. So, with the successful integration of AT in a lesson, children with SLD would excel academically.

1.8 Conceptual Background

In this section, I would discuss some main concepts in the study such as Assistive

Technology, Specific Learning Disorders, and their related sub-concepts.

1.8.1 Assistive Technology

There are many definitions for assistive technology. Assistive technology is defined as a

device and a service that support students with SLD in accessing the curriculum (Dell et al.,

2017). AT also refers to "personalized technology-based assistive solutions that are used by

individual learners for learning activities and participation in the classroom and other school

activities and participation in the classroom and other school activities, including interaction with

peers" (Hoogerwerf et al., 2020, p. 110). Assistive technology is an umbrella term covering the

systems and services related to the delivery of assistive products and services (WHO, 2016). The

term *assistive service* means any service that directly assists an individual with a disability or use

of an AT device (WHO, 2016). So, AT as a service include support that directly assists a child

with a disability in the evaluation, selection, purchase, and use of an AT device (Dell et al.,

2017). *Assistive products* may also include devices, equipment, instruments, and software,

designed and produced especially, or available generally on the market (Diane et al., 2021). Also,

AT services may include assessment, product fitting, training, troubleshooting and maintenance

support, which are critical to the safe and effective use of products (Diane et al., 2021). As AT

works to support the inclusion of children with SLD into inclusive settings, Chambers (2020)

contends that AT "consists of a range of devices and services which work to support children to

augment their existing abilities, compensate for or bypass the difficulties they may experience"

(p. 7).

Furthermore, the term *AT provision* entails "everything that is needed to assure that a

person with disability who might benefit from AT actually obtains it and obtains the most

appropriate AT solution needed" (de Witte, 2018, p. 467). The combination of products and

strategies to meet a child's needs is what is called an *AT solution* (de Witte, 2018, p. 467). AT

might involve mainstream information and communication technology devices and devices

specifically to be used by children with SLD that can be used independently or with some help

(Hoogerwerf et al., 2020). Accordingly, AT is understood as a complex system requiring policies

and markets that can deliver end-to-end products and services (MacLachlan et al., 2018b). The

application of systems thinking within the global AT community has identified five strategic

drivers which are critical to realizing the full potential of AT for global citizens (WHO, 2020).

Termed the "5 Ps" and comprising people (that is, AT users and their social networks), policy,

products, personnel, and provision, these form the basis of strategic actions by the WHO Global

Access to AT team (WHO, 2020). Additional, situational factors of "procurement, place, pace,

promotion, and partnership" have been hypothesized as other critical factors influencing AT

outcomes (MacLachlan & Scherer, 2018).

AT is paid for in a variety of ways in Canada and internationally, including through

public funding, third-party insurance, charity, out-of-pocket payment, or a combination of these

methods (Schreiber et al., 2017). Publicly funded AT programs tend to vary widely in terms of

their structure, eligibility criteria, and assistive devices funded (Schreiber et al., 2017). Also,

non-governmental organizations and their foreign partners help to provide support for people

with disabilities including AT devices and services (Zuurmond et al., 2019). Most people

generally think AT compels purchasing expensive hardware or software specially designed to

meet a particular child's precise needs, and that requires extensive training to use them (Koch,

2017). However, there are AT components built into the operating systems of various mobile

devices, Microsoft and Mac/Apple computers, laptops, and tablets that do not require additional

software or hardware other than what comes installed in them (Android, 2020; Apple, 2020; Microsoft, 2020). So, when the AT is finally provided for the children with disabilities (including children with SLD), it has great impact in supporting their educational needs (Al-Dababneh & Al-Zboon, 2020) and its importance is such that Tamakloe and Agbenyega (2017, p. 32) stated that "Assistive technology is the way of the future for all sorts of children with disabilities".

1.8.2 Types of Assistive Technology

AT can be classified as low-tech, mid-tech and high-tech devices (Chambers, 2019; Dell et al., 2017). No-tech or low-tech AT consists of devices and tools that assist children with SLD but does not need extensive training or high cost to acquire (Chambers, 2020). For example, pencil grips, graphics organizers, adapted paper and highlighted pens, clipboards; color overlay/filter, velcro under desk for sensors, sticky notes to reduce texts, slant board, handheld magnifiers, large print text, paper and pen, calculators and digital clocks. Also, mid-tech AT devices are moderate in their pricing and may include " GoTalk[TM], digital recording devices, talking calculators, electronic visual timers, audio books and tablets" (Chambers, 2020, p. 4). Furthermore, high-tech AT devices are difficult to get as they are very expensive (Conderman, 2015). Some examples of high-tech devices are eye-gaze systems, head pointers, environmental controls, powered wheel chairs with navigation software and room controls, speech-to-text and text-to-speech software and complicated systems, computers, iPads/iPods, communication software or device, talking word processor, screen reader software, word prediction, literacy software, tactile graphics, Read&Write Gold [TM], Microsoft OneNote, Kurzweil 3000, Dragon Naturally Speaking, Siri ®, WordQ[TM], talking calculators, Co:Writer®, LiveScribe[TM] Smart Pens, Global positioning system, mind mapping, Google and Mobile Technology (Chambers, 2020; Taylor et al., 2020).

Some AT has been specifically developed for functional use while others, particularly emergent technologies, can be adapted for, or used in an assistive capacity (Chambers, 2020). As technology is advancing rapidly, mainstream technology is being developed to include all children in schools, thus making the need for separate assistive devices and tools less necessary (Ismaili & Ibrahimi, 2017). Some examples of emerging technologies are "Virtual Reality, Augmented Reality and Artificial Intelligence" (Chambers, 2020, p. 7; Taylor et al., 2020, p. 7) but care should be taken for their effective integration into pedagogic practices of the classroom or they might not have great impact on the learning in a classroom (Magana, 2019). Virtual reality, augmented reality and artificial intelligence are mainstream technologies in the public sector already but due to high costs, they are not widely used in schools (Taylor et al., 2020) but these technologies allow opportunities for safe and effective learning when used (Viner et al., 2022).

In addition to learning, AT is a tool for communication, social interaction and physical access to resources (Koch, 2017). AT mediates challenges children encounter such as reading, writing, and spelling by providing access for information and customizing display features (such as font, font size, highlighting, spacing, speeds, and page displays) (Dawson et al., 2019). In selecting the appropriate AT device for a child with SLD, the individualized education plan (IEP) team should consider an appropriate match for the child's needs as a child's IEP documents the decisions made about most aspects of the educational programme of a child with SLD (Conderman, 2015).

1.8.3 Models for Assistive Technology Selection

To assist in the selection of specific AT matching a child's needs, some common models and frameworks are available to the IEP team such as the SETT (Student, Environments, Tasks and Tools) framework (Zabala, 2005); the Functional Evaluation for Assistive Technology

(FEAT) by Raskind and Bryant (2002); the Matching Person and Technology (MPT) model (Scherer et al., 2007) and the R.A.T. (Replacement, Amplification and Transformation) framework (Hughes et al., 2006) to increase critical decision making concerning the integration of technology into the classroom.

The SETT framework is used for matching AT to a child with SLD. The SETT Framework is a four-part model intended to promote collaborative decision-making in all phases of assistive technology service design and delivery from consideration through implementation and evaluation of effectiveness (Zabala, 2005). SETT is an acronym for Student, Environments, Tasks and Tools. The SETT Framework is a tool that helps teams gather and organize information that can be used to guide collaborative decisions about services that foster the educational success of students with disabilities. Originally developed to support assistive technology selection and use in educational settings, the principles of the SETT Framework have been used to guide decisions about a much broader range of educational services, and also, with minor adjustments, have been successfully used in non-educational environments and service plans. Furthermore, the SETT Framework is based on the premise that in order to develop an appropriate system of Tools (supports, devices, services, strategies, accommodations, modifications, etc.) teams must first develop a shared understanding of the student, the customary environments in which the student spends time, and the tasks that are required for the student to be able to do or learn to do to be an active participant in the teaching/learning processes that lead to educational success. When the needs, abilities, and interests of the Student, the details of the Environments, and the specific Tasks required of students in those environments are fully explored, teams are able to consider what needs to be included in a

system of tools that is Student-centered, Environmentally useful, and Task-focused (Zabala, 2005).

Another model to select a specific AT for a child is the Matching Person and Technology (MPT) model by Scherer et al. (2007). The MPT model and its instruments have been the most cited in the international literature and used to verify the predisposition to use AT during prescription and delivery (Alves et al., 2017; Braccialli, 2017). It is a collaborative approach in which the AT user and the prescriber will work together to select the most appropriate technology for the use of a particular person. The model highlights three areas that influence the use of AT: (a) environmental factors; (b) the needs, personal and psychosocial characteristics and preferences of consumers; (c) and whether the functions and characteristics of the desirable AT is appropriate, whether it can be used without discomfort or stress, cost, ease of use and transportability (Scherer, 2018). In order to assist in the evaluation process, based on the MPT model, a series of standardized instruments was developed that, through an individualized and user-centered approach, proposes to make the most appropriate match between the individual and technology (Scherer & Federici, 2015).

The next model to match the child with the right AT is the Functional Evaluation for Assistive Technology (FEAT). Raskind and Bryant (2002), in their FEAT, provided a means for collecting data on specific tasks that occur in a variety of settings. The FEAT scale includes forms for identifying the most appropriate and potentially effective AT device for a student considering four major components: the individual, tasks, context, and device. By having each teacher complete the scale, the AT specialist can identify tasks and expectations in the various contexts or settings and determine the student's strengths and weaknesses. Collectively, this

information is analyzed in relation to the features of various AT devices to determine potentially a good student-technology match.

Lastly, the R.A.T framework of selection of AT for a child with SLD was developed by Hughes (1998) as a self-assessment for teachers to increase critical technological decision (Hughes et al., 2006). The model leads you to understand if digital technology is functioning as replacement, amplification, or transformation in educational practice (Hughes et al., 2006). For example, Technology as Replacement – technology used to replace and, in no way, changed established instructional practices, student learning processes, or content goals; Technology as Amplification – technology increases efficiency, effectiveness, and productivity of instructional practices, student learning processes, or content goals and Technology as Transformation – technology reinvents aspects of instruction, learning, or curriculum in new and original ways (Hughes et al., 2006; Hughes, 2017). To assess a technology's contribution, it is good to consider an instance of technology use and assess it systematically in terms of three broad themes: instructional methods, student learning processes, and curriculum goals with each of these three themes further articulated by identifying more specific dimensions of each (Hughes et al., 2006; Hughes, 2017). However, when the selected AT doesn't suit the child for whatever reason, it is likely to be abandoned and there should be constant assessment of AT devices to ensure sustainability and thus promote enhanced inclusion of the child in the inclusive school (Rowlands, 2015).

1.8.4 Specific Learning Disorders

The Diagnostic and Statistical Manual of Mental Disorders Fifth edition (DSM-5) considers specific learning disorders (SLD) to be a type of neurodevelopmental disorder that impedes the ability to learn or use specific academic skills (e.g., reading, writing, or arithmetic), which are the foundation for other academic learning (American Psychiatric Association [APA],

2013). The DSM-5 estimates the prevalence rate of SLD to fall between 5 and 15% among

school-age children (APA, 2013) with early signs of learning difficulties appearing in the

preschool years. SLD is understood to be a cross-cultural and chronic condition that typically

persists into adulthood, albeit with cultural differences and developmental changes in the way the

learning difficulties manifest (APA, 2013). The term learning disabilities (LD) is called different

names in different countries but in this study, LD will be used interchangeably with SLD.

According to DSM-5, the diagnosis of a student with SLD includes the following

symptoms as explained by APA (2013):

1. Persistent difficulties in reading, writing, arithmetic, or mathematical reasoning skills

during formal years of schooling. Symptoms may include inaccurate or slow and effortful

reading, poor written expression that lacks clarity, difficulties remembering number facts,

or inaccurate mathematical reasoning.

2. Current academic skills must be well below the average range of scores in culturally

and linguistically appropriate tests of reading, writing, or mathematics. Accordingly, a

person who is dyslexic must read with great effort and not in the same manner as those

who are typical readers.

3. Learning difficulties begin during the school-age years.

4. The individual's difficulties must not be better explained by developmental,

neurological, and sensory (vision or hearing), or motor disorders and must significantly

interfere with academic achievement, occupational performance, or activities of daily

living. (p. 10)

The DSM-5 diagnostic criteria for SLD reflect two major changes, each of which

necessitated other changes: one overarching category of SLD with 'specifiers' to characterize the

specific manifestations of learning difficulties at the time of assessment in three major academic

domains, namely reading, writing, mathematics and elimination of the IQ-achievement

discrepancy requirement and its replacement with four criteria (A – D), all of which must be met

(Tannock, 2014). They are:

> Criterion A refers to the key characteristics of SLD (at least one of six symptoms of
>
> learning difficulties that have persisted for at least 6 months despite the provision of extra
>
> help or targeted instruction). Criterion B refers to measurement of those characteristics
>
> (the affected academic skills are substantially and quantifiably below those expected for
>
> ages and cause impairment in academic, occupational, or everyday activities, as
>
> confirmed by individually administered standardized achievement measures and
>
> comprehensive clinical assessment). Criterion C refers to age at onset of problems
>
> (during the school-age years, although may not fully manifest until young adulthood in
>
> some individuals), and Criterion D specifies which disorders (Intellectual Disabilities,
>
> uncorrected auditory or visual acuity problems, other mental or neurological disorders) or
>
> adverse conditions (psychosocial adversity, lack of proficiency in the language of
>
> instruction, inadequate instruction) must be ruled out before a diagnosis of SLD can be
>
> confirmed. (Tannock, 2014, p.10)

1.8.5 Types of Specific Learning Disorders

SLD may vary in severity such as mild, moderate or severe (APA, 2013). There are four

types of SLD which are: *SLD with impairment in reading* (Dyslexia)-manifested by difficulties

with word reading accuracy, reading rate or fluency, and/or reading comprehension; *SLD with*

impairment in written expression (Dysgraphia)-manifested by difficulties with spelling accuracy,

grammar and punctuation accuracy, and/or clarity or organization of written expression; *SLD*

with impairment in mathematics (Dyscalculia)-manifested by difficulties with number sense,

memorization of arithmetic facts, accurate or fluent calculation, and/or accurate math reasoning and *Non-verbal learning disorders* which affect all learning not related to language as this involve motor difficulties, visual-spatial difficulties, and various social deficits (APA, 2013).

DSM-5 does not limit the diagnosis of SLD to reading, math, or written expression but more generally describes problems in achieved academic skills with the potential for specification of the more traditional areas (APA, 2013). A diagnosis is made based on a clinical review of a child's history, teacher reports and academic records, and responses to interventions (APA, 2013). Difficulties must be persistent, scores must be well below the range on appropriate measures, and the problems cannot be better explained by other disorders (APA, 2013). Thus, a significant interference in achievement, occupation, or activities of daily living must be present (APA, 2013).

1.8.6 Specific Learning Disorders and Universal Design for Learning

Universal design for learning (UDL) aims to provide access to learning for all students proactively that is lessons that are designed to meet the needs of all students not only students with SLD or instead of producing "one-size-fits-all" lessons that are then modified for different abilities (Rose & Meyer, 2002). UDL framework is one of the planning tools that includes the consideration of technology to cater for the needs of all children (Centre for Applied Special Technology [CAST], 2020) not only children with SLD in the classroom. According to CAST (2020), there are three main guidelines that teachers must take into account which consists of: multiple means of engagement, multiple means of representation and multiple means of action and expression.

So, planning lessons using UDL principles then works to ensure that all children (with or without SLD) in an inclusive classroom are included in the lesson plan and technology use helps the teacher to achieve the objectives of the lesson alongside helping the child with SLD to bypass

the difficulty and the child without a SLD to gain from the AT. As Edyburn (2020) adds, the

right AT augments and compensate for a SLD. Benton-Borghi (2015) also recognized that UDL

which guides content presentation and student interaction, is only one piece of the puzzle, so she

combined it with TPACK to present a model for how teachers " represent the content...engage

the students...assess the students' understanding of content from multiple perspectives" (p. 296).

So, UDL helps all diverse children in education, including children with SLD in all their

categories of disorders, to be assisted to learn through the provision of AT (Ndlovu, 2021).

1.8.7 Assistive Technology and Universal Design for Learning

Rogers-Shaw et al. (2017) described UDL as "a framework for the teaching-learning

transaction that conceptualized knowledge through learner-centered foci emphasizing

accessibility, collaboration and community" (p. 20). The goal of UDL is to "enhance learning for

all students" (Quaglia, 2015, p. 1). AT and UDL complement each other such that advances in

one leads to advances in the other (Rose et al., 2005). Employing AT is one way to prevent

discrimination in education as UDL aims to provide access to learning for all students

proactively (Rose & Meyer, 2002). According to Rose and Meyer (2002), the UDL framework's

principles emphasize three aspects of pedagogy which are the means of representing information,

expression of knowledge, and engagement in learning. A review of existing AT interventions

conducted by Perlmutter et al. (2017), determined AT supports can result in positive outcomes

for adolescents and adults with learning disabilities, but supports must be customized for each

individual. While AT focuses on the individual, UDL focuses on the curriculum and reducing

barriers (Perlmutter et al., 2017).

Rogers-Shaw et al. (2017) argued that leveraging technology in universal design could

lead to greater inclusivity; however, they caution the simple application of technology is

insufficient to achieve this greater inclusivity if educators do not adopt the principles of UDL to

more effectively meet the needs of all learners. In order for UDL to be effective, AT is required for everyone. If, however, technologies were employed as instructional technologies in support of UDL rather than AT to ameliorate for barriers, they would become tools available to all children and therefore promote an inclusive learning environment (White & Robertson, 2015). The UDL framework could allow that teachers use emergent technologies (such as augmented and virtual reality) to teach all the children in an inclusive classroom. As UDL becomes more pervasive and learning becomes more inclusive, the number of children living in Cameroon and Canada whose disability negatively impacts their education should be inversely correlated to the increase in inclusive curriculum design.

1.8.8 International Assistive Technology Policy Context

Assistive technology was first introduced in international policies through the Standard Rules on the Equalization of Opportunities for Persons with Disabilities (UN, 1994) and was further entrenched into international policies with the advent of the Convention on the Rights of Persons with Disabilities (CRPD) (UN, 2007). The Incheon Strategy, *Make the right real*, is an example of a strategy that includes the provision of assistive technology as an important means to achieve disability-inclusive development (United Nations Economic and Social Commission for Asia and the Pacific, 2012). The World Report on Disability has highlighted the need for action to improve the provision of assistive technology globally (World Health Organization & World Bank, 2011), and this has been reiterated in the Global Disability Action Plan 2014–2021 (WHO, 2015b).

The Standard Rules, one of the four rules on preconditions for equal participation requires States to ensure the development and supply of assistive products to assist people with disabilities to increase their level of independence and to exercise their rights (Maclachlan et al., 2018a). States are also to ensure the provision of assistive products according to the need.

Besides supporting the development, production, distribution and servicing of AT, States are to support the dissemination of knowledge about AT, provide access to AT which includes financial accessibility and provision of AT free of charge or at such a low cost that people requiring AT or their families can afford them (Maclachlan et al., 2018a). Moreover, States should consider requirements of girls and boys concerning the design, durability and age-appropriateness of assistive products (UN, 1994). The CRPD is an international treaty that aims to promote, protect and ensure the rights of persons with disabilities so that they can fully participate in the society and enjoy the same freedoms and opportunities as others (Bratan et al., 2020). The CRPD provides an important framework for the inclusion of persons with disabilities with the help of AT (Bratan et al., 2020). However, today, only 5-15% of the world's population who require AT have access to it (WHO, 2018). Access to AT has been identified by the CRPD as a human rights obligation and a necessary facilitator in the achievement of all 17 Sustainable Development Goals, widely adopted in 2015 (Tebbutt et al., 2016).

As of December 2021, the CRPD had 163 signatories and 184 member state or countries that have ratified the CRPD (United Nations Treaty Collection, 2021; United Nations, 2022) ensuring the availability of high-quality, affordable assistive products for children with disabilities which is considered as a human right as it represents an essential step towards equal opportunities. The technological innovations have made it possible for experts to develop AT that can also assist people with disabilities in their learning processes (Reddy et al., 2021). There are many types of assistive products, so, to assist in prioritization, the World Health Organization has published a list of the fifty most needed assistive products (WHO, 2017). The World Health Organization has also provided guidance on the necessary steps in assistive product provision, including selecting the appropriate products through screening and assessment, fitting or

providing the product, training the person on how to use the product, and follow up for review and maintenance (WHO, 2017).

The implementation of CRPD as it pertains to AT continues to be challenging for many countries, resulting in the World Health Organization launching the Global Cooperation on Assistive Technology initiative to provide direct action to the realization of the CRPD principles and improve the AT situation worldwide (Khasnabis et al., 2015). The CRPD emphasizes the rights of people with disabilities to access lifelong learning without discrimination and on an equal basis with others as well as not to be excluded from mainstream education due to their disability (UN, 2006). It is the responsibility of States that have ratified the CRPD to ensure affordable provision of AT for people with disabilities (Maclachlan et al., 2018a). Various governments are committed to ratifying the CRPD which specifies access to AT for an affordable cost as being a right and an important component in inclusive education (WHO, 2015a).

Effective deployment of AT in education is also supported by a range of international organizations and an overview of delivery systems for AT in education in other jurisdictions highlighted the essential role of expert advice and support services (WHO, 2015b). A mandate to make AT devices available to children is clearly stated within the CRPD and countries that are developing specific domestic laws should consider including a specific reference to AT (Hayes & Bulat, 2017). Generally, in low- and middle-income countries, the provision of AT is inadequate with poorly structured systems in place to aid service delivery (Borg & Östergren, 2015; Visagie et al., 2017).

As the coronavirus disease 2019 (COVID-19) pandemic has impacted all segments of the society, it has posed particular challenges for the inclusion of persons with disabilities (PWD) as

they often benefit from AT (Smith et al., 2020). COVID-19 has disrupted the delivery of AT

services, primarily due to infection control measures resulting in lack of provider availability and

diminished one-to-one services (Smith et al., 2020). The authors identified a need for stronger

user-centered development of funding policies and infrastructures that are more sustainable and

resilient, best practices for remote service delivery, robust and accessible tools and systems and

increased capacity of PWD, caregivers and clinicians to respond to the pandemic and other crisis

situations within a "rights-based approach and a universal health coverage system" which

recognizes AT as an essential need (Smith et al., 2020, p. 9).

　　In this era of COVID-19 where strong advocacy for online learning or distance education

is occurring, many of the content types of technologies used for online learning come with

accessibility challenges that can leave students with SLD at the margins of online education

(Hashey & Stahl, 2014). In reality, creating accessible digital content both ensure that students

with disabilities are included and also makes content more accessible for all students (Cifuentes

et al., 2016). However, the literature indicates that accessibility should always be viewed as a

fundamental to course design (Gronseth, 2018). Research suggests that although online

instruction can be a new site of rich learning experiences, many online resources are inaccessible

to a wide range of students (Cifuentes et al., 2016; Gronseth, 2018; Hashey & Stahl, 2014). This

creates a barrier to learning for many students with SLD as well as for other students that benefit

from accessible resources.

　　As a possible solution, many researchers suggest that when instructors are designing

digital learning environments, applying the Web Content Accessibility Guidelines, along with

the tenants of UDL will have a positive impact on student's experience (Cifuentes et al., 2016;

Gronseth, 2018). In addition, Mulfari (2018) argued that a personalized human computer

interface should be prototyped to better support the interaction between the remote student with SLD and the academic environment. It is widely advocated that in order to create accessible digital content, content should conform to the Web Content Accessibility Guidelines (Cifuentes et al., 2016; Gronseth, 2018; Hashey & Stahl, 2014). Furthermore, the use of online accessibility checklists and checkers is encouraged when analyzing both created and curated resources (Cifuentes, et al., 2016; Hashey & Stahl, 2014). An example of this is using WebAIM's online colour contrast checker, which will quickly assess if content meets the required contrast ratio to be considered accessible, or using the built in accessibility checkers in Microsoft Office or Google Docs (Gronseth, 2018; Hashey & Stahl, 2014). These checklists offer thorough and evaluative criteria of resources.

Finally, distance education is often seen as an appropriate outlet to provide education to students with SLD; however, some students experience learning anxiety due to outdated AT and a lack of student-instructor interaction (Coleman & Berge, 2018). Effective use of AT can prove to be benediction in times of pandemic (Dhingra et al., 2021) and so educational stakeholders now have an opportunity to learn from the COVID-19 response to develop and promote access to AT through inclusive and sustainable systems as well as policies that will serve people with disabilities (including children with SLD) more effectively in the future (Smith et al., 2021).

1.9 Definition of Terms

The following terms are defined as used in this study in Table 1.

Table 1

Glossary of Terms

Term	Meaning	Author
Assistive Technology	It is a range of devices and services which work to support children to augment their existing abilities compensate for or bypass the difficulties they may	Chambers, 2020

	experience.	
Assistive Technology Provision	It refers to everything that is needed to assure that a person with disability who might benefit from AT actually obtains it and obtains the most appropriate AT solution needed.	de Witte, 2018
Assistive Technology Service	It refers to any service that directly assists an individual with a disability or use of an AT device.	WHO, 2016
Assistive Technology Solution	It is the combination of products and strategies to meet a child's needs.	de Witte, 2018
Child or student	A child refers to any person under the age of 18 years.	UNICEF, n.d.
Disability	It is a physical or mental impairment that substantially limits one or more major life activities of an individual.	WHO, 2015a
High tech devices	It refers to electronic devices which require significant training but also have a great capacity for individualization.	Alkahtani, 2013
Inclusion	It is the educational practice of educating children with disabilities in classrooms with children without disabilities.	Webster, 2021
Inclusive Classroom	It is one in which all the students have the right to feel safe, supported and included in school and in the regular classroom as much as possible.	Watson, 2021
Inclusive Education	refers to a belief that every student is entitled to an instructional program that meets his or her individual needs and learning characteristics; a commitment to build and maintain an assured sense of belonging for all students, regardless of strengths or challenges.	Watson, 2021
Individualized Educational Plan	It is a written plan/program developed by the schools' special education team with input from the parents and specifies the student's academic goals and the method to obtain these goals.	Watson, 2020
Low technology devices	It refers to non-electronic devices that are easy to use and requires little training such as pencil grip.	Alkahtani, 2013
Mid- technology devices	It refers to electronic devices which require little training to use such as adaptive keyboards.	Alkahtani, 2013
Manipulatives	It refers to concrete or virtual objects (e.g., blocks and chips) often used in elementary grades to illustrate abstract mathematical concepts.	Lafay et al., 2019
Persons with disabilities	Refers to those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others.	United Nations, 2006
Ratification	It is a concrete action taken by States (countries) which signals the intention to undertake legal rights and	United Nations, 2006

	obligations contained in the Convention of the Rights of Persons with Disabilities or its Optional Protocol.	
Special Education	Refers to specially designed instruction, at no cost to parents, to meet the unique needs of an eligible individual, including the specially designed instruction conducted in schools and in other settings.	Disability Rights Education and Defence Fund, 2021
Specific Learning Disorders	Refers to neurodevelopmental disorders that are typically diagnosed in early school-aged children, although may not be recognized until adulthood. They are characterized by a persistent impairment in at least one of three major areas: reading, written expression, and/or math.	American Psychiatric Association, 2017
Technology Integration	It is the meaningful implementation of technology in education to achieve learning goals.	Kimmons, 2018
Universal Design for Learning	Refers to guidelines that call for designing learning materials such that they provide for multiple means of representation, multiple means of action and expression, and multiple means of engagement.	Wayer et al., 2016

1.10 Organization of the Thesis

This study is divided into five chapters. Chapter One will provide an overview of the study including the background to the study, statement of the problem, significance of the study, purpose of the study, research questions and a glossary of terms. Chapter Two will deal with the literature review related to AT use in inclusive classrooms. Furthermore, Chapter Three will outline the methodology of the study. This includes a description of and the rationale for the research design, data collection and data analysis method, trustworthiness and ethical considerations for the study. Moreover, Chapter Four will describe the analysis and results of the study. Lastly, Chapter Five will deal with the conclusion of the study which will include discussion, limitations, implications and recommendations for future research.

1.11 Summary

This chapter presented the background of the study, statement of the problem, significance of the study, purpose of the study, research questions, background contexts,

theoretical background, conceptual background, operational definition of terms and the

organization of the thesis. The next chapter dealt with the literature review.

Chapter 2: Literature Review

2.0 Introduction

This chapter examines prominent literature on assistive technology used in the school-based instruction of children with SLD in inclusive classrooms. The purpose of this chapter is to ground the study within the existing literature on the topic. The chapter discusses on the following subtopics namely: Assistive Technology for use in inclusive classrooms; Reading and Assistive Technology; Reading and Writing and Assistive Technology; Writing and Assistive Technology; Mathematics and Assistive Technology and some gaps in the research literature.

2.1 Assistive Technology for use in inclusive classrooms

AT can be used for multiple learning disabilities as well as for benefitting all the children in a classroom through a UDL perspective (Sider & Maich, 2014). AT has the potential to enable children with SLD to "live, learn and work more independently" through the application of specialized technologies that reduce, eliminate or minimize the impact of a disability (Edyburn, 2015). Therefore, it is important to use AT to support children with SLD as AT is capable of meeting the unique needs of every individual child. WHO (2015a) added that all children with SLD are entitled to available and affordable AT. Tamakloe and Agbenyega (2017) also added that AT devices can create a positive environment for the independence and improvement of skills for children with SLD. According to Constantinescu (2015), the use of technology is the foundation of UDL which originated from the use of AT with children with SLD but has broadened to include all children in the inclusive classroom. Thus, AT is used in classrooms to support the inclusion of children with SLD (Chambers, 2020) because the AT can assist in supporting many of the areas that are vital for children to develop a sense of belonging and inclusion in the classroom. AT helps children to be included in inclusive classrooms rather than

in pull-out settings as the AT allows the child to maintain engagement with the curriculum (CAST, 2020) and contribute to the classroom activities (Chambers, 2020). For example, a C-Pen[TM] will assist a child to read independently and comprehend the content being read and so stays in class than being withdrawn for supported reading instruction (CAST, 2020). Lewandowski et al. (2016) examined AT options for students with SLD and attention deficit hyperactivity disorder. They found out that AT was helpful but did not attempt to draw firm conclusions about the type of AT that was useful and the extent of its usefulness.

Recent research on iPads showed its importance in improving the educational outcomes for students with SLD (Chmiliar, 2017; Hilton, 2018; Maich & Hall, 2016; Maich et al., 2017). Technology apps on these devices are another tool for supporting students with SLD access to curriculum content (Atanga et al., 2019). Countless apps in the iTunes store can be used to address literacy development (Stone-Macdonald, 2015). Ok et al. (2016) offered guidance on how to find quality apps for use with students with SLD. Maich and Hall (2016) studied two primary school classrooms in Hamilton, Ontario with the creation of a focus group of five educators and from their observation and interviews, provided a step-by-step process that teachers can follow when introducing iPad into their inclusive classrooms as well as practical supports for educators. In addition, Maich et al. (2017) argued that AT such as that available in an iPad® have increasingly been used to support learning for all students especially those with SLD. They considered how new skills could be taught and how task analysis is a critical part of the process from a UDL perspective. There are many examples of an iPad's features that help to individualized it as an effective, efficient accessible AT tool such as a screen reader (voiceover) feature, the ability to set large text and icons, speech-to-text options (Siri®), text-to-speech options, predictive text, guided access, assistive touch, switch control, Braille capabilities,

hearing aid capabilities and Assistive Touch®-supporting diversity in gesture use and individual abilities (Apple Inc., 2017).

McMahon and Walker (2014) highlighted the tools inherent in the iPad which are relevant to UDL. For example, they suggested that tools such as Voiceover, Invert Colours, Zoom and iBooks can address multiple means of representation; Camera, Calendar, Reminders and Contacts, along with third-party apps, address multiple means of representation; and Podcasts, Maps, iTunes U, and Stopwatch address multiple means of engagement. According to Conn et al. (2019), iPads can be used to enhance the literacy of all learners. The authors found out that the Define Word, Search Web, and Search Wikipedia features of the iBook application were extremely useful to improve student comprehension especially for students experiencing difficulty with reading. In addition, Ok (2018) investigated the use of iPads as an AT to help children with learning disabilities and found out many benefits for using iPads and other online resources for AT apps for the children and thus urged all teachers to follow the SETT framework to select the best AT for the children as AT is very beneficial to children with SLD.

Furthermore, by implementing Google Technology (Google drive, Google slides, Google Docs and Google Classroom) in the inclusive classroom will improve the motivation and academic achievements of students with SLD (Francis, 2017; Government of Australia, 2015). For example, Google classroom can be used as an AT to help students, whether they require an accommodation or not, as it provides an organized platform where students can access, work on and submit assignments and enables real-time learning all on the web (Government of Australia, 2015). Furthermore, teachers can view students' work live and students can receive feedback as they go even before they have submitted their work (Government of Australia, 2015). Applications within the software also provide students with SLD- like writing disorders with an

opportunity to speak their thoughts and have it written down on paper, ability for test to be read

to a student who has difficulty reading and ability to collaborate while using the software

alongside other applications (Government of Australia, 2015).

Moreover, Augmented reality is one of the emerging technologies to be used for children

with SLD. Augmented reality enables the presentation of instructions in a step-by-step manner

which can be particularly beneficial to children with disabilities (Lin et al., 2016). Augmented

reality provides opportunities to promote lifelong learning among children with a variety of

needs (Gün & Atasoy, 2017; Ozdemir et al., 2018) like children with SLD. Virtual overlays or

interactive digital elements have been placed along with the mediated view of the physical

environment such as sound, video, or 2D and 3D graphics to enhance the real-world environment

(Aldowah et al., 2019; Al-Samarraie & Saeed, 2018). Hrishikesh and Nair (2016) in their study

indicated that augmented reality makes it possible for children with disabilities to understand

concepts faster and better. Additionally, Yusof et al. (2014) have shown that augmented reality

offers exciting and fun teaching aids for children with disabilities as it catches their attention.

Likewise, there is evidence that shows that augmented reality positively impacts the

educational experience of children, increases confidence, increases the level of commitment and

interest (Fombona et al., 2017), provides opportunities for self-learning (Akçayir & Akçayir,

2017), enhances collaborative learning (Phon et al., 2014), improves satisfaction and increases

motivation in children (Bacca et al., 2018). In the learning skills domain, children with

disabilities are identified to experience deficits in learning many subjects, in particular science

and maths, new words, and vocabulary acquisition (Cakir & Korkmaz, 2019), hence, using

augmented reality can be effective in facilitating skills acquisition learning, providing the means

for children with disabilities to enhance their motivation and helping them to understand information (Cakir & Korkmaz, 2019).

With the evolution of technologies, mobile technologies such as Smartphones, iPhones, and tablets are becoming more ubiquitous in the society and in the classrooms (Cumming & Rodríguez, 2017; Shuck, 2016). The flexible nature of mobile technologies render them particularly useful tools for teaching and learning and schools are increasingly integrating the use of personal mobile devices (Bring Your Own Device) (Chambers et al., 2017). Apple's iPad is one mobile device found to be a feasible technology option for students (Apple Inc., 2017), including those with SLD. The iPad has received considerable attention in schools throughout the world and is being adopted in classrooms to support student engagement and learning in all subjects including students' acquisition of knowledge and skills, such as communication, literacy, numeracy, project/problem-based learning, and to support peer collaboration (Chambers et al., 2017).

The Google Chrome extension Text Help's *Read&Write* has become an increasingly popular digital tool. Mcglynn and Kozlowski (2017) noted that *Read&Write* can support students with SLD through its speech synthesis application, as well as its many other capabilities. R*ead&Write* also provides a variety of powerful tools to help these students with reading, writing, studying, and research, thus allowing them the opportunity to access reading material and tasks that would otherwise be too difficult (Mcglynn & Kozlowski, 2017). *Read&Write* is a multifunction AT for reading, writing and spelling for children with SLD (Texthelp, 2016). *Read&Write* is an AT that is widely used adopted in schools because of its multiple features in one tool, its compatibility with multiple devices and its simplicity (Texthelp, 2016).

Research has confirmed the improved academic performance of children with SLD when AT has been used coupled with effective instruction in the areas of reading, writing, math, information processing skills and so on (Constantinescu, 2015). Appropriate teaching strategies can include the use of AT to complement existing abilities or bypass challenges experienced by children (Young & McCormick, 2014). The effective use of AT devices also enables "young children with disabilities to bypass their weaknesses because these devices augment the children's strengths to reach their potentials" (Tamakloe & Agbenyega, 2017, p. 29). According to Chambers (2020), in bypassing areas of difficulty in writing, AT (like spell-checking software and grammar support) can be used to assist the children to address areas in which they have extreme difficulty. LaRue et al. (2016) argued that, AT can help children with SLD perform and develop various functional skills as well as allow them to access support to complete a certain task or activity. However, AT has increased in use in recent decades due to accessibility of computers and the digital age (Viner et al., 2022) as new technologies are designed to take care of the children's individual learning needs.

2.2 Reading and Assistive Technology

Reading skill achievement is essential and an important competency necessary for knowledge building and students with reading disabilities hinder teachers' flow of the lessons and the development of students' life skills (Demirok et al., 2019). With the revolution of technology in the 21st century, AT is seen to be applied into the education settings at all levels and in all fields as technological enrichment of teachers' educational environment both facilitates and helps them to motivate students more easily (Demirok et al., 2019). For children with reading disorders, a number of AT are available to help them overcome their decoding difficulties, such as text-to-speech, read-aloud tools and reading pens (Dawson et al., 2019).

Meyer and Bouck (2014) found that text-to-speech is being used more frequently as a classroom accommodation for children with disabilities and those students enjoyed using the text-to-speech. In the same vein, text-to-speech software facilitates children's access to written texts by highlighting each word of a written text while reading it aloud, thus providing the reader with a synchronized auditory and visual presentation of the written text (Staels & Van den Broeck, 2015). According to Lindeblad et al. (2017) and Nordström et al. (2019), technological support into the educational environment of the pupils with reading difficulties can improve their reading skills and enable them to succeed in reading and comprehending with some AT like text-to-speech and speech-to-text; *Prizmo* having Optical Character Recognition and text-to-speech functions; Voice Dream Reader; and Kurzweil (all used via computers, laptops, mobile devices like smartphones, tablets and iPads). Some studies carried out by researchers using AT to support students with reading disorders or difficulties will be discussed below.

Harper et al. (2017) carried out a study investigating the effectiveness of an AT tool the Livescribe Pen to support one grade four student who had dyslexia over a one-year period with teachers and parents. The Livescribe Pen assistive technology is a smartpen equipped with a removeable ballpoint ink cartridge, a microphone to enhance audio recording, a playback speaker, an infrared camera, and internal flash memory that can store handwritten notes, audio, and images. The authors' findings revealed its impact as an AT on both the academic successes for children with SLD as well as non-academic gains such as an increase in independence, more time for social activities, and the ability to develop strategies for homework success. Their findings further indicated much more in terms of impact as the Livescribe Pen seemed to increase the quality of life for the child with SLD from an academic and social standpoint. The use of the Livescribe Pen allowed the student more access to the curriculum and an audio tool to

promote academic independence. Most importantly, the academic team and the parent reported a sense of higher aspirations for this student; ones they had not thought possible previously. Finally, the study revealed two elements critically important for students with SLD, that is, the importance of fostering communities of support and self-determination.

Fälth and Svensson (2015) carried out a study which investigated whether a multifunction application (*Prizmo*) for iPhone/iPad had the potential to provide assistance for students with a dyslexic profile. Twelve students and their teachers participated in this intervention study. All participants used apps on a smartphone or tablet in connection with text-to-speech or speech-to-text. The students used the multifunctional app (*Prizmo*) in a tablet to scan tests from books or newspapers and then made the text listenable via text-to-speech. *Prizmo* is an optical character reader with built-in speech synthesis. This app is compatible with iPhone 3GS, iPad 3 or later versions, and with iPod Touch. Thus, it is not primarily developed for use in school. As its primary functions are scanning text and synthesizing speech it can function as a tool for students whose reading difficulties are due to poor word decoding. A supporting function in speech synthesis is that a yellow rectangle marks the words that are spoken (a "Karaoke feature"). This feature makes it easier to accompany the spoken text if desired. The use of applications like ATs may indirectly have a positive impact both on word decoding and reading comprehension, as motivation, interest and time for text reading increase (Fälth & Svensson, 2015). The authors found out that students with the dyslexic profile who used the multifunctional app benefitted from decoding ability as well as motivation for learning.

Gunduz et al. (2019) also carried out a study to determine the opinions of special education teachers' regarding using AT for children with reading difficulties and found out that the teachers' opinions were moderate. The teachers used the following AT: Text-to-speech and

Speech-to-text to either facilitate or replace reading with child having reading difficulties as well as other AT like *Prizmo* having optimal character recognition and text-to-speech functions (apps which allows child to crop the images that are scanned and can read texts aloud and also highlighted the read word) and Voice Dream Reader (to read portal document format files, webpages and word documents). Additional features like note taking, adjustable fonts, speed, voice type, dictionary and text highlighting were also available for readers with reading difficulties. All these AT helped the children with SLD who had reading difficulties to be able to read fluently in the classroom.

Furthermore, Mize et al. (2020) conducted a study on students with reading learning disabilities who faced struggles in acquiring basic reading abilities, including oral reading fluency. The current study builds on previous work that compared peer-assisted instruction to iPad-assisted instruction on oral reading fluency, which led to the conclusion that a combined approach may be more effective than either approach alone. A multiple baseline design was used to examine the effectiveness of a combined peer-assisted instruction and iPad-assisted instruction approach on oral reading fluency of four 5th grade students with reading learning disabilities. Overall, there were moderate and positive experimental effects on oral reading fluency. Student gains were similar to expectations for typically achieving students from winter to spring.

Schiavo et al. (2021) carried out a study in which they designed an assistive reading tool that integrates read-aloud technology with eye tracking to regulate the speed of reading and support struggling readers in following the text while listening to it. The authors assessed 20 children in the study aged 8-10 years with a diagnosis of reading disabilities. The results show that children with reading difficulties improved their comprehension scores by 24% measured on a standardized instrument for the assessment of reading comprehension and that children with

more inaccurate reading tended to benefit more. Finally, the findings ensured a better integration between audio and visual text information paving the way to improve standard read-aloud technology with gaze-contingency and self-adaptable techniques to personalize the reading experience.

Schmitt et al. (2019) conducted a study which compared the effectiveness of two assistive technologies to accommodate the word reading skills of four middle school students with reading learning disabilities. The students used the following AT: Kurzweil 3000 (continuous text-to-speech)-a computer software program that allows students to follow along on a computer monitor while passages are read aloud and a reading pen (discontinuous text-to-speech) - a device that allows students to scan and hear selected words read aloud. The results of the study indicated that in three of the four students, the continuous text-to-speech technology led to the greatest improvements in both comprehension accuracy and rate when compared to silent reading while the fourth student demonstrated the highest comprehension accuracy and rate in the discontinuous text-to-speech condition. The authors concluded that discontinuous text-to-speech condition led to the lowest comprehension rates across all four students and they generally found out that the continuous text-to-speech AT was more acceptable of the two accommodations.

For the use of video modeling instruction in reading for students with learning disabilities, Decker and Buggey (2014) assessed the effectiveness of video self-modeling and video modeling with pupil to improve the reading fluency skills of six elementary students with learning disabilities using a multiple baseline across participants design. During intervention, three students received video self-modeling instruction, and the other three were administered video modeling with pupil instruction. In the video self-modeling condition, the videos showed

the student reading a passage fluently, whereas in the video modeling with pupil condition, the videos presented a peer reading a passage. Students in both conditions watched the videos individually once a day, and were administered curriculum-based measures twice a week. Students in both video self-modeling and video modeling with pupil conditions improved their reading fluency from baseline to intervention. The authors concluded that fluency growth achieved by the students in both conditions continued to improve during the maintenance phase.

Similarly, Edwards and Lambros (2018) also evaluated the effects of video self-modeling on the reading fluency of three seventh grade students with two of them diagnosed with learning disabilities using a multiple baseline across students. The authors recorded two videos of each student during the last two baseline sessions, and edited to show the student reading a passage fluently. Also, during the video self-modeling sessions, the students watched themselves twice reading a passage fluently in the video. After two viewings of the video, the students read the same passage presented in the video to measure their reading fluency and the reading videos were alternated between sessions. Generalization measures to novel reading passages were conducted once a week. The authors concluded that for the two students with learning disabilities, the video self-modeling intervention was moderate to highly effective to improve the number of count word per minute that they read and to reduce the number of errors per minute on the passages shown in the videos.

White and Robertson (2015) found out from their study that text-to-speech technologies could benefit students by decreasing their dependence on others to read text to them. They also argued that if teachers are to routinely use AT in their classrooms, they should be trained in the use of the AT. White and Robertson (2015)'s results show that, "All of the students in this study had difficulties with reading, but with assistive technologies which compensated, they were able

to work at grade level" (p. 1274). Furthermore, the use of text-to-speech provided students with disabilities the opportunity to read the same books as their peers and to send emails to their friends, resulting in improvements in both motivation to read and reading comprehension (White & Robertson, 2015). In the studies of Mirzaei et al. (2014), augmented reality was combined with audio and video (Audio Visual Speech Recognition) in aiding deaf students to read text. Through speech recognition techniques, facial expressions allowed capturing what the narrator said, without the need of knowing sign language. With the use of a screen, the speech became readable text displayed with augmented reality allowing deaf students to read and better understand what was communicated correctly.

2.3 Reading and Writing and Assistive Technology

Reading and writing are two very important skills needed by all children in school but some children with SLD have reading and writing difficulties. One way to ameliorate reading and writing difficulties is to compensate for the difficulty by using AT. For example, a child with reading difficulties might listen to a text being read instead of reading the text which is a workaround to the problem (Edyburn, 2015). Reading and writing applications (with text-to-speech and speech-to-text functions), used as AT for children with reading difficulties are increasingly used in education, however, research has not sufficiently enough evaluated its potential (Nordström et al., 2019). AT such as text-to-speech and speech-to-text are very helpful for children with reading and writing disabilities and as such are often included as an option in new smartphones and tablets (Haßler et al., 2016). Some research studies which explained how AT was used for children with SLD in reading and writing are discussed by researchers.

In a qualitative study by Björn and Svensson (2021), 68 students from grades 4, 8 and high school with reading and writing difficulties participated in an intervention study using an

iPad as an AT. The intervention involved recommending the student to read literature with the talking book app *Legimus*, to write text in the writing program with the text-to-speech app Skolstil, to scan text in a book with the scanner app *Prizmo* or on a paper by taking a photo, to get an Optical Character Recognition detection and a voice reading the text aloud, to speak to the speech translation app *SayHi* in order to transfer spoken sentences into written text and then translate them into another language (here only English), to use the voice-based reading tool *Voice Dream Reader* to find information on the Internet, and finally, to play with the game app *Ruzzle* to strengthen vocabulary knowledge and gain motivation. Even though the intervention sessions took place separately in a one-to-one context, the students were allowed to use the iPad and the apps in the classroom or at home whenever they wanted. The intervention study contained 24 supervised training sessions for the students with reading and writing tasks using iPads with special supportive applications to investigate whether there has been any transfer from the intervention, to the student's everyday school activities. The results showed that the students were positive to the AT (the applications on the iPads), they found the apps easy to learn how to use and they appreciated the benefits they could give. The authors concluded by suggesting that in order to improve transfer, AT should be introduced earlier to students, in the younger grades, before study habits have been formed and to inform teachers about the use of AT in the classroom, including what is available and how it can benefit students.

Nordström et al. (2019) carried out a study to explore how assistive reading and writing applications were perceived to function with regard to students' possibilities to assimilate (i.e., "read") and communicate (i.e., "write") text. The authors conducted a six-week app intervention with 54 special education teachers and assessed 59 students with reading difficulties from Grade 4, Grade 8 and from high school. The results showed individual differences in how teachers

61

perceived app usage for text-interaction purposes, including how app usage affected student motivation and autonomy for text-based learning. 82% of the younger and 47% of older students continued to use the technology after the intervention, but in various degrees. The authors concluded that students with reading difficulties seem to be able to use AT in order to assimilate text (i.e., to read) and to communicate text (i.e., to write), and, thus, AT had the potential to promote participation in regular education. This study also found out those students with reading difficulties could use reading and writing apps (with text-to-speech and speech-to-text) in portable tablets to be able to gain access to, and to produce text in an applied school setting. To use text-to-speech and speech-to-text as assistive technology efficiently may require relative extensive support and training, but even with this support, not all students in this study benefited from the potential use of the technology, as the processes of being able to gain access to and to produce text with assistive technology seem to be a difficult process for some of the students. The authors then proposed that in order to enable all students with reading difficulties possibilities to use assistive technology efficiently, its uses need to be customized even further than was done in this extensive intervention.

In a pilot study by Lindeblad et al. (2017), 35 students aged 10–12 years with documented reading and writing difficulties (of which 30% diagnosed were with dyslexia) participated for one year of AT intervention. The authors investigated the transfer effect on reading ability when using AT systematically. The students used different kinds of apps in tablets like text-to-speech, speech-to-text, *Prizmo* (scanner and text-to-speech), or Pages (word processor). They received 20 sessions of systematic training with these apps for 6 weeks. The results suggested that AT can create a transfer effect on reading ability, that is, increasing decoding ability and decreasing the gap to non-impaired readers. In addition, the authors

discussed the need to challenge the concept of reading to fit modern means of accessibility to text. The authors concluded that children with reading impairment could benefit from AT in regards of their reading development process and increase their chances of not falling behind peers, thereby increasing school motivation and an increase in independent learning. According to the authors, AT as applications in smartphones and tablets may aid children with reading impairment to have an equal platform for learning in school as their peers without reading difficulties. Also, AT could facilitate the information gaining process and subsequently increase motivation to learn and increase interest in reading activities and finally, AT had wider effects on its users as stigmatizing situations when leaving the classroom for pull-out services were avoided.

In addition, Svensson et al. (2021) also carried out a study including 149 students with the aim of exploring the effects of a variety of AT for students with severe reading disabilities with 24 sessions of AT training for a period of one-year follow-up. The overall goal was to obtain a deeper understanding of the lived experience related to AT in and out of the classroom environment to support improvement in students' reading and ability to assimilate and communicate text. The authors found out that the use of AT seems to have transfer effects on the reading ability and to be supportive especially for children with the most severe reading difficulties. The authors concluded that the AT used by the children with reading disabilities helped them to assimilate text, boost their reading thereby increasing their reading performance and increases their motivation for overall school work.

Kisanga and Kisanga (2020) undertook a study on the role of AT devices in fostering the participation and learning of 17 students with visual impairment in the classroom. They used low-tech AT devices (such as typewriter, manual Perkins Braille machines and white canes) and

63

high-tech AT devices (screen readers-Non-Visual Desktop Access; Microsoft Job Access with

Speech; magnifying Devices-Closed Circuit Television; Non-verbal Desktop Access; Braille

note touch and embossers). The authors found out that these AT used facilitated the learning of

the 17 students with visual impairment by "improving on their reading and writing,

comprehension and reading speed, enhancing accessibility of electronic materials and

audiobooks, minimizing over-dependence on sighted students and enhancing accessibility of

educational materials at any place and anytime" (p.3).

Farooq et al. (2015) conducted a study with 100 hearing impaired students to identify the

AT that are more in use by them and explored the effects of each on their reading and writing.

The authors found out that the role of high-tech and low-tech AT was highly prominent with the

parents of the hearing impaired students also included in the study and found satisfaction with

the use of AT for their children. Farooq et al. (2015) also discovered that the students used the

following AT:" hearing aids, cochlear implant, vibrotacticle, loop system, infrared system and

FM system and students using more than one device at a time "(p.8). The authors further

concluded that these students were getting benefit from the use of the ATs and performing

differently depending upon the nature of their devices with improved test scores in reading and

writing tasks as well as their overall academic achievement (Farooq et al., 2015).

The Smart pen is a relatively low-cost and easy-to-use technology tool that can be used as

an AT tool to help students with learning disabilities realize success in inclusive classrooms by

providing instructional support and/or a method of accommodation in three areas of use namely

in study skills, independent work, and assessment (Patti & Garland, 2015). The Smart pen has

the potential to increase access and performance of students with learning disabilities. Patti and

Garland (2015) explained how a student with a learning disability in reading (Charles) used a

Smart pen Livescribe [TM] as an AT tool to be able to bypass his difficulty with reading summary

tasks. Once the use of the Smart pen was implemented for Charles' reading summary responses,

his scores immediately and consistently rose to a comparable level to his peers, with typical

scores of 4 or 5 each day. His teacher indicated satisfaction with use of the technology, as it was

easy to use, required little additional work on his part, and allowed him to accurately assess

Charles' comprehension of the reading material. Charles reported he also was satisfied with the

use of the technology because it allowed him to complete the classroom task in a way that

worked for him. The Smart pen might also be helpful to him in other ways like note-taking.

McCollum et al. (2014) carried out a study to determine the effects of a speech-to-text

software application in the areas of reading and written expression of three students with SLD.

The authors chose Nuance's Dragon Naturally Speaking as the speech-to-text AT program for the

students to use in the study and trained them on how to use the AT program. The results show

that with the proper selection of the AT and training and use of the speech recognition

programme, the three students with SLD made greater gains in their writing ability, motivation

and confidence found in the three students in the study. The authors concluded that these three

students made improvements in the areas of word count usage, vocabulary, and correct writing

sequences when allowed to use this speech-to-text technology. Finally, the students also learned

they could write and effectively express their thoughts.

Finally, a qualitative research study conducted by Dawson et al. (2019) used observations

and interviews with a fifth-grade student who had excellent language comprehension skills but

read on a low second grade level. Despite efforts made by the boy's teachers, parents, and school

interventionist, the boy continued to display difficulties in reading and writing and had

underdeveloped handwriting and spelling skills. The case study highlights different reading and

writing AT available to dyslexic students. The *Read&Write* assistive technology indicated promising results for the fifth-grade boy after being implemented at school and at home for homework. His writing scores increased with the use of speech-to-text and word prediction features. His reading also showed improvements with the text-to-speech function.

2.4 Writing and Assistive Technology

Writing skills require certain cognitive skills such as the ability to bring words together (Erdem, 2017). Children with SLD find the task of writing difficult if not impossible as problems with writing stem from processing difficulties, rapid naming speed impairments and dysgraphia (Schock & Lee, 2016). There are many AT that are available to support the writing skills of students with SLD (Adebisi et al., 2015). For assisting students in writing, Ok and Rao (2019) outline a variety of AT offered through Chrome that are geared specifically towards writing. For example, Speech Recognition or speech-to-text/dictation "transcribes spoken words into text and has traditionally been used as AT for students with disabilities having difficulties with writing" (Ok & Rao, 2019, p. 208). Speech Recognition assists writers by allowing them to enhance the quality and length of their writing (Ok & Rao, 2019). Digital graphic organizers are another tool that can assist children who struggle to organize their ideas for writing. Some examples include *MindMap 2.0, Lucidchart for Education* and *Connected Mind* (Ok & Rao, 2019).

Speech Recognition technology has become a ubiquitous part of life but how can we best use this technology as an accommodation for our children with SLD throughout the school year and during testing? Cochrane and Kelly (2020) explained how to use speech recognition as an AT for writing through a systematic process: *Consider It* (as part of the assistive technology consideration); *Try It* out (with students using a systematic process); *Assess It* (with data to show if it works) and *Implement It* (to maximize student success). Cochrane and Kelly (2020)

suggested that speech recognition is one possible tool in a tool belt of strategies and methods that

students may use, depending on the task and the context. For example, dictating text during a

class activity may not always be practical. They give useful pointers to consider for deciding

whether to introduce the free internet-based speech recognition systems such as Siri or Google

Docs, or the commercial programs such as Dragon Naturally Speaking. The authors pointed out

that the only way to find out whether speech recognition is appropriate is to try it, and to teach

learners how to use it, and they offer eight "Scaffolded Steps to Teach the Speech Recognition

Writing process" and also offered advice on setting up the software and on assessing the impact

of the technology (Cochrane & Kelly, 2020, p. 7).

Additional examples of web-based graphic organizers such as *Inspiration (Version 9)* and

SimpleMind x-PRecog also help to facilitate group work within the classroom and students can

also access digital graphic organizers that include templates which allow them to collaborate

with other students as they develop visual maps (Ok & Rao, 2019). Word processors such as

word prediction software and grammar and spell checkers are additional AT that can be

effectively used to ease the writing process for learners who experience difficulties with written

expression (Ok & Rao, 2019). Subsequent research has largely supported the hypothesis that for

children with SLD, the speech-to-text technology produces gains in fluency relative to

handwriting; this is qualified in some studies by a decrease in word accuracy (Caute & Woolf,

2016). Research has also shown that speech-to-text software can support children in producing a

given piece of writing (Ok & Rao, 2019).

Some research studies on using AT in supporting children with SLD in written expression

will be discussed below. Latif et al. (2015) highlighted the benefits of using the modern mobile

technology features in providing a learning platform for young dyslexic writers. The authors

designed and implemented an android-based application to encourage the learning process and to help dyslexic children improve their fundamental handwriting skill. In addition, a handwriting learning algorithm based on concepts of machine learning was also designed and implemented to decide the learning content, evaluate the learning performance, display the performance results, and record the learning growth to show the strengths and weaknesses of a dyslexic child. The results of the evaluation provided by the participants revealed that application had the potential benefits to foster the learning process and help children with dyslexia by improving their foundational writing skills.

Moreover, Haug and Klein (2018) investigated the use of speech-to-text to teach a writing strategy. The authors pre-tested 45 Grade 5 students on argument writing and trained them to use speech-to-text. The students participated in four lessons on an argument writing strategy and wrote a practice text for each lesson. The authors then randomly assigned the students to compose practice texts in 1 of 2 modalities: handwriting or speech-to-text. The students then completed posttests on argument writing in both modalities. Both modality conditions resulted in statistically significant, large gains in text quality, word count, and variety of argument moves and significant transfer to the untrained modality. The modalities did not differ significantly in their effects on argument writing or cognitive load. The results of the study suggested that speech-to-text provided an alternative medium for learning writing strategies for students with SLD.

Also, a study by Gonzalez-Ledo et al. (2015) used a multiple baseline across subjects design to explore the effects of using a computer graphic organizer program during planning on the narrative writing compositions of four fourth- and fifth-grade boys with SLD. Four dependent variables were measured: total number of words, total minutes planning, number of

common story elements, and overall organization. Baseline planning was done with paper and pencil, while intervention planning was done using the computer graphic organizer program *Kidspiration 3.0* (2011). Compositions in both conditions were written and edited using paper and pencil. The results of the study indicated that computer graphic organizers used during planning had a positive effect on three of four dependent measures. When looking at mean scores, participants wrote more words, planned for longer periods of time, and included more story elements in their compositions. Furthermore, there were nominal to no improvements in overall organization across the four participants. The authors concluded by suggesting that teachers of students with SLD should consider using computer graphic organizers for narrative writing planning. Additionally, Evmenova and Regan (2019) also explained the use of one technology-based graphic organizer with embedded self-regulated learning strategies as well as UDL features that can be used to enhance the writing process for students with learning disabilities. Such technology categories as technology-based graphic organizers, word prediction, speech recognition, talking word processors, as well as multimedia and digital storytelling programs are discussed. All these technologies can improve the quantity and/or quality of writing for students with learning disabilities.

Also, Boykin (2015) carried out a study to determine the effects of a computer-based graphic organizer with embedded self-regulated learning strategies on the argumentative writing performance by 4th-and 6th-grade typical and struggling writers in the science and social studies content areas. Results from this study indicated that the computer-based graphic organizer with embedded self-regulated learning strategies positively impacted the argumentative writing of typical and struggling writers. The improvements were in the areas of holistic quality, number of transition words, and number of sentences. However, there were no statistically significant

differences in number of words or accuracy across conditions. In addition, students who used the computer-based graphic organizer to write their argumentative responses showed greater self-regulated learning strategy use in comparison to the control group. Students in the experimental condition were able to internalize the self-regulated learning strategies and maintain their performance when writing without the computer-based graphic organizer, outperforming the control group on most measures. Following instruction, students in the experimental group self-reported a greater sense of motivation to write than students in the control group.

Furthermore, Hopcan and Tokel (2021) examine the effectiveness of a mobile writing application for students with dysgraphia and to determine whether students' writing skills improved after using this application. The results of the authors revealed that: 1) the mobile writing application contributed to the acquisition of writing skills (letter formation, spelling, and words) for students with dysgraphia, 2) the percentage of students' on-task duration were in a range of 80% and 100%. When students' writing speed was examined session by session, there was an increase in them all. The authors concluded that the students' correct attempts increased session by session while the number of incorrect attempts decreased.

Lastly, Berninger et al. (2015) conducted a study to investigate the effectiveness of iPad computerized writing instruction for thirty-five grade 4-9 students with diagnosed writing difficulties. The authors used 18 two-hour lessons with multiple learning activities aimed at improving subword (handwriting), word (spelling), and syntax (sentence composing) level language skills by engaging all four language systems (listening, speaking, reading, and writing) to create a functional writing system. To evaluate treatment effectiveness, the authors used normed measures of handwriting, spelling, and composing. The authors found out that the sample as a whole improved significantly from pretest to posttest in three handwriting measures,

four spelling measures, and both written and oral syntax construction measures. All but oral syntax was evaluated with pen and paper tasks, showing that the computer writing instruction transferred to better writing with pen and paper. Performance on learning activities during instruction correlated with writing outcomes; and individual students tended to improve in their writing skill. Thus, the authors concluded that computers should be used for Tier 3 instruction to improve the writing skills of students in grades 4–9 with history of persisting writing disabilities.

2.5 Mathematics and Assistive Technology

Mathematics curriculum and instruction continue to be a challenge to all teachers who require proper planning to use ATs to improve the learning of mathematics (Reddy et al., 2021). Children's difficulties while studying mathematics can be reduced with ATs if appropriately implemented (Bouck & Satsangi, 2020). Children with SLD experience difficulty with learning mathematics due to some reasons such as weak conceptual understanding of mathematics topics (Ok & Rao, 2019); low-esteem towards or while doing mathematics, mathematics phobia (Reddy et al., 2021). Augmented and virtual reality can help to enable pupils to grasp mathematics concepts faster. According to Rahman et al. (2020), teachers can leverage learning activities of children with learning disabilities with the use of mobile augmented reality learning applications with multimedia elements, such as audio, graphics, animation, and video, the impact of which can make such children highly motivated, active, and interested in the learning process.

Demitriadou et al. (2020) showed that learning geometric shapes with the augmented reality application increased primary students' interest in mathematics education and improve their conceptual understanding. Furthermore, extended reality technologies which incorporate virtual, augmented, and mixed reality helped mathematics teachers' preparation and may be powerful for allowing teachers to interact with and understand mathematics ideas in new ways

and to consider new ways of teaching it to all the children (Walkington et al., 2021). Augmented and virtual reality platforms now support shared, immersive experiences that enable children to engage directly, physically, and perceptually with mathematical objects (Walkington et al., 2021).

Furthermore, manipulatives also support children with and without disabilities in mathematics (Satsangi, 2015). An alternative to concrete manipulatives is virtual manipulatives, including internet- and app-based manipulatives. Virtual manipulatives are digital representations of concrete manipulatives for use on computers, mobile devices, or interactive whiteboards (e.g., virtual base 10 blocks, virtual fraction cubes, and virtual algebra tiles) (Bouck et al., 2018). Virtual manipulatives used on commonly desired devices, such as iPads, as well as can move from class to class or even to home with students (Satsangi & Miller, 2017), representing the transportable element. In terms of availability, multiple virtual manipulative options exist, including for purchase and free and across different platforms (e.g., Chromebooks, iPads, computers). Free virtual manipulatives include, for example, the National Library of Virtual Manipulatives and the Math Learning Center apps (Bouck et al., 2017; Ok & Rao, 2019).

Virtual manipulatives, particularly when accessed via mobile devices, are engaging (Satsangi & Bouck, 2015; Shin et al., 2017) and increase student independence (Satsangi et al., 2016). Researchers suggest virtual manipulatives are equally effective when used to teach mathematical concepts for students with disabilities as concrete manipulatives (Bouck et al., 2017; Bouck et al., 2018; Satsangi et al., 2016). The math program *EquatIO,* provides math word prediction as well as a speech recognition capability for writing formulas and equations (Ok & Rao, 2019). Researchers have recommended these digital math resources: *Brainingcamp, National Library of Virtual Manipulatives, The Math Dictionary for Kids, Webmath* and *IXL*

(Bouck et al. 2017; Ok & Rao, 2019). Many studies have been carried out to use AT to teach mathematics to children with SLD and some are discussed below.

Reddy et al. (2021) carried out a study on mathematics students' perception of using assistive technologies in the learning of mathematics. In this study, the students were evaluated on the use of AT such as lecture capture recordings, virtual tutorial sessions using big blue button, satellite tutorials, tablets, mobile devices, interactive whiteboards, simulation games, mathematics software, and online videos for the teaching and learning of mathematics. This study revealed that the two most effectively and frequently used AT are online videos and lecture capture recordings. The study also revealed that laptops and mobile devices are the most commonly used devices to access the available AT by the students. Furthermore, students perceived that the use of AT for learning mathematics is important since AT enhance communication and collaboration and foster engaged learning. Overall, the results show that AT is indeed a saviour of mathematics with a significantly positive attitude garnered toward using them for learning mathematics. The use of AT in mathematics topics tends to make learning more attractive, enhances the learning methodologies in mathematics, and makes the concept in mathematics better to understand. Moreover, AT creates a sense of self-independent learning and accommodates students' learning preferences. From the current study, it can be deduced that the use of AT in mathematics education has improved children's performances in mathematics and to some extent reduced the negativity toward mathematics as a subject.

Also, in their study, Tobar-Muñoz et al. (2014) designed an inclusive augmented reality-enriched videogame for Logical Math Skills Learning called *Gremlings in my mirror*. The authors tested the game with a set of 20 students with SLD of different ages. From their experiment, it could be deduced that the performance on the game is similar for students with

different needs. Furthermore, all the students achieved the goals of the game and felt strongly

motivated in the learning process which is convenient for students with augmented reality in

inclusive education. Thus, the results and feedback from the teaching staff suggested that

augmented reality and digital game based learning allowed the integration of children with SLD

in the learning process. Furthermore, Lin et al. (2016) explored a new way to integrate advanced

display technology into educational activities for children with SLD by developing a free

interactive mobile augmented reality application to facilitate the learning of geometry. Twenty-

one elementary school children participated in the experiment which they carried out. The results

showed that the augmented reality system could help the school children to finish puzzle game

activities independent of teacher's assistance. With the use of augmented reality display

technology, the children demonstrated improved ability to complete puzzle game tasks when

compared to the use of traditional paper-based methods. Performance data indicated that the use

of augmented reality technology could enhance the learning motivation and frustration tolerance

in children with disabilities.

Taking advantage of the ability of virtual and augmented reality to visualize 3D objects,

Demitriadou et al. (2020) investigated the potential of using virtual and augmented reality

technologies for teaching the lesson of geometric solids to primary school children. As part of

the study 30 fourth, fifth and sixth class primary school students were divided into three groups

that included a control group and two experimental groups. The first and second experimental

groups used dedicated virtual and augmented reality applications to learn about geometric solids,

while students from the control group used traditional printed material as part of the learning

process. The results indicated that the implementation of new technologies in education of virtual

and augmented reality improve interactivity and student interest in mathematics education,

contributing to more efficient learning and understanding of mathematical concepts when compared to traditional teaching methods. No significant difference was found between virtual and augmented reality technologies with regards to the efficiency of the methods that contribute to the learning of mathematics, suggesting that both virtual and augmented reality display similar potential for educational activities in mathematics.

Furthermore, Ok and Bryant (2016) investigated the effects of explicit, strategic intervention with iPad application practice on the multiplication fact performance and strategy use of four fifth-grade elementary students with learning disabilities who received 15 1:1 intervention sessions in multiplication facts. The results indicated that all students made significant growth in multiplication fact performance across the study and maintained the intervention gains 2 weeks following the intervention. Overall, students increased their use of a doubling strategy taught during intervention and were able to retrieve facts automatically after iPad intervention sessions. So, the iPads assisted with the completion of more problems per minute and improved maths fact performance of the students with learning disabilities. Additionally, social validity interview results indicated that participants had positive perspectives about the intervention. Moreover, Ok et al. (2019) undertook a research on the effects of computer-assisted instruction for both computers and mobile devices when teaching mathematics to students with learning disabilities. The results represent a medium intervention effect and a large maintenance effect of using computer-assisted instruction for students with learning disabilities on their mathematics progress. In addition, findings revealed a relationship between the number of evidence-based instructional variables embedded in the computer-assisted instruction and the effect on student performance. Overall, results indicated that well-designed

computer-assisted instruction with effective instructional variables should be considered as a promising intervention to support mathematics instruction for students with learning disabilities.

Manipulatives are considered a best practice for educating students with disabilities and so Bouck et al. (2015) investigated the use of a virtual manipulative through the National Library of Virtual Manipulatives–*polynominoes* (tiles)–as a tool to help teachers present a unit on area and perimeter to students with disabilities. Their results suggested instruction with virtual manipulatives improved the understanding of area and perimeter by these students with disabilities. The students performed better on the posttest in terms of number of problems correct and number of problems attempted than on the pretest. In the same vein, Bouck et al. (2017) compared the use of app-based manipulatives to concrete manipulatives in supporting students with disabilities in solving subtraction problems with regrouping. Using an adapted alternating treatment design with three students with disabilities, the authors found out that app base 10 blocks were more effective in terms of solving subtraction with regrouping for two of the students. They also found that all three students were more independent with the app-based manipulatives, although only two of the three students preferred the app-based manipulatives to the concrete manipulatives. In a nutshell, the manipulatives used helped all the three students to grasp the concept of solving subtraction with regrouping faster and practically could solve the problem individually.

Also, Pitchford (2015) carried out a randomized control trial to evaluate the effectiveness of a tablet intervention for supporting the development of early mathematical skills in primary school children in Malawi. A total sample of 318 children, spanning Standards 1–3, attending a medium-sized urban primary school, were randomized to one of three groups: maths tablet intervention, non-maths tablet control, and standard face-to-face practice. Children were pre-

tested using tablets at the start of the school year on two tests of mathematical knowledge and a range of basic skills related to scholastic progression. Class teachers then delivered the intervention over an 8-weeks period, for the equivalent of 30-min per day. Technical support was provided from the local voluntary service overseas. Children were then post-tested on the same assessments as given at pre-test. A final sample of 283 children, from Standards 1–3, present at both pre- and post-test, was analyzed to investigate the effectiveness of the maths tablet intervention. The authors found significant effects of the maths tablet intervention over and above standard face-to-face practice or using tablets without the maths software were found in Standards 2 and 3. In Standard 3 the greater learning gains shown by the maths tablet intervention group compared to both of the control groups on the tablet-based assessments transferred to paper and pencil format, illustrating generalization of knowledge gained. Thus, the authors concluded that tablet technology can effectively support early year's mathematical skills in developing countries if the software is carefully designed to engage the child in the learning process and the content is grounded in a solid well-constructed curriculum appropriate for the child's developmental stage.

Hughes (2019) studied the effectiveness of point-of-view video modeling instruction to teach three elementary and middle school students with disabilities, including a fifth grader with learning disabilities, to simplify fractions using concrete manipulatives (pom-poms). During the point-of-view video modeling intervention, the students watched the video, and then completed five fraction problems. The authors concluded that the point-of-view video modeling intervention was very effective to teach the student with learning disabilities the use of manipulatives to simplify fractions, with a mean of 90% more problems solved correctly during intervention than in baseline. So, for this student, effects of the point-of-view video modeling

instruction were maintained several weeks after the end of the intervention. Similarly, Satsangi et al. (2019) investigated the effects of video modeling with adult to teach students to solve area and perimeter word problems of rectangles and squares using a multiple problem across students design. The study included three students with two students with learning disabilities (ninth and tenth graders). In the video modeling with adult phase, the students watched a video that modeled the procedures to solve a geometry problem, and afterwards, were instructed to solve five problems on a worksheet. While working on the problems, the students could watch either part or the entire video again, if they chose. In addition, if students struggled to perform one of the steps in a problem, the interventionist instructed them to watch the corresponding part of the video. The interventionist provided further instruction if afterwards the students continued having trouble with the step. The authors found out that video modeling with adult was effective to improve students' accuracy to solve the geometry word problems, with mean gains from baseline to intervention ranging from 90% to 92% for the percentage of problems solved correctly across students. The authors concluded that the effects on students' accuracy and independence of the video modeling intervention were sustained or increased over time in the maintenance phase.

Overall, AT use thus empowered children with SLD to bypass the barriers hindering their learning as it plays to their strengths and work around their weaknesses or challenges as can be deduced from the empirical literature discussed. So, "including students with disabilities in general education settings requires the provision of all necessary devices and services, in addition to ensuring the least restrictive environment. Ensuring the least restrictive educational environment means that students' most important needs and wants must be met" (Abu-Alghayth, 2020, p. 227). Conclusively, there is a definite need for AT in order for children with SLD to

learn effectively and live as independently as possible (Alharbi, 2018). However, the use of AT will only be rewarding if the children are willing to use them for their learning (Reddy et al., 2021). According to (Barrett et al., 2019; Daniel, 2016; Maich et al., 2017; Rajkumar, 2016), the success of any technology used for learning or education purposes lies in the children's attitude, perception, willingness, and readiness to use them for their learning. Thus, the findings from the various researchers cited above showed that the various AT was beneficial to the children with SLD by improving their reading, writing, speaking, mathematics skills and performances. Finally, AT ensures that students (with or without SLD) complete their courses and programs successfully even during pandemic and emergencies such as COVID-19 pandemic (Reddy et al., 2021).

2.6 Gaps in the Research Literature

There is little comparative qualitative case study research done on the use of AT in the school-based instruction of children with SLD in inclusive schools in more than one country which this study seeks to address. Berardi et al. (2021), Mattison et al. (2020) and WHO (2018) argued that the current mode of acquisition and delivery of AT is underutilized and ineffective in meeting the needs of the children with SLD leading to unmet needs of AT. This study seeks to suggest ways to curb these unmet AT needs for children with SLD. Moreover, the lack of training of teachers on how to integrate technology (AT) in the teaching/learning process will also be addressed by this study suggesting some technological integration models which teachers might use in their classrooms when they have undergone some training. Furthermore, many countries have enacted laws, policies, and legislations on AT access and provision and some of them might have become obsolete while others are being implemented slowly. In this 21st century, it is thus necessary that such laws, policies, and legislations be changed or reviewed and

be well implemented. Therefore, the purpose of this study is to critically explore and compare the use of assistive technology in the school-based instruction for children with SLD in Cameroon and Canada.

2.7 Summary

From the literature reviewed, the importance of AT to the academic success of children with SLD cannot be overemphasized and hence the need for this study. In this chapter, I discussed an overview of some current research on AT use in an inclusive classroom as pertain to reading, reading and writing, writing, and mathematics. Finally, I focused on some gaps in the research literature. In the next chapter, the methodology of the study would be discussed.

Chapter 3: Methodology

3.0 Introduction

To achieve the purpose of this study, a qualitative research approach was chosen. The purpose of this comparative case study was to critically explore and compare the use of AT in the school-based instruction of children with SLD in Cameroon and Canada. This study was deemed necessary because the effective use of AT in the school-based instruction of children with SLD not only support children with SLD but many children in the classroom using the universal design for learning approach (Sider & Maich, 2014). This chapter dealt with the methodology of this study including its timeline, research questions, qualitative research genre, its research design, the rationale for selecting geopolitical locales, the researcher's role, data collection method, data analysis strategies, trustworthiness and ethical consideration. In addition, a summary of this research project was also included.

3.1 Timeline for the Study

The timeline for this study is shown in Table 2.

Table 2

Timeline for the study

Specific Research Activities	Target Months
Thesis Introduction	January 2021
Thesis Proposal	February-March 2021
Thesis Chapters 1-3	April-June 2021
Data Collection, Inspection and Analysis	July-September 2021
Report Writing (Chapters 4 & 5)	October-December 2021
Submission of Thesis to SGS	February 2022

3.2 Research Questions

This research was guided by some open-ended questions which according to Creswell (2016) should begin with words like "how" or "what." Such questions would explore and bring out multiple perspectives of the phenomenon under study. The study is guided by the following research questions:

1) What are the available assistive technologies used in the school-based instruction of children with SLD?

2) What laws, policies, and legislations have been enacted by Cameroon and Canada to control AT access and provision?

3.3 Research Genre

Qualitative research is a paradigm in which the researcher examines a problem in which the variables that contribute to the problem are unknown (Creswell, 2012). The researcher begins with an open-ended approach to answer a question and gradually identifies the themes and constructs that will explain the phenomenon. Qualitative research asserts that a phenomenon is more than the sum of its parts and must therefore be studied in a holistic manner. Some examples of Qualitative research are: "case study, ethnography, phenomenology, grounded theory, and narrative research designs amongst others" (Leedy et al., 2019, p. 230). Denzin and Lincoln (2011) summarized the characteristics of qualitative research into five key attributes relevant to case study research as:

i) reducing the use of positivist or post positivist perspectives

ii) accepting postmodern sensibilities

iii) capturing the individual's point of view; examining the constraints of everyday life; securing rich descriptions. (p. 8-10)

In this study, I chose a case study approach because it was well-suited in answering the research questions appropriately and adequately. The strength of the case study method is that it allows for the examination of the phenomenon in depth using data from the analysis of documents (Yin, 2010). Also, the case study was used because the focus of the study is more to describe and explain rather than predict. In addition, the case study allows for empirical inquiry of phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2010).

3.4 Research Design

In this study, a case study and a comparative design were deemed appropriate. Yin (2010) described a case study methodology as a distinctive means of empirical inquiry particularly suitable for exploring the how and why of contemporary phenomena within a real-life context. This methodology is relevant when the researcher believes the context to be highly pertinent to the subject under study, hence the rationale for my choosing such an approach that allowed for "cross-national" (Hakim, 2000, p. 71) comparison between the use of AT in the school-based instruction for children with SLD in Cameroon and Canada. Furthermore, Bryman (2016) argued that a comparative research design consists of studying two contrasting cases using more or less identical methods. Thus, the combination of a case study and a comparative design (comparative case study design) was used in this study.

Moreover, comparative case study techniques are recognized as providing a means to examine a multiplicity of perspectives to illustrate a social entity or pattern and to test ideas and processes (Hakim, 2000). Comparative case studies involve the analysis and synthesis of the similarities, and differences and patterns across two or more cases that share a common focus or goal in a way that produces knowledge that is easier to generalize about causal questions-how

and why particular programmes or policies work or fail to work (Goodrich, 2014). For this study, I used a qualitative comparative case study approach. Before a comparison is done, units for comparison must be established (Manzon, 2007) and in this study, I used two units of comparisons which were *AT availability* and *laws, policies, and legislations on AT access and provision* to compare and contrast the two countries. By comparing these two countries, it enabled me to compare AT availability, laws, policies, and legislations on AT access and provision. This methodology allowed me, therefore, to critically explore and compare the AT use in the school-based instruction of children with SLD in Cameroon and Canada.

3.5 Rationale for Selecting Geopolitical Locales

I used critical case purposive sampling for selecting the two countries under study in order to assess the availability of AT as well as to also assess if laws, policies and legislations to control AT access and provision does exist in both countries amongst other reasons. I selected the countries with one from the Global South (Cameroon) and the other from the Global North (Canada) generally because of the location of my supervisor and I, our lived experiences and the knowledge that we bring to the process. I also selected the two countries specifically for four reasons. Firstly, both countries are signatories of the United Nations Convention for the Rights of People with Disabilities (United Nations, 2017). Secondly, both countries use AT (besides mainstream technologies) in their schools to assist children with SLD in their education (Cameroon, 2010a; Courtad & Bouck, 2013). Thirdly, there are laws, policies, and legislations enacted by both countries to ensure AT access and provision (Cameroon, 2010a; Edmunds & Edmunds, 2014) and lastly, both countries see the need for the education of all children (including those with SLD) as a right in their constitutions and foster the concept of special

education and /or inclusive education (Cameroon, 1996; Government of Canada, 2021a) to cater for the needs of children with SLD.

3.6 The Researcher's Role

The researcher's role as the primary instrument of data collection and analysis will be discussed below. I am a trained primary school teacher and currently a Head Teacher of a public primary school. My interest in this study stems from the fact that as a teacher for more than twenty years, I have taught children with SLD in reading, writing and mathematics and have seen how AT has helped such children in their studies to bypass the area of difficulty. With my technological and teaching experiences, seminars/workshops on special and inclusive education that I attended over the years and some special education courses that I did while undergoing my studies, it is believed that the knowledge I have gathered would help to address many issues in this study and better the chances of supporting children with SLD in our schools. I thus entered this research study with the hope of developing an understanding of how to use AT to support the school-based instruction of children with SLD. Furthermore, I carried out searches of relevant documents from Cameroon and Canada in relation to the use of AT in the school-based instruction of children with SLD in order to find out if AT was provided for such children as well as to check if each country had laws, policies, and legislations for AT access and provision to better understand if their AT needs are met. I remained ever mindful of my subjectivity by trying to disconnect my pre-conceived ideas about the use of AT in school-based instruction of children with SLD. Finally, after analyzing the data, reflexive reporting of the results obtained from the findings was done and presented in a later chapter.

3.7 Data Collection

Data were collected from documents. Documents, as a record of human activity, provide a valuable source of data in case study research (Mills et al., 2010). There are three primary types of documents which according to O'Leary (2014) are:

a) **Public Records:** The official, ongoing records of an organization's activities. Examples include student transcripts, mission statements, annual reports, policy manuals, student handbooks, strategic plans, and syllabi.

b) **Personal Documents**: First-person accounts of individual' actions, experiences, and beliefs. Examples include calendars, e-mails, scrapbooks, blogs, Facebook posts, duty logs, incident reports, reflections/journals, and newspapers.

c) **Physical Evidence**: Physical objects found within the study setting (often called artifacts). Examples include flyers, posters, agendas, handbooks, and training materials.

3.7.1 Document Selection

I selected documents for analysis based on five inclusion criteria below: Firstly, the chosen documents dealt with the research topic under study. Secondly, the documents were published by the various governments and Ministries of Education of the two countries, other national and international organizations. Thirdly, the documents were written in English language. Fourthly, the documents were open access from 1983-2021. And lastly, these documents were found in either the websites of Ministries of Education and specialized Ministries from both countries, databases, country reports, policy websites and also from the websites of national and international organizations. A summary chart of the criteria for document selection is found in Table 3.

Table 3

Five criteria used to select the documents for analysis

Five inclusion criteria used for selection of documents
The chosen documents dealt with the research topic under study.
The documents were published by the various governments and ministries of education of the two countries, other national and international organizations.
The documents were written in English Language.
The documents were open access from 1983 -2021.
The documents were found in either the websites of Ministries of Education from both countries, country reports, policy websites and also from the websites of national and international organizations.

3.7.2 Search procedure for documents in Cameroon

I did a comprehensive online search for the publicly-available documents from

Cameroon and Canada differently using different search terms in English language only. I used

different search terms because the same search terms did not retrieve any document after online

searching for documents for a specific country. To search for the publicly-available documents in

Cameroon, I used these search terms such as *Disability laws in Cameroon, Inclusive Education*

Policy in Cameroon, Special education in Cameroon, Assistive Technology laws in Cameroon

and Cameroon law concerning people with special needs to do an online Google search

(https://www.google.com) on the various Ministries of Education and Ministry of Social Affairs

websites to come up with six documents matching the inclusion criteria above and they were

prepared for the analysis. The six Cameroonian documents coded CAM1-CAM6 shown in Table

4 were analyzed in this study.

Table 4

Selected documents from Cameroon

Code	Title of Document	Author, year	Purpose of Document	Aspects of AT mentioned	Links

CAM1	Law No.83/013 of 21st July 1983	Cameroon, 1984	The law provides the general dispositions and practical modalities for the protection of persons with disabilities.	It provided grants to support special education schools with the provision of equipment and related services for children with SLD including AT devices and services.	https://www.ilo.org /dyn/natlex/natlex4. detail?p_lang=en& p_isn=21619
CAM2	Decree No. 90/1516 of 26 November 1990	Cameroon, 1990	It is a decree fixing the modalities of the application of the Law No.83/013 of 21st July 1983 on the protection of people with disabilities.	It ensures that children are enrolled in ordinary schools with the provision of AT for them amongst other benefits.	https://hdl.handle.net /1813/76314
CAM3	Law No. 2010/002 of 13th April 2010	Cameroon, 2010a	It aimed at the prevention of disabilities, social, economic and psychological rehabilitation and integration of persons with disabilities and the promotion of national solidarity in favour of persons with disabilities in its 31 sections.	It has provision for the material and financial needs as well as pedagogic support for persons with disabilities who require assistive technological devices to enhance their learning.	https://www.ilo.org /dyn/natlex/natlex4. detail? p_isn=110467 &p_lang=en

CAM4	Decree No. 2010/0243/ PM of February 26, 2010	Cameroon, 2010b	This decree aimed at fixing the modalities for the exercise of the powers transferred by the State of Cameroon to the Communes in terms of the allocation of aid and relief to the indigent and the needy including persons with disabilities.	It offered aid and relief in the form of grants or financial assistance to help people with disabilities to be supplied with various AT devices like audio phones, walkers, and braille machines amongst others.	http://www.minas.cm/en /decrees/36-decret-no-2010-0243-pm-du-26-fevrier-2010-fixant-les-modalites-d-exercice -des-competences-transferees-par-l-etat-du-cameroun-aux-communes-en-matiere-d-attribution-des-aides-et-des-secours-aux-indigents-et-aux-necessiteux/file.html
CAM5	Decree No. 2018/6233/PM of 26 July 2018	Cameroon, 2018	To lay down the terms and conditions of enforcement of Law No. 2010/002 of 13 April 2010 on the promotion and protection of persons with disabilities.	It discusses the provision of supports and educational materials needed by children with SLD such as AT devices.	https://www.spm.gov.cm /site/?q=fr/content/d%C3 %A9cret-n%C2%B0-20186233-pm-du-26-jul-2018-fixant-les-modalit%C3%A9s-dapplication-de-la-loi-n%C2%B0-2010002
CAM6	Protection of Persons with Disabilities	Cameroon Ministry of Social Affairs (MINAS), 2018	It is responsible for the elaboration and implementation of the Government policy as concerns prevention, assistance and protection of people with disabilities.	It deals with government actions in terms of laws and educational related services and support like provision of AT devices and other services.	http://www.minas.gov.cm/ index.php?option=com_ content&view=article&id =156&Itemid=182&lang=en

3.7.3 Search procedure for documents in Canada

To get the publicly-available documents from Canada, another comprehensive online search was conducted for Canada-wide and then in all the 13 jurisdictions from Google Canada (http://www.google.ca), Disability policy Alliance (http://www.disabilitypolicyalliance.ca), Canadian legal information institute (CanLII-http://www.canlii.org/en) and the 13 provincial

Ministries of Education's websites using the following search terms: d*isability policy, Assistive*
Technology programs, special education policy, education act, school act, inclusive education
policy, disability support program, legislation and policy for children with special needs and
Assistive Technology policy and came out with 10 documents for Canada-Wide (coded as CW1-
10) shown in Table 5 and 8 documents selected from the 13 jurisdictions found in Appendix A
as they would be too long to be included in this chapter (Coded as CJ1-8) which were analyzed.
So, a total of 18 documents were analyzed for Canada in the study.

Table 5

Selected documents for Canada-Wide

Code	Title of Document	Author, year	Purpose of Document	Aspects of AT mentioned	Links
CW1	Canadian Survey of Disability Report	Statistics Canada, 2017	It provided comprehensive data on persons with disabilities by province and territory and age group, as well as disability types and severity of the disability.	The survey explained that over seventy specific ATs were used in the areas of hearing, seeing, moving, bending, reaching, fine motor skills, SLD amongst others.	https://www150.statcan.gc.ca/n1/pub/89-654-x/89-654-x2018001-eng.htm
CW2	The Accessible Canada Act	Employment and Social Development Canada, 2019	Its aim was to eliminate barriers and to ensure greater opportunities for people with disability in Canada.	Provided access for people with disabilities in areas under federal jurisdiction like information/communication technologies, accessible formats etc.	https://www.canada.ca/en/employment-social-development/programs/accessible-canada.html
CW 3	Canada Student Grant for Students with Permanent Disabilities	The Government of Canada , 2021b	This grant is available to students with permanent disabilities for each year of study to help eligible students in their education.	The grant assists eligible students to procure the necessary supports and or accommodation like provision of AT devices and services to enable them success in their education. Students also apply for a loan to get required AT devices and services.	https://www.canada.ca/en/employment-social-development/services/education/grants/disabilities.html

CW4	Support for New Accessible Technology Project	Innovation, Science and Economic Development Canada, 2021	It launched 5 projects which have received investments from the Accessible Technology Program carried out by the 5 selected companies.	These projects supported the development of assistive and adaptive digital devices and technologies for people with disabilities across Canada.	https://www.newswire.ca/news-releases/government-of-canada-announces-support-for-new-accessible-technology-projects-861076395.html
CW5	The Regulatory Context for Assistive Technologies and Accessible Products in Canada	Gordon et al., 2007	It aimed to assist people with disabilities to advocate for themselves and others as well as to provide essential and comprehensive information and suggestions for reform to ground the development of policy in a way that is responsive to the concerns of those who use and work with AT.	It dealt with issues like consumers of AT; clarified the political and legal landscape that governed the sale, use, importation, safety and labelling of AT in Canada including a description of the various funding programs for AT within the federal, provincial and territorial jurisdictions.	http://www.ic.gc.ca/app/oca/crd/dcmnt.do?id=1498&lang=eng
CW6	Canadian Assistive Technologies	The Canadian Assistive Technologies Limited team, 2021	To ensure that every person with disabilities has the tools and training they need in order to empower them to be able to live the lives they want through the power of accessibility.	On their website, there is a list of Disability Resources (by province/territory) for people with disabilities including AT devices and services to be acquired upon application.	https://canasstech.com/pages/resources
CW7	The Federal Disability Reference Guide	Government of Canada, 2013	To help ensure that federal programs, policies and services maintain or enhance the social and economic inclusion of people with disabilities.	It discussed some areas of AT use as follows: A T Links; AT Tools, Tips and Tricks etc. as per some policies and legislations.	https://www.canada.ca/en/employment-social-development/programs/disability/arc/reference-guide.html

CW8	March of Dimes Canada: Assistive Mobile Technology Initiative	March of Dimes Canada, 2016	It is aimed at providing AT devices and services to people with disabilities.	It supplies AT devices and services to children upon application by providing funding to cover costs of purchasing AT.	https://www.marchofdimma.ca/EN/eveeve/special/ppage/AssistivA-Mobile-Technology-Initiative.aspa
CW9	The Participation and Activity Limitation Survey (PALS)	Statistics Canada, 2008b	It is designed to collect information on adult and children with a disability.	It discusses the types of AT that children use, how they are acquired and the unmet and met needs of AT in Canada.	https://www150.statcan.gc.ca/n1/en/catalogue/89-628-X
CW10	Canada Student Financial Assistance Act, SC, 1994 C 28	Employment and Social Development Canada, 2021	The act and the annexed Regulations are to help the making of loans and the provision of other forms of financial assistance to students.	This financial assistance help the students with SLD to cover their cost of education-related expenses, services and equipment	https://www.canlii.org/en/ca/laws/stat/sc-1994-c-28/latest/sc-1994-c-28.html

3.7.4 Documents used for the Study

For this study, I used 24 (6 documents from Cameroon, refer to Table 4; 10 documents from Canada-Wide, refer to Table 5 and 8 documents from selected Canadian jurisdictions, refer to Appendix A) out of the 71 documents found in the form of laws, decrees, policies, legislations, country reports, manuals, school division and other related government websites, government reports and disability country survey reports from the countries. These documents were selected as they met the inclusion criteria mentioned earlier in this chapter (see Table 3). Using documents of all types helped me to uncover meaning, develop understanding and discover insights relevant to the research questions. Consultation and examination of documents gave easy access and stability as they could be reviewed several times. I also made sure that the selected documents were authentic, credible, meaningful and representative to the research topic (Bryman, 2016) as well as assessed the documents for "completedness, uneven or even, original purpose and the targeted audience" (Bowen, 2009, p. 34).

3.8 Data Analysis Method

I analyzed the data got from the selected documents concurrently as they were being collected from the documents, so as to enable me to reflect on and follow the study as it progressed (Glesne, 2015). I used document analysis to analyze the selected documents from the two cases that I had to study in this research. Document analysis can provide a window into a variety of historical, political, social, economic, and personal dimensions of the case beyond the immediacy of interviews and observations (Mills et al., 2012). Document analysis is the analysis of the content of documents and is a form of qualitative research that uses a systematic procedure to analyze documentary evidence and answer research questions as it focuses on what is written within the documents (Given, 2008). Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around an assessment topic (Bowen, 2009). The analytic procedure entails finding, selecting, appraising and synthesizing data contained in documents (Bowen, 2009). Document analysis also yields data (excerpts, quotations or entire passages) that are then organized into major themes, categories and cases examples specifically through content analysis (Labuschagne, 2003). Document analysis is particularly applicable to qualitative case studies producing rich descriptions of a single phenomenon, event, organization or program (Stake, 2006).

When I had collected all the data for the analysis, I coded the data elements (Braun & Clarke, 2013) and later used two methods of analysis to interpret the data which were within-case analysis and cross-case analysis (Merriam, 2013). After familiarizing myself with the data by reading and re-reading of the data, I went on to code the data elements. During the coding process, I worked systematically with all the documents attending to each document with equal consideration, and identifying aspects of the documents that are interesting and may be

informative in developing themes (Bryne, 2022). When all relevant documents have been coded, I reviewed the coded documents and analysed them so as to how the different codes may be combined according to shared meanings so that they may form themes (Bryne, 2022). The documents were stored in different folders in an electronic folder for each country as I went on to analyse and interpret the codes and themes, and identifying which were relevant to the research questions (Braun & Clarke, 2013; Bryne, 2022).

In the within-case country analysis, I organized and analyzed the data collected from the documents in the specific country as pertaining to the research questions. As part of the within-case analysis, I read my field notes generated during the document collection as I read through all the contents of the documents from each country a minimum of three times. I then took the documents one by one from each country and read, summarized and recorded what they said related to AT availability and on the laws, policies, and legislations on AT access and provision. Next, was the categorization of the selected documents and storing their electronic format and links in folders for each country in two designated electronic folders to be reviewed by my supervisor and I. After the completion of the within-case country analysis, the results in terms of emergent themes were written for both countries which led me to engage immediately in the cross-case country analysis to locate the commonalities and differences found between the two countries with data from the selected documents during the analysis (Stake, 2006). The purpose of the cross-case country analysis was to highlight the commonalities and differences within and across the countries on the use of AT in the school-based instruction of children with SLD.

3.8.1 Rationale for Data Analysis Method

I chose to use document analysis for the following reasons: Firstly, document analysis is an efficient and effective way of gathering data because documents are manageable and practical resources. Secondly, documents are commonplace and come in a variety of forms, making

documents a very accessible and reliable source of data (Bowen, 2009). Thirdly, obtaining and

analyzing documents is often far more cost efficient and time efficient than conducting your own

research or experiments (Bowen, 2009). Fourthly, documents are stable, non-reactive data

sources, meaning that they can be read and reviewed multiple times and remain unchanged by

the researcher's influence or research process (Bowen, 2009). Fifthly, documents can provide

background information and broad coverage of data, and are therefore helpful in contextualizing

one's research within its subject or field (Bowen, 2009). And lastly, document analysis can also

point to questions that need to be asked or to situations that need to be observed, making the use

of document analysis a way to ensure your research is critical and comprehensive (Bowen, 2009).

3.8.2 Procedure for Data Analysis

The steps that I took for the document analysis after obtaining the publicly available

documents from the comprehensive online searches were skimming, reading, delimitation,

categorization, storing, analysis, interpretation, and reporting as explained in Table 6.

Table 6

Steps for conducting the document analysis

Steps	Names of Steps	Steps that I took in the document analysis
1	Skimming	Skimming of the selected documents to check if the content were appropriate for use in the study as well as their originality (or "first-pass document review"-Bowen, 2009, p.32)
2	Reading	Thorough reading of selected documents to mark areas of texts or passages or words that were relevant to AT availability, laws, policies, and legislations on AT access and provision.
3	Delimitation	Browsing through the selected texts and identified sections that belonged to the topic and writing them down for help in answering the research questions.
4	Categorization and Coding	Content analysis was used to analyze the data collected from the relevant sections of the selected documents. The information was then organized into what is related to the research questions (Bowen, 2009) with the data coded generating themes for reviewing and analysis.
5	Storing	Selected documents were store in electronic folders for each country as

		the analysis was going on and could be reviewed several times to clarify a point.
6	Analysis	The selected documents concerning issues of AT availability, laws, policies, and legislations for AT access and provision for the two countries were briefly discussed stating their purposes and what aspects of AT was dealt with in the documents as per the emergent themes. Then, a within-case country analysis was done using the themes immediately followed by a cross-case country analysis to bring out the commonalities and differences between their approaches to AT availability and the laws, policies, and legislations available for AT access and provision.
7	Interpretation	The next phase of the analysis was to describe and analyzed the findings from the documents on AT related issues. There after the results were interpreted.
8	Reporting	The findings of Cameroon were presented before those of Canada according to alphabetical order of the names of the countries. The reflexive report writing was presented in one narrative comprehensive analysis to form a multifaceted overall picture.

3.9 Trustworthiness

Bryman (2016) explained different criteria for evaluating qualitative research such as credibility, dependability, confirmability, and transferability. I discussed how I achieved each of them in this study below. Trustworthiness is how authentic my results and findings will be and if I am saying exactly what is happening in the countries through the documents (Miles & Huberman, 1994). To ensure **credibility** of the study, I made sure that I selected just the right information that answers the research questions while taking care to clarify my biases at the onset of the study. In order for the document analysis results to be credible and valid (Bowen, 2009), I ensured that the originality of the documents were checked as there were documents from the official websites of each of the various Ministries, school divisions and international organizations.

To establish **dependability**, I produced evidence of a decision trail at each stage of the research process. I kept an audit trail to provide a rationale for my methodological and interpretative judgment as well as my detailed rich field notes. I ensured that I get rich

descriptions from documents and allowed my supervisor to audit my research methods (Lincoln & Guba, 1985). I used a journal to document the steps of data collection and analysis. Furthermore, an electronic folder was used to share my analysis with my supervisor as well as all other information about my research including decisions and interpretations made during my data collection and analysis.

To ensure **transferability,** I ensured that my results were meaningful to the countries not involved in the research study by writing the report using rich, thick descriptions (Lincoln & Guba,1985) and peer debriefing done by my supervisor to review my strategy and emerging themes before completing the data analysis process. In the policy arena, the notion of transferability of findings can be replaced with what Lingrad (2010) call "policy borrowing" and "policy learning" which refers to the governments looking at and taking up what their counterparts are doing and applying it to their contexts.

 To ensure **confirmability**, I provided explicit explanations regarding the case studies, data collection, management, interpretation and presentation process as well as show that the data represents the narratives from the documents and not the researcher's own views as will be evaluated by an external reviewer (s) who would provide an assessment of it.

3.10 Ethical Considerations

In this study, all the documents selected for analysis were handled with care in a consistent and ethical manner to ensure that there should be no risks involved in misinterpretations of the documents. The documents used were open access and were got from the government, school divisions or provincial websites which were valid and reliable.

3.11 Summary

In this chapter, the methodology of the study was highlighted. The data analysis was done as soon as the documents were being searched and selected. Issues of trustworthiness were addressed before, during and after the different stages of the research study. In the next chapter, the analysis and results of the study are presented.

Chapter 4: Analysis and Results

4.0 Introduction

Children with SLD encounter learning challenges when attending inclusive schools with children without SLD and so support is needed to help them in their education. One form of support to help these children in their education is the use of assistive technology. Assistive Technology greatly support children with SLD in bypassing their various learning challenges, encourages independence and helps them to excel in their education amongst other benefits. The purpose of this study was to critically explore and compare the use of assistive technology in the school-based instruction for children with SLD in Cameroon and Canada. This study was conducted to answer the two research questions below:

1) What are the assistive technologies that are used in the school-based instruction for children with SLD?

2) What laws, policies, and legislations have been enacted to control AT access and provision for children with SLD?

The purpose of this chapter is to analyze the selected documents and present the results of the analysis got through document analysis of the twenty-four selected documents analyzed from Cameroon and Canada which met the inclusion criteria outlined in chapter three. This study used the qualitative comparative case study research design as it consisted of studying two contrasting cases using more or less identical methods. The two geopolitical locales were selected using critical case purposive sampling. During the document analysis, selected documents which met the inclusion criteria were skimmed and read thoroughly to come out with portions which were related to the research questions discussed under ten emergent themes. The analysis of the results consisted of a within-case analysis and later a cross-case analysis between the countries to come

out with the commonalities and differences between Cameroon and Canada in terms of the use of assistive technology in the school-based instruction of children with SLD.

This chapter also includes the discussion of the ten emergent themes from the selected documents which related to the research questions under study. From the analyzed documents from Cameroon and Canada, various measures such as implementation of special and inclusive education, assistive devices programs, funding sources, social assistance, financial assistance and tax exemptions were used to make sure that AT is made available for people with disabilities including the children with SLD. Furthermore, there were also laws, policies, and legislations enacted by both countries to guide the access and provision of AT for children with SLD. Additionally, excerpts from the various selected documents from each country were used to support the analysis and results. A summary table is provided to aid comprehension of the analysis and results of the study. Lastly, trustworthiness of the study was ensured by various methods such as selecting just the right portion in the document concerned with the information to answer the research questions under emergent themes, keeping an audit trail, strategy reviewing by the supervisor at all stages of the research process including the analysis and an assessment from external reviewers.

The chapter was divided into five main sections namely the presentation of data in terms of within-case analysis using the emergent themes, thematic representation of the analysis and results, cross-case analysis, commonalities and differences between Cameroon and Canada and a brief summary of the chapter.

4.1 Within-Case Analysis and Results

The data obtained from the selected documents from both countries was analyzed using the within-case analysis and the results discussed in the form of the emergent themes given below.

4.1.1 Education is made accessible to children with disabilities.

Education is made accessible to children with SLD in Cameroon as has been shown from the documents excerpts below. In this document (*Law No.83/013 of 21st July 1983*) enacted by the government of the Republic of Cameroon in 1983 (with its decree of implementation *No. 90/1516 of November 26, 1990)*, the government of Cameroon legislated support for the education of children with disabilities and their integration in public general education schools. The law also contained provisions for various grants to support special education schools, special pedagogical assistance and training of the specialized staff. As indicated in section *1.1.4 of law No.83/013 of July 21st 1983 (Chapter 3, Article 1 and 3)* outlined some dispositions laid down by the government for the protection of persons with disabilities in Cameroon. It stated that:

> The education of children and young adults with disabilities shall take place in regular and special schools … in case of necessity, regular schools enrolling children with disabilities shall be provided with special teachers and didactic materials adapted to the children's needs. To ease access of pupils and students with disabilities into various classes in ordinary schools, these schools shall make the necessary adjustments to suit the needs of all children. (Cameroon, 1990, p.3)

Furthermore, another document (*Law No. 2010/002 of 13 April 2010*) on providing protection and promotion of people with disabilities in Cameroon mentioned some special measures to guarantee access for people with disabilities to education and vocational training as well as provide for the expenses of their education through various support provided such as the total or partial exemption from school and university fees; the granting of scholarships; exemption from age, the provision of adapted teaching material and specialized teachers. Excerpts of Articles 28, 29, 30 and 31 are shown ahead.

Article 28: The State takes special measures to guarantee access for people with disabilities to education and vocational training. These measures include:

- Material and financial support.

- Educational support. (Cameroon, 2010a, p. 4)

Article 29:

(1) The State contributes to the assumption of responsibility for the expenses of education and first professional training of the pupils and the handicapped indigent students.

(2) This support consists of the total or partial exemption from school and university fees and the granting of scholarships. (Cameroon, 2010a, p. 4)

Article 30:

Children and adolescents with disabilities of any kind benefit education and learning conditions adapted to their condition. (Cameroon, 2010a, p. 4)

Article 31:

Pupils and students with disabilities benefit from special measures including exemption from age, the provision of adapted teaching material and specialized teachers. (Cameroon, 2010a, p. 4)

Lastly, this document (*Decree No. 2018/6233/PM of 26 July 2018*) fixing the procedures for the application of *Law N° 2010/002 of 13 April 2010* on the protection and promotion of persons with disabilities in Cameroon, in its Article 3 (1) stated that the education of people with disabilities are provided by the State depending on the nature of disability to make education accessible to them and in Article 3 (2), disability should not be a reason for refusing the admission or registration of a child in any school. An excerpt of Article 3 is found below.

Article 3:

> (1) Education and vocational training of persons with disabilities are provided either in

> traditional training institutions and centers or in specialized training centers created or

> subsidized by the State, depending on the nature or degree of disability.

> (2) Disability is not, in any case, a reason for refusing the admission or registration of a

> student in a conventional institution or training center. (Cameroon, 2018, p. 2)

Similarly, in Canada, the *Accessible Canada Act* came into force on the 11th July 2019 and this *Accessible Canada Act* aimed at eliminating barriers and ensuring greater opportunities for people with disabilities in Canada (Employment and Social Development Canada, 2019). Specifically, the Act sets out to create a culture change, through monitoring and oversight, with respect to access for people with disabilities in areas under federal jurisdiction including buildings/public spaces, employment opportunities, information/communication technologies, delivering public programs/services and transportation (Employment and Social Development Canada, 2019). With respect to education, the federal government mandates that children must receive education and that public education must be accessible to all children in all the accessible formats (Employment and Social Development Canada, 2019). Based on these guidelines, each jurisdiction is left to implement their own system.

Additionally, another document called the *Policy on Accessible Education for Students with Disabilities, 2018* updates the *2004 Guidelines on Accessible Education* to take into account current social science research, case law developments, legislation and international human rights obligations (Ontario Human Rights Commission, 2018). It is the Ontario Human Rights Commission's intention that the *Policy on Accessible Education for Students with Disabilities, 2018* will help education providers recognize and fulfill their obligations under the Ontario

Human Rights Code, design their facilities, policies and procedures more inclusively, respond appropriately and in a timely way to accommodation requests, and effectively address complaints related to disability (Ontario Human Rights Commission, 2018).

The policy can also help students and their families understand their rights and responsibilities under the Ontario Human Rights Commission, clarify what it means to take part appropriately in the accommodation process, and know where to find further resources (Ontario Human Rights Commission, 2018). It is aimed at maintaining accessible, inclusive, discrimination and harassment-free education environments that respect human rights for all students with disabilities. The Ontario Human Rights Commission's *Policy on Accessible Education for Students with Disabilities* will help education providers recognize and fulfill their obligations under the Ontario Human Rights Code, design their facilities, policies and procedures more inclusively, respond appropriately and in a timely way to accommodation requests, and effectively address complaints related to disability before they escalate to human rights claims made to the Human Rights Tribunal of Ontario (Ontario Human Rights Commission, 2018). The other jurisdictions in Canada have similar policies in place to ensure that education is made accessible to children with disabilities but there are differences between the jurisdictions and the federal system of Canada.

From all the various documents analyzed from both countries above, it can be seen that both countries have employed special measures to ensure that education is made accessible to children with SLD. These measures included providing children with SLD with didactic materials adapted to the children's needs, providing all the expenses needed by them, total or partial exemption from school fees, granting of scholarships, exemption from age, provision of adapted teaching materials and specialized teachers, material, financial and educational support

amongst other resources. It is true that with these measures, education is made readily accessible to children with SLD in both countries.

4.1.2 Special education is provided to equip children with SLD with effective programs and services.

In Cameroon, there is provision for special education for people with disabilities including children with SLD as can be seen from these documents. For example, in *Decree N °90/1516 of November 26, 1990* (fixing the modalities of application of *Law N ° 83/013 of July 21, 1983* relating to the protection of persons with disabilities) concerning the education of children with disabilities including children with SLD in its Articles 1, 2 and 3 stated below.

Article 1:

The education of children and adolescents with disabilities is provided in ordinary schools and special education centers. (Cameroon, 1984, p. 1)

Article 2:

1) Children with hearing, visual or mental disabilities benefit from a special education allowing them to acquire the autonomy necessary for their enrollment in ordinary schools.

2) This training is provided in special education centers. However, sections of initiation to the communication methods necessary for the integration of disabled children can be created in ordinary schools.

3) The evaluation reports drawn up in these titles guide school placements. (Cameroon, 1984, p. 1)

Article 3:

1) Ordinary schools in which disabled children are enrolled are provided, if necessary, with specialized staff and teaching material adapted to the requirements of their educational framework.

2) To facilitate the access of handicapped pupils and students to the classes, the ordinary

schools which welcome them include as far as possible the necessary arrangements.

(Cameroon, 1984, p. 1)

In another document (*Law No. 2010/002 of 13 April 2010)* on providing protection and

promotion of disabled people in its Article 16 mentions the rehabilitation that is offered to people

with disabilities to better equip them which includes special education amongst others. An

excerpt of Article 16 is found below.

Article 16:

(1) Rehabilitation aims to enable the disabled person to reach and maintain an optimal

functional level from a physical, sensory, intellectual and psychosocial point of view, and

thus to equip them with the means to acquire greater autonomy.

(2) It includes:… special education of the disabled person. (Cameroon, 2010a, p. 3)

Furthermore, in the same document, its Article 24 mentioned that special education

consists of initiating the physically, sensory, mental and multiple handicapped people in the

methods of communication appropriate in order to enable them to have access to normal

schooling and, later, to vocational training. An excerpt of Article 24 is found below.

Article 24:

Special education consists of initiating the physically, sensory, mental and multiple

handicapped people in the methods of communication appropriate in order to enable them

to have access to normal schooling and, later, to vocational training. (Cameroon, 2010a, p.

5)

Similarly in Canada, there are also federal and provincial/territorial provisions for

special education for children with SLD in all the 13 jurisdictions. For example in the province

of Ontario, this document, S*pecial Education in Ontario, Kindergarten to Grade 12: Policy and Resource Guide (2017)* provides information on how special education is carried out in Ontario for students who have behavioural, communicational, intellectual, physical, or multiple exceptionalities who require special education programs and/or services to benefit fully from their school experience (Ontario Ministry of Education, 2017). Special education programs and services primarily consist of instruction and assessments that are different from those provided to the general student population. These may take the form of accommodations (such as specific teaching strategies, preferential seating, and assistive technology) and/or an educational program that is modified from the age-appropriate grade level expectations in a particular course or , as outlined in the Ontario Ministry of Education's curriculum policy documents (Ontario Ministry of Education, 2017). The Ontario Ministry of Education developed the document *Special Education in Ontario, Kindergarten to Grade 12: Policy and Resource Guide (2017)* to support educators in the implementation of effective programs and/or services for students with special education needs. This provincial policy illustrates the other types of policies in the other Canadian jurisdictions even though there are differences between the jurisdictions and the federal system of Canada.

To conclude from the analyzed documents, it can be deduced that both countries provide special education for the children with SLD. This special education is provided with all the necessary support, accommodations and other resources to better equip these children with effective programs and services to help them in their education and future life. In special education, the children are provided with specialized staff and teaching material adapted to their needs, rehabilitation and special education programs and/or services like differential instruction

and assessment, specific teaching strategies, preferential seating, assistive technology, modified educational program amongst others.

4.1.3 Inclusive education is being practiced but needs more resources for its full implementation.

In Cameroon, inclusive education is being practiced with some resources and support to help students with SLD in their education. Some documents stated what is done as far as inclusive education is concerned. For example, in the document (*Decree N° 2018/6233/PM of 26 July 2018)*, in its Article 4 stated that the State of Cameroon promotes inclusive education and vocational training through various ways as shown from the extracts below.

Article 4: The State promotes inclusive education and vocational training for people with disabilities through:

- Introduction to appropriate communication methods allowing them to access normal schooling and vocational training programs.

- the development of standards in school, university and vocational training programs for teachers to learn sign language and braille.

- the development of traditional public institutions to facilitate access for pupils and students with disabilities in classrooms.

- the provision of specialized teachers and trainers in public schools and universities that receive pupils and students with disabilities;

- the assignment of qualified personnel in private special education institutions;

- initial and continuing training of specialized staff in the supervision of disable people,

- the provision of pupils and students with disabilities with educational materials appropriate to the nature of the disability;

-the use of interpreters for sign language in schools or universities;

- the introduction for the hearing impaired of the spell check test in place of the dictation test;

- the installation of pupils or students with disabilities in rooms located on the ground floor or near the board, depending on the nature of their handicaps, exempts them from age. (Cameroon, 2018, p. 2)

Similarly, in Canada, all the 13 jurisdictions encourage inclusive education by enacting policies required for its support of all children including those with SLD. For example, the New Brunswick's *Policy 322* on *Inclusive Education* was introduced in 2013 after a comprehensive review. To ensure that all provincial public schools are inclusive, the policy defined a system that supports students in common learning environments. *Policy 322* stated out clear requirements for each educational authority including procedures for the development of personalized learning plans, inclusive graduation, and clear guidelines for any variation to the common learning environment (New Brunswick Department of Education and Early Childhood Development, 2013). The New Brunswick *Policy 322* is a provincial legally-binding policy that sets out the requirements of an Inclusive Education system for all public schools, overseen by the Department of Education and Early Childhood Development (New Brunswick Department of Education and Early Childhood Development, 2013). It laid out in detail standards for inclusion, including requirements for all school personnel to ensure that each student can fully participate in a common learning environment by applying student-centred learning and providing accommodations (including AT devices and services) with variations occurring only under strictly limited conditions (New Brunswick Department of Education and Early Childhood Development, 2013). This provincial policy illustrates the other types of policies for the

provision of inclusive education in the other Canadian jurisdictions recognizing that there are differences between these jurisdictions to the federal system of Canada.

To sum it up from the analyzed documents from both countries, inclusive education is practiced in both countries but more resources are needed for its full implementation in all jurisdictions in both countries. This would involve putting measures in place to ensure that they are enough trained personnel, assistive technologies for each child, access of children with SLD to the classrooms, educational materials for the children, sign language interpreters, accommodations amongst others.

4.1.4 Assistive Technology is provided but needs remain.

From the selected parts of these documents below from Cameroon and Canada, it can be concluded that AT is provided for people with disabilities including children with SLD in both countries. For example, in Cameroon, *Decree No. 90/1516 of November 26, 1990* was signed by the Cameroon Government fixing the modalities of the application of the *Law No. 83/013 of July 21, 1983* relating to the protection of persons with disabilities in Cameroon. This decree in its *Article 3* stated that children with disabilities should be enrolled in ordinary schools with the provision of specialized staff and teaching materials adapted to their needs such as assistive devices (Cameroon, 1984). Yet another decree, *Decree No. 2010/0243 / PM of February 26, 2010* laid provision of aids and relief offered to people with disabilities and in its *Article 6 (2)* explicitly mentioned some of these AT as shown below.

Article 6 (2):

> These aids and relief consist in particular of : apparatus and equipment adapted to the indigent and the needy, to namely, among others, tricycles, white canes, prostheses, arm chairs manual or electric rollers, crutches, Canadian crutches, English canes, audiophones, walkers, braille machines, orthotics, orthopedic shoes, dentures, wristwatches for blind,

the provision of school supplies and teaching materials; the supply of certain foods and

clothing; of legal aid; grants or financial assistance to support social and economic

integration or reintegration. (Cameroon, 2010b, p. 3)

Also, another document (*Law No. 2010/002 of April 13, 2010)* on the provision of

protection and promotion of disabled people in Cameroon, in its *Article 31* and *32* below, stated

that pupils and students with disabilities benefitted from the provision of adapted teaching

materials and access to information and communication technologies amongst other measures.

Excerpts of Articles 31 and 32 are given below.

Article 31:

Pupils and students with disabilities benefit from special measures including exemption

from age, the provision of adapted teaching materials and specialized teachers.

(Cameroon, 2010a, p. 4)

Article 32:

The State, decentralized territorial communities and civil society take all appropriate

measures to facilitate access for people with disabilities to Information and

Communication Technologies. (Cameroon, 2010a, p. 4)

Still in Cameroon, another document, *Decree No. 2018/6233/PM of 26 July 2018* was to

lay down the terms and conditions of enforcement of *Law No. 2010/002 of 13 April 2010* on the

promotion and protection of persons with disabilities. In its *Article 4,* the State promotes

inclusive education and vocational training for person disabilities through: *"the provision of*

pupils and students with disabilities with educational materials appropriate to the nature of the

disability" (Cameroon, 2018, p. 2)

In its *Article 6*, the State shall make appropriate arrangements for the equitable participation of persons with disabilities in official examinations and competitions. These include: "the development of the conditions for the conduct of tests, such as to enable them to use teaching materials, technical aids, or to use human accompaniment adapted to the nature of their disability"(Cameroon, 2018, p. 3) Furthermore, in its *Article 11*, the didactic support provided for consisted of: "the equipment of the multimedia rooms of the special examination centers for the visually impaired with voice screen review system by standardizing the methods of rendering official examination by type of disability"(Cameroon, 2018, p. 4).

Similarly in Canada, from the analyzed documents, it was found out that AT is available in Canada for use by people with disabilities including children with SLD but there are still unmet needs for AT. For example, in the document, *Participation and Activity Limitation Survey 2006: A Profile of Assistive Technology for People with Disability*, it was found out that: "90,480 children aged 5 to 14 used or needed assistive technology to help them participate in their daily activities, representing slightly more than half (51.8%) of all children with disabilities in that age group in Canada" (Statistics Canada, 2008b, p. 20). Considering all of the needs for AT reported by children needing or using this technology, *Participation and Activity Limitation Survey 2006* found that:

> "slightly less than half of all children's needs for assistive technology were met
> completely (45.3%), one quarter had none of the assistive technology they needed,
> (24.6%) and the remaining third had some of the equipment they required but needed
> more (30.1%). The number of children who had completely met needs did not seem to
> depend on the degree of severity and were quite evenly split among mild, moderate,
> severe or very severe degrees of disability. The same can be said for children who have

completely unmet needs except for those with a mild disability where there are only

13.2% of them. In terms of gender differences, girls had a significantly higher rate of met

needs regarding the use of assistive technology. More specifically, 48.7% of girls were

already using all the aids that they needed compared to 43.4% of boys who reported the

same. Consequently, boys experienced higher levels of unmet need than girls (27.0% and

20.4%, respectively). The type of assistive devices used by children with disabilities

varied by the type of disability but for each type of limitation, children used the same

assistive devices. Over half of children with disabilities aged 5 to 14 who required aids

and assistive devices do not have their needs fully met (Statistics Canada, 2008b, p. 20)

Also, in the *Federal Disability Reference Guide* prepared by the Government of Canada in

2013 also had a section dealing with the acquisition of AT for people with disabilities. In Section

D of the *Federal Disability Reference Guide,* it mentioned many types of AT through various

links together with information about AT, tools, tips, programs and services to help them apply

and secure the AT of choice. Section D would be briefly discussed in the 4 areas of what each

area entails as follows:

Assistive Technology Links includes resources on the Canadian Assistive Devices

Industry, development groups, and the acquisition of assistive devices; *The Workplace*

Accommodation Toolkit provides information about different assistive technologies,

services and accommodations that are available to people with disabilities; *Assistive*

Technology Tools, Tips and Tricks contains information and resources on assistive

technology that targets students and adults with learning disabilities or other cognitive

challenges and *Environment Canada's Adaptive Computer Technology Program* assists

with the workplace integration of people with visual-, mobility-or sensory-related

disabilities who require computer access. Environment Canada currently provides

Adaptive Computer Technology services to other government departments. (Government

of Canada, 2013, Section D)

Additionally, the *Canadian Assistive Technology website* developers who have been

supplying AT for people with disabilities for 30 years have a website that strived to ensure that

every person with a disability including children with SLD have the AT tools and training they

need in order to empower them to be able to live the lives they want through the power of

accessibility. The website listed ATs for low vision, visual impairments, custom computer

configurations and web accessibility solutions. For example, screen magnification software and

electronic magnifiers such as closed-circuit televisions, both Desktop and Portable; Braille

embossers and note-takers, digital book players and even Global Positioning System Mobility

solutions; building of computer system specific to your Assistive Technology needs, and can

offer desktop or laptop systems in PC or MAC environments, making every website accessible

and implement accessibility solutions (Canadian Assistive Technology Limited Team, 2021).

Furthermore, the *2017 Canadian Survey on Disability* was a national survey of Canadians

whose everyday activities are limited because of a health related problem. The *Canadian Survey*

on Disability was developed by Statistics Canada in collaboration with Employment and Social

Development Canada and conducted from March 1 to August 31, 2017. The survey reported on

the type of technology-based aids and assistive devices which were used by people with

disabilities to include cellphone, smartphones, or smart-watch with specialized features to help

with their condition, computer, laptop or table with specialized software or other adaptations to

help with their condition, recording equipment or a portable note-taking device, device for

playing audio books or e-books, textbooks in e-format, or closed circuit devices (Statistics

Canada, 2017). Furthermore, the most commonly required technology-related aids or assistive

devices were a computer, laptop or tablet with specialized software or other adaptations (43.6%),

recording equipment or portable note-taking device (26.6%), or a device for playing audio books

or e-books (20.2%) or computer with specialized glasses (17%) and wireless handheld device

with specialized features (15%). Students with disabilities most commonly reported having

unmet needs for a device for playing audio books or e-books (52.0%) and a recording equipment

or a portable note taking device (46.3%) (Statistics Canada, 2017). The technological-based aids

and assistive devices were used by people with disabilities including children with SLD together

with other software such as below:

> Among those who used a phone or computer device, 39.3% had a device with speech-to-
>
> text, text-to-speech or voice recognition software, 30.0% had one with screen
>
> magnification software, and 16.4% had a device with a screen reader. About one-quarter
>
> (25.2%) of persons with disabilities used a device for playing audio books or e-books and
>
> 83.3% reported the audio or e-books were available in an accessible format for them.
>
> (Statistics Canada, 2017, p. 10).

And lastly, *the Regulatory Context for Assistive Technologies and Accessible Products in*

Canada was a report of a project prepared by Gordon et al. of the Arch Disability Law Centre in

2007. The project aimed to assist people with disabilities to advocate for themselves and others

as well as to provide essential and comprehensive information and suggestions for reform to

ground the development of policy in a way that is responsive to the concerns of those who use

and work with AT. The report was divided into four parts and found out that: "There were

multiple funding programs for AT throughout Canada and the Government of Canada must work

with provincial and territorial governments to establish consistent and comprehensive funding

programs that make assistive devices available to all who need them and to ensure that all necessary regulations are in place, enforced and effective" (Gordon et al., 2007, p. 8) amongst others.

From the analyzed documents from Cameroon and Canada, it can be noted that both countries provide AT for people with disabilities including children with SLD although there are still unmet needs of AT in both countries. Some of these AT provided for children with SLD are audio phones, Braille machines, wristwatches for the blind, screen magnification software, electronic magnifiers, note takers, digital book players, wireless handheld device, computer with specialized software, smartphones, smart-watch with specialized features, computer, laptop or table with specialized software or other adaptations, recording equipment or a portable note-taking device, device for playing audio books or e-books, textbooks in e-format, or closed circuit devices amongst others. It is thus evident that AT is available for the school-based instruction for children with SLD but needs remain. So, both governments should look for strategies to ensure that every child in need of an AT receives it due to the many benefits of AT to children with SLD.

4.1.5 Social assistance is provided for children with SLD but more assistance is needed.

Social assistance would be used to mention all the benefits, support, services and public assistance given to people with disabilities. From the Cameroon documents, the government in its *Law No. 83/013 of 21 July 1983* relative protection of people with disabilities laid out provisions for some types of social assistance provided for people with disabilities such as individual and collective aid granted to the disabled people as part of public assistance such as the disability pension, exemption from school fees for children born to indigent disabled parents and various emergency services. An excerpt of Article 8 is below.

Article 8:

(1) Individual and collective aid may be granted to disabled people as part of public assistance. They concern in particular:

- the disability pension

- exemption from school fees for children born to indigent disabled parents

- various emergency services,

(2) Assistance to the disabled is proportional to the degree of disability of the beneficiary. (Cameroon, 1984, p. 2)

Also, in this other document in Cameroon (*Decree No. 90/1516 of 26 November 1990)*, some other supports are mentioned to help people with disabilities in *Article 27 (2)* in the form of "durable relief which is social assistance linked to needs requiring sustained assistance as concern: equipment, school aids or any assistance deemed as such by the Minister in charge of Social Affairs" (Cameroon, 1990, p.7).

On the other hand, in Canada, social assistance is provided to persons with disabilities including children with SLD in all 13 jurisdictions in the form of school-based student support units and other measures. For example, in the province of Manitoba, the *Student Services Unit* includes a team of consultants who have education and experience in working with students with SLD in the school system. The student service unit consultants support the work of student support teams in Manitoba schools. A student service unit consultant may consult with student support teams related to school-based, classroom-based or student-specific planning and programming (Manitoba Education, 2015). The student service unit consultants may also support school or division teams by providing workshops on topics relevant to the student support role. Student service unit consultants can support school and division teams in many areas such as

classroom support; student-specific needs; transition planning, student-specific planning; positive behaviour supports (Manitoba Education, 2015) amongst others.

Manitoba Education has developed a lending library for Assistive Technology software available to school divisions in rural and northern Manitoba from their student services unit. They are also consultation and workshops together with consultation support available to assist in selection and implementation of AT software based on classroom and student needs. Schools can borrow AT through the Alternative Format Services for students with other print disabilities and other special equipment from Manitoba Education to support learning for students who are blind or visually impaired, based on the recommendation of the consultant for the blind and visually impaired and equipment availability (Manitoba Education, 2015). These items (for example, braille writer, closed-circuit television magnification system, computer access devices) are assistive devices not normally available in the classroom (Manitoba Education, 2015). Consultants may also provide direct teaching for students who use these devices. The student services also provide professional development sessions available on request of the student services administrator. This provincial student support services unit illustrates the other types of student support services unit and other measures for the provision of social assistance in the other Canadian jurisdictions recognizing that there are differences between these jurisdictions and the federal system of Canada.

Also, students with SLD in Canada could also be assisted in the acquisition of AT by public funding or payment from parents/family members or loaning or renting as explained in the document (*Participation and Activity Limitation Survey 2006: A Profile of Assistive Technology for People with Disability)* in the excerpt below:

The *Participation Activity and Limitation Survey (2006)* results also show that the burden of paying for a child's aids mostly fell on the child's parents and /or family members. Across Canada, parents or family members were the main contributors for children's aids (60.7%). Another common payment source for children's aids came from public funds such as the health care system and other government programs. For all of Canada, 21.4% of assistive devices were paid for through public funds. Nearly one in ten (7.6%) aids used by Canadian children aged 5 to 14 were rented or purchased with a payment plan. The most commonly cited reason for children not having the aids they needed was cost. More specifically, 56.6% of respondents, across Canada, stated cost as the main reason for unmet needs. (Statistics Canada, 2008b, p. 24)

Furthermore, still in Canada, on the Innovation, Science and Economic Development Canada's website on *Support for new accessible Technology Projects*, the government of Canada is investing in the *Accessible Technology Program* to empower all Canadians including those with disabilities to support them in their education and community life. Furthermore, the Honourable François-Philippe Champagne, Minister for Innovation, Science and Industry, announced five projects to be funded under the federal *Accessible Technology Program* to support the development of assistive and adaptive digital devices and technologies (Innovation, Science and Economic Development Canada, 2021). The *Accessible Technology Program* will co-fund innovative projects led by the private sector, not-for-profit organizations and research institutes to develop new assistive and adaptive digital devices and technologies in order to make it easier for Canadians with disabilities to more fully participate in the digital economy (Innovation, Science and Economic Development Canada, 2021). So far, the government of Canada has funded 25 projects with the announcing of 5 new projects on April 15, 2021. An

example of one of such funded projects which had received investments from the *Accessible Technology Program* was the $212,500 for AbleDocs Inc. to develop an assistive reader that reads PDF content for persons living with visual and cognitive impairments, providing better access to information on the Internet on both Android and iOS devices (Innovation, Science and Economic Development Canada, 2021).

From the analyzed documents from Cameroon and Canada, it showed that various types of social assistance are being offered for children with SLD but more social assistance is still required. Social assistance would consist of all the benefits, support, services and public assistance that are given to children with SLD in the community. It can be noted that some forms of social assistance can individual and collective aid granted to children with SLD which could be used to purchase AT for their use; durable relief which is social assistance linked to needs like purchase of equipment, school aids and so on; various Student Support services units which help students to provide classroom support, student-specific needs such as AT needs amongst others. Furthermore, social assistance can take the form of public assistance to children with SLD whereby even a parent or family member or the government or a Non-governmental or charity organization can procure an AT device for children with SLD. Government funded programs also help in the provision of AT for children with SLD.

4.1.6 Laws, policies and legislations exist to guide the access and provision of AT for children with SLD but needs revision and improved implementation.

The laws, policies and legislations enacted by both Cameroon and Canada on AT access and provision helps to establish a rationale for different forms of provision as well as secure the few resources and ensures that they are well managed. For example, In Cameroon, there are some laws, decrees and circulars on persons with disabilities dealing with issues of AT access

and provision even though not explicitly mentioned in the documents such as the *Cameroon Ministry of Social Affairs (MINAS) website* which has all the laws, decrees and circulars enacted for the protection of persons with disabilities (MINAS, 2018). MINAS is thus responsible for the development and implementation of government policy on prevention, assistance and protection for persons with disabilities. For example, *Law No.83/013 of 21 July 1983* in its Articles 6 and 8 below explains briefly how the State contributes to cover the expenses of education and vocational training for all children with SLD through allocation of special aid, individual and collective aid amongst others. An excerpt of Article 6 and 8 are found below.

Article 6:

The State contributes to the extent of its means, to cover the expenses of education and first vocational training of handicapped children, by welcoming them in its establishments, or by allocating special aid for their education, at the request of the latter or their legal guardian. (Cameroon, 1984, p. 2)

Article 8:

(1) Individual and collective aid may be granted to disabled people as part of public assistance. They concern in particular: - the disability pension

- exemption from school fees for children born to indigent disabled parents

- various emergency services,

(2) Assistance to the disabled is proportional to the degree of disability of the beneficiary. (Cameroon, 1984, p. 2)

Another document in Cameroon is *Decree No. 2018/6233/PM of 26 July 2018* which mentions in its Article 9 that people with disabilities receive support for education and vocational training in various means such as total or partial exemption from school and university fees,

granting of scholarships and the granting of subsidies for the purchase of didactic equipment (including assistive devices). An excerpt of Article 9 is provided.

Article 9:

> (1) Indigent people with disabilities receive support for education and vocational training.
>
> It is: - total or partial exemption from school and university fees
>
> - the granting of scholarships
>
> -the granting of subsidies for the purchase of didactic equipment for the supervision of disabled people with special educational needs. (Cameroon, 2018, p. 3)
>
> Another document is (*Law No. 2010/002 of 13 April 2010)* which provides measures for

the protection and promotion of people with disabilities and in its Article 1 in terms of "prevention of disability and the rehabilitation, ensuring the psychological, social and economic integration of the disabled person and promotion of national solidarity towards people with disabilities" (Cameroon, 2010a, p. 1)

In the same vein, in Canada, the federal as well as the 13 provincial/territorial governments have all enacted policies and legislations on AT access and provision explicitly mentioned in many of their documents. For example, in the document, The *Regulatory Context for Assistive Technologies and Accessible Products in Canada, 2007* in its part IV, it "offers law reforms and policy approaches for the regulation of assistive devices in a manner that maximizes their accessibility and safety" (Gordon et al., 2007, p. 8). Also, the *Disability Reference Guide* is a tool for identifying, clarifying and promoting policies to address issues that affect people with disabilities. While the objective of the *Disability Reference Guide* is to help ensure that federal programs, policies and services maintain or enhance the social and economic inclusion of people

with disabilities, much of the *Disability Reference Guide'*s content may be of use to other governments, organizations or institutions (Government of Canada, 2013).

The *Disability Reference Guide* can help to "ensure that legislation, policies, programs and services: are inclusive of people with disabilities; respect the rights and needs of people with disabilities; and promote positive attitudes and raise awareness about the needs of people with disabilities in order to prevent unintended negative outcomes"(Government of Canada, 2013, p. 1). The *Disability Reference Guide* also acts as a resource in the creation of policies and programs that reflect of the rights and needs of people with disabilities in Canada. The *Disability Reference Guide* stresses that it is necessary to "ensure that government policies and practices do not have unintended negative consequences on people with disabilities and help to prevent barriers to accessibility" (Government of Canada, 2013, p. 8) in their education and community life. Thus, policy and program design should always consider the needs of the people with disabilities.

Additionally, the province of Alberta's document on *Learning and Technology Policy Framework* is available which was enacted in 2013 by Alberta Education. The *Learning and Technology Policy Framework* explained how using technology supports the development of competencies in all students including students with SLD (Alberta Education, 2013). The *Learning and Technology Policy Framework* involves the following five areas of policy: "student-centred learning; research and innovation; professional learning; leadership; and access, infrastructure and digital learning environments" (Alberta Education, 2013, p. 6). These five policy directions provided comprehensive structures to enable the innovative use of technology in learning, teaching, leadership and administration. The Alberta's *Learning and Technology Policy Framework* established a common vision for government and school authorities across the

province with respect to how technology should support student learning in the K-12 education system (Alberta Education, 2013). This vision of student-centred learning emphasizes the importance of enabling and supporting students to use technology (especially AT for students with SLD) to create and share knowledge (Alberta Education, 2013). This provincial policy illustrates the other types of policies for AT access and provision in the other Canadian jurisdictions recognizing that there are differences between these jurisdictions to the federal system of Canada.

From the various documents analyzed from Cameroon and Canada, it can be seen that there exist laws, policies and legislations which dictate how AT is accessed and provided for people with disabilities either explicitly or otherwise mentioned in the documents. These laws, policies and legislations need revision and improved implementation for them to meet the growing needs of AT for children with SLD.

4.1.7 Financial assistance is provided to purchase AT but more financial assistance is needed.

From the careful study of the selected parts of the documents from Cameroon and Canada, I realized that both countries provided some form of financial assistance in terms of aid, relief funds, grants, student aids or loans to help students for their education-related expenses, acquisition of assistive devices and services amongst others. For example, from this document in Cameroon (*Law No. 83/013 of 21 July 1983*) which was enacted for the protection for people with disabilities stated in its Article 6 that the State provides financial assistance which covers the expenses of education and vocational training for the children with disabilities by welcoming them in schools or by allocating special aid for their education. An excerpt of Article 6 is found below.

Article 6:

The State contributes to the extent of its means, to cover the expenses of education and

first vocational training of handicapped children, by welcoming them in its

establishments, or by allocating special aid for their education, at the request of the latter

or their legal guardian. (Cameroon, 1984, p. 2)

Also, in this document (*Law No. 2010/002 of 13 April 2010*) in its Articles 28 laid out

special measures to guarantee access for people with disabilities to education and vocational

training such as material, financial and educational support. Also in its Article 29, the State

contributes to the assumption of responsibility for the expenses of education and first

professional training of the pupils and students with disabilities with support consisting of the

total or partial exemption from school and university fees and the granting of scholarships.

Excerpts of Articles 28 and 29 are provided below.

Article 28:

The State takes special measures to guarantee access for people with disabilities to

education and vocational training. These measures include material, financial and

educational support. (Cameroon, 2010a, p. 4)

Article 29:

(1) The State contributes to the assumption of responsibility for the expenses of education

and first professional training of the pupils and the handicapped indigent students.

(2) This support consists of the total or partial exemption from school and university fees

and the granting of scholarships. (Cameroon, 2010a, p. 4)

Additionally, another document in Cameroon (*Decree No. 2010/0243 / PM of February

26, 2010*) was signed by the government of Cameroon fixing the modalities for the exercise of

the powers transferred by the State of Cameroon to the Communes in terms of the allocation of

aid and relief to the indigent and the needy including persons with disabilities. These aid, relief, grant or financial assistance in the form of donations in kind or services and in cash helped children to acquire ATs for their use in the classroom amongst other education-related expenses. An excerpt of the Decree's Article 6(1) and (2) is provided.

Article 6:

(1): Aid and relief to be awarded to the indigent and the needy are mainly in kind, in the form of donations or services, and exceptionally, in cash.

(2) These aids and relief consist in particular of ...grants or financial assistance to support social and economic integration or reintegration. (Cameroon, 2010b, p. 3)

Also, another document, Decree No.95/1516 of 26th November *1990* signed by the Cameroon government also brought out the various aids to education provided to children with SLD. In the Decree's Article 4 below, it listed some forms of educational aid provided for children with SLD such as educational and financial support amongst others (Cameroon, 1990). Further, in its Article 5, subsection 4, it stated that: "Aid for education and vocational training for young people with disabilities includes: the assignment of qualified persons to private special education institutions and the allocation of subsidies or specialized teaching material, the allocation of school and university grants, aid in cash or in kind to indigent handicapped young people and children born to handicapped and needy parents" (Cameroon, 1990, p. 2). Additionally, in the same document, Article 6 explained that subventions were given to schools engaged in the education of children with SLD for their support/ accommodations like the provision of AT devices and services as well as to cover all or part of their cost of schooling as well as the allocation of scholarships to them (Cameroon, 1990).

On the other hand, while Canada's education system falls primarily under provincial and territorial responsibility, the Government of Canada also provides the *Canada Student Grant for Students with Permanent Disabilities in Canada* despite the fact that *Students Financial Acts* are found in each of the 13 jurisdictions (Government of Canada, 2021b). The Government of Canada makes this grant available to students with disabilities for each year of study from August 1st to July 31st. Students with disabilities can apply at the same time as they apply for student aid within their province or territory. This grant is not available to students from the Northwest Territories, Nunavut and Québec as they have their own student aid programs. Students could be eligible for this grant if they apply and it is verified that they: have a financial need; are a student in a qualified program at a designated school; are a student with a permanent disability; and should include one of the following with their loan application as proof of their disability: a medical certificate; a psycho-educational assessment; or documents that prove you have received federal or provincial permanent disability assistance. Until the end of the 2022 to 2023 school year, the students would each receive $4,000 per year as long as they still qualify and the amount of the grant remains the same regardless of their assessed need (Government of Canada, 2021b). This could reduce or replace the need for a student loan. Furthermore, through these grants, the Government provides financial assistance to help cover the costs of accommodation, tuition, books, and of exceptional education-related costs such as tutors, oral or sign interpreters, attendant care for studies, note takers, readers and Braillers (Government of Canada, 2021b).

Additionally, the *Canada Student Loans Program* offers loan forgiveness for qualifying borrowers who have a severe permanent disability and the *Disability Supports Deduction* provides tax relief for: "the cost of disability supports incurred for the purposes of education,

such as sign language interpretation, talking textbooks and other AT devices and services"
(Gordon et al., 2007, p. 20). Similarly, there is also the *Canada Student Financial Assistance Act*
which went in force in 1994 with each of the 13 jurisdictions enacting the *Act* with the aim of
helping to give out loans and provision of other forms of financial assistance to students
including students with SLD to cover their education-related costs and equipment amongst other
needs together with the *Canada Student Financial Assistance Regulation SOR/98-829*
(Employment and Social Development Canada, 2021). All these Acts and Regulations help
students with SLD with their education-related expenses but more financial assistance is always
needed to help meet their unmet needs.

Lastly, a parent or guardian in the province of Ontario who is caring for a child with a
severe disability may be able to get financial support through *the Assistance for Children with
Severe Disabilities Program* funded by the Ontario Ministry of Children, Community and Social
Services. *The Assistance for Children with Severe Disabilities Program* provides financial
support for low-income and moderate-income families to cover some of the extra costs of caring
for a child who has a severe disability (Ontario Ministry of Children, Community and Social
Services, 2021). Eligible parents and guardians can receive between $25 and $500 a month to
help with disability-related costs even in this COVID-19 era (Ontario Ministry of Children,
Community and Social Services, 2021). The financial support for disability-related costs is given
depending on your household income, the size of your family and your child's disability-related
costs and the program may provide between $25 and $500 a month to help with costs such as:
travel to doctors' appointments, hospitals and other appointments related to the child's disability;
special shoes and clothes and parental relief such as respite (Ontario Ministry of Children,
Community and Social Services, 2021). In addition to the *monthly financial support,* children

receiving *Assistance for Children with Severe Disabilities* also receive coverage for: an assessment for an assistive device and/or the consumer contribution for a device provided under the assistive devices program; batteries and repairs for mobility devices; hearing aids and vision care, including eyeglasses and so on (Ontario Ministry of Children, Community and Social Services, 2021). This provincial financial assistance illustrates the other types of financial assistance/programs in the other Canadian jurisdictions recognizing that there are differences between these jurisdictions and the federal system of Canada.

From the documents analyzed from both countries, it showed that financial assistance is provided for children with SLD to purchase AT but more financial assistance is needed to help them in the procurement of AT as well as their other education-related expenses. This financial assistance can take the form of aid, relief, grants, funds, loans, allocation schools with a special aid for educational needs for children with SLD, educational support, assistance programs, monthly financial support, coverage for an assessment for an assistive device amongst others.

4.1.8 Funding sources exist to support access to AT but the funding is insufficient.

In Cameroon, this document (*Decree N°. 90/1516 of 26 November 1990)* in its Articles 4 and 23 (1) and (2) dealt with all the educational, individual social assistance and collective aid provided for people with disabilities and given to other recognized groups, associations and organizations to take care of people with disabilities. Furthermore, in Article 26, the same document mentioned material and financial assistance that may be granted in the form of pension or relief to people with disabilities to help them in their education and life. More can be seen from the extracts below:

Article 4:

Educational aid includes: exemption from age, return to class, educational support for teachers and financial support. (Cameroon, 1990, p. 2)

129

Article 23:

1) Individual social assistance may be granted to disabled people. They include: family and institutional placement, material, financial and psycho-social assistance.

2) Collective aid may be granted to groups and associations of disabled people and to legally recognized organizations which take care of disabled people or their families. (Cameroon, 1990, p. 6)

Article 26:

Material and financial assistance may be granted in the form of pension or relief to indigent disabled people. (Cameroon, 1990, p. 6).

Also, this other document (*Law No. 2010/002 of 13 April 2010*) on providing protection and promotion of people with disabilities mentioned in its Article 42 that the costs relating to many interventions (such as financial support for education, invalidity allowance, grants to private organizations which help people with disabilities, support for the construction of equipment and infrastructure adapted to people with disabilities amongst others) are covered by the national solidarity assistance. An excerpt is provided below.

Article 42: The costs relating to the following interventions are covered by the national solidarity assistance:

- financial support for education and first vocational training expenses;

- the invalidity allowance provided for in article 19 above;

- grants to private organizations working in the supervision of disabled people.

- Support for the construction of equipment and infrastructure adapted to disabled people.

- All other interventions relating to national solidarity. (Cameroon, 2010a, p. 6)

Similarly, in Canada, there also exist some funding options through federal, provincial and territorial government programs as well as non-governmental or charitable organizations programs specific to assistive devices as mentioned in the document (*The Regulatory Context for Assistive Technologies and Accessible Products in Canada, 2007*). These funding programs provide financial assistance and support for people with disabilities in accessing assistive devices for their various needs (Gordon et al., 2007, p. 8). Also, given the restrictions of provincial government programs, people with disabilities always look for non-governmental sources of funding for assistance in paying their portion of the cost of a device, or for assistance for payment of devices that are not covered by government funding programs (Gordon et al., 2007, p. 20). Some examples of charitable and service organizations as mentioned in the same document above are as follows:

> Charitable organizations such as, the Rotary Club, the Royal Canadian Legion, the Kiwanis and the Lions Club may provide financial assistance and Service organizations including March of Dimes and the Easter Seals Society etc, may act as transfer agencies providing assistive devices in Canada. Also, the Canadian National Institute for the Blind is one of the country's largest suppliers of assistive devices for persons who are blind or low vision. (Gordon et al., 2007, p. 32).

Additionally, children with SLD in Canada are supported in the acquisition of assistive devices by public funding, payment from parents/family members, loaning, renting or purchase with a payment plan as discussed in the document, *Participation and Activity Limitation Survey 2006: A Profile of Assistive Technology for People with Disability* (Statistics Canada, 2008b).

Lastly, in another document (*Government of Yukon website*), it was announced that the Government of Yukon had worked with Yukon First Nations governments on a government-to-

131

government basis at the community level and at the Yukon-wide level to implement the Joint Education Action Plan 2014–2024, which focused on supporting First Nation student learning needs and outcomes; implementing culturally inclusive schools amongst others (Government of Yukon, 2020). The Government of Yukon and Yukon First Nations governments were thus partnering to provide $950,000 to purchase 1,300 devices to improve access to technology for Yukon First Nations students in Kindergarten to Grade 12 (Government of Yukon, 2020). The Government of Yukon has committed $478,400 to this initiative, which is being matched by Yukon First Nations governments who will determine how devices are distributed to citizens in their communities (Government of Yukon, 2020). Also, this initiative supports joint efforts to support First Nations student learning needs and outcomes as identified in the Joint Education Action Plan and recommendations of the Audit 2019 report on Kindergarten to Grade 12 education in Yukon (Government of Yukon, 2020). Improved access to technology supports blended learning approaches and more personalized, flexible learning opportunities for students while developing skills for the future, including using digital tools for inquiry, reading, research, work on assignments and collaboration with teachers and classmates (Government of Yukon, 2020). This provincial funding source for AT illustrates the other types of funding sources of AT in the other Canadian jurisdictions recognizing that there are differences between these jurisdictions to the federal system of Canada.

All in all, from the analyzed documents from both countries, it showed that funding for assistive devices for children with SLD is very important and provided for by both countries. The funding for assistive devices for children with SLD should be increased as without many funding sources for assistive devices for children with SLD, their education and community life might be limited. Some of these funding sources include the parents, family members, public funding,

government, non-governmental organizations, charity and service organizations, non-for-profit organizations, donor organizations, AT providers amongst others.

4.1.9 Tax exemptions exist for Assistive Technology but they need tax incentives.

From the two documents extracts cited below, it can be noticed that both countries prescribe some form of tax exemptions for AT used by people with disabilities. For example, in Cameroon, in *Decree N°. 90/1516 of 26 November 1990*, it is mentioned that one of the preferential measures taken for people with disabilities is *tax exemptions* for their goods and services including AT. The document further stated that: *"tax exemptions are granted by the Minister of Finance on the recommendation of the Minister in charge of Social Affairs"* (Cameroon, 1990, p. 9).

Similarly, in the Canada document: *The Regulatory Context for Assistive Technologies and Accessible Products in Canada, 2007,* it stated that: "All assistive devices used by persons with disabilities should be exempt from duty brokerage fees and tax" (Gordon et al., 2007, p. 57).

So, it can be concluded from the analyzed documents from both countries that assistive devices used by persons with disabilities including children with SLD should be exempted from duty brokerage fees and other taxes as assistive devices are not used as a luxury but rather are important for the education and life of children with SLD. Thus, tax incentives should be given for assistive devices used by children with SLD in both countries. This will make AT readily available to those children with SLD in need.

4.1.10 Assistive Devices programs exist in some jurisdictions but should be made available in all jurisdictions.

In Cameroon, there are no documents which mention any assistive devices programs available. So, one can conclude that there are no existing assistive devices programs in Cameroon. On the other hand, in Canada, there exist various assistive devices programs in most

of the jurisdictions which help to provide assistive devices to people with disabilities including

children with SLD such as the *March of Dimes: Assistive Devices Programs and its Assistive*

Technology Initiative which supplies AT to those in need upon an application on their website.

M*arch of Dimes Canada* is a registered national charity organization with special programs in

Halifax, Montreal, Vancouver and Calgary where by children with disabilities including children

with SLD can call requesting funding for the supply of AT for their use like tablets and various

apps (March of Dimes Canada, 2021).

The *March of Dimes* also aims at creating a society inclusive of people with disabilities

and their mission is to maximize the independence, personal empowerment and community

participation of people with disabilities (March of Dimes Canada, 2021). Their website offers a

wide range of AT devices and services to people with disabilities throughout Canada. *The*

Assistive Technology Program is financed by their partners who are administered by the Ottawa

and London community foundations. *March of Dimes* also has an *Assistive Mobile Technology*

Initiative which deals with many AT devices and services to support people with disabilities in

and around Calgary, Southern Alberta and British Columbia that would benefit most from it

(March of Dimes Canada, 2021). Students are free to apply for the *Assistive Technology*

program. The *March of Dimes Canada* covers the cost of purchasing the tablets and selected AT

apps at $2500 per child (March of Dimes Canada, 2021).

Additionally, in Canada, another document is the *Policies and Procedures Manual for the*

Assistive Devices Program of the Ontario Ministry of Health and Long-Term Care to provide

financial assistance to Ontario people with disabilities to help them to get equipment and the

supplies they need. The *Assistive Devices Program* (ADP) will fund up to 75% of the cost of

equipment required by people with long term physical disabilities. ADP maintains a list of

equipment that it will fund as well as eligibility criteria on their website. This means that the person using the assistive device pays 25% of the cost which might be still be very costly for people with disabilities (Ontario Ministry of Health and Long-Term Care, 2016). Also, the cost of repairing the AT is not covered by the funding program and there is lack of funding for persons with disabilities to acquire AT for their use including children with SLD (Ontario Ministry of Health and Long-Term Care, 2016). ADP covers over 8,000 separate pieces of equipment or supplies and covers 100% of the cost, if the child or family receives financial support from some other programs available in Ontario (Ontario Ministry of Health and Long-Term Care, 2016). An excerpt is given below of who benefits from 100% ADP.

> ADP covers 100% of the cost, if the child or family receives financial support from one of these programs: children and youth who are receiving Ministry of Children, Community and Social Services Assistance for Children with Severe Disabilities or parents/guardians who receive the Ontario Works or Ontario Disability Support Program. (Ontario Ministry of Health and Long-Term Care, 2016, p. 11)

This provincial assistive devices programs illustrates the other types of assistive devices programs in the other Canadian jurisdictions recognizing that there are differences between these jurisdictions and the federal system of Canada.

In summary, it was discovered from the documents analyzed from both Cameroon and Canada that Cameroon does not have any assistive devices programs while Canada has them in most of its jurisdictions which help to provide financial assistance to people with disabilities to get assistive devices that they need. Both countries should ensure that assistive devices programs are available in all jurisdictions in their countries and this would provide the finances needed to get the required AT for all children in need.

4.1.11 Other: Complaints about Assistive Technology use exists and ways to address them are
suggested.

None of the Cameroon documents mentioned any method of resolving complaints about AT but one document in Canada, *The Regulatory Context for Assistive Technologies and Accessible Products in Canada*, in part III of the document outlined additional tools that people with disabilities who use assistive devices may use to resolve their complaints about assistive devices. It: *"suggest areas of law and avenues of redress that consumers may explore, such as products liability claims and statutory regimes that regulate the sale and purchase of goods"* (Gordon et al., 2007, p. 60).

People with disabilities should first seek a legal opinion before proceeding with a civil claim as they have to consider both the benefits and possible consequences that may result from any judicial decision (Gordon et al., 2007). When considering whether or not to file a civil claim, it is important that the people with disabilities should be aware of any relevant limitations legislation in the specified jurisdiction and understand the statutory regimes that regulate the sale and purchase of goods in their jurisdictions (Gordon et al., 2007). In this way, children with SLD would also address their complaints about AT and get tangible solutions to their worries.

4.1.12 Thematic representation of the Analysis and Results

Table 7 shows a thematic representation of the analysis and results.

Table 7

Thematic representation of the analysis and results

Themes	Response		Analysis
	Cameroon	**Canada**	
Education is made accessible	Cameroon documents analyzed showed that education was made accessible for children with SLD using preferential measures	From the Canadian documents analyzed, it showed that education is also made accessible by ensuring	From the documents analyzed from both countries, it showed that special measures were being taken to ensure that education is made

to children with SLD	such as free education, providing assistance to cover all their school expenses, total or partial exemption from school fees, granting of scholarships, providing material, financial and education support and assistive devices provision amongst others.	accessibility in all aspects in the country through the Accessible Canada Act to create a barrier-free Canada for all its citizens including children with SLD and having various policies to ensure accessible education for such children in all jurisdictions.	accessible to children with SLD.
Special education is provided to equip children with SLD with effective programs and services	From the documents analyzed, it showed that special education was provided with the many benefits for children with SLD.	The documents analyzed here showed that special education is practiced in all jurisdictions in Canada which gives children with SLD: specialized instruction, assessment, accommodations, educational programs etc.	From the documents analyzed from both countries, it showed that special education is provided to help children with SLD in their education by providing them with all necessary support and accommodations that they might need to bypass the difficulties they face.
Inclusive education is being practiced but needs more resources for its full implementation	From the documents analyzed, it showed that inclusive education is practiced but more resources and support/accommodations are needed for its full implementation.	The documents analyzed here, showed that inclusive education is being practiced but more resources are needed to fully implement it in all jurisdictions.	From the documents analyzed from both countries, it showed that inclusive education is being practiced but more resources and support/accommodations are required for full inclusion in all schools.
Assistive Technology is provided but needs remain	Various documents analyzed showed that AT was provided for children with SLD to help them in their education even though there were still unmet needs.	From the documents analyzed, it showed that AT was readily available for children with SLD but there were still unmet needs in some jurisdictions.	From the documents analyzed from both countries, it showed that AT is provided for children with SLD but there were still unmet needs.

Social assistance is provided for children with SLD but more assistance is needed	Documents analyzed here, indicated that social assistance was available for children with SLD in the form of individual and collective aids, durable relief just to name a few but more assistance is envisaged.	Analyzed documents showed that social assistance was provided for children with SLD in all the jurisdictions like those provided by the various Student Support Services Units in all jurisdictions amongst others.	From the documents analyzed from both countries, it showed that various types of social assistance are being offered for children with SLD but more assistance is still required.
Laws, policies and legislations exist to guide the access and provision of AT for children with SLD but needs revision and improved implementation	There exist some laws and decrees enacted by the government to guide AT access and provision even though not explicitly mentioned in the analyzed documents.	Laws, policies and legislations exist in all jurisdictions guiding the access and provision of AT for children with SLD.	From the documents analyzed from both countries, it showed that laws, policies and legislations exist that regulate AT access and provision but needs revision and improved implementation.
Financial assistance is provided to purchase AT but more is still needed	It was discovered from the documents analyzed that financial assistance is provided to children with SLD such as State subsidies given to schools, allocation of special aid for the children's education, allocation of school grants etc but more of such assistance is needed.	It was found out from the analyzed documents that financial assistance was provided to the children with SLD such as grants for student services and equipment, Canada Student Financial Assistance, Assistance for children with severe disabilities etc.	From the documents analyzed from both countries, it showed that financial assistance is provided for children with SLD to buy AT but more financial assistance is needed to help them in their education-related expenses.
Funding sources exist to support access to AT but funding is insufficient	It can be shown from the analyzed documents that funding sources exist such as the national solidarity assistance but more funding is needed to meet up with the unmet needs of AT provision.	It can also be shown from the documents analyzed that many funding sources exist but more funding is still needed for AT provision to meet the unmet needs eg. the various federal,	From the documents analyzed from both countries, it shows that many funding sources are available for the provision of AT to children with SLD but more funding is still required in all jurisdictions to better

		provincial/territorial funding programs specific to assistive devices.	help them to provide their various disability-related costs like AT provision amongst others.
Tax exemptions exist for AT but they need tax incentives	Tax exemptions are mentioned for goods and services offered to children with SLD as shown from analyzed documents.	Tax exemptions are also mentioned in analyzed documents specific to AT such that assistive devices used by children with SLD should be exempted from duty brokerage fees and taxes as AT aren't frivolous purchases.	From the documents analyzed from both countries, it should be noted that all assistive devices used by children with SLD should be free from taxes and duty brokerage fees with tax incentives provided for goods and services used by children with SLD and duty-free for all AT products for people with disabilities.
Assistive Devices Programs exist in most jurisdictions but should be made available in all jurisdictions	None of the documents analyzed here mentioned anything concerning any Assistive Devices Programs.	From the analyzed documents, it can be seen that Assistive Devices Programs are provided in most jurisdictions to help in providing financial assistance for the acquisition of AT needed by children with SLD such as the Ontario Assistive Devices Programs; March of Dimes: Assistive Devices Programs and Assistive mobile Technology Initiative.	From the documents analyzed from both countries, it showed that Assistive Devices Programs are available in most jurisdictions in Canada and absent in Cameroon. So, it is suggested that Assistive Devices Programs be made available for all jurisdictions in both countries.

4.2 Cross-Case Analysis

In this section, the exploration of the two case studies discussed the use of AT in the

school-based instruction of children with SLD from the perspectives of AT availability and

policies, laws and legislations relating to AT access and provision. This brought out the

commonalities and differences which helped to understand to a certain extent why there are

variations in AT availability, access and provision in each country. The commonalities and differences were briefly discussed below and a summary table was presented afterwards.

4.2.1 Commonalities

From the various documents analyzed from Cameroon and Canada, some commonalities will be briefly discussed below.

Firstly, Cameroon and Canada have embarked on special measures to ensure that education is accessible for children with SLD. From the analyzed documents from both countries, some of these strategies to ensure that education was made accessible for children with SLD were provision of grants to support schools for special and inclusive education, providing the needed accommodations (including AT) and other required aids for children with SLD success in school, specialized pedagogical assistance and training of staff, various didactic materials to meet children's needs, providing scholarships, exemptions from school fees, providing material, financial and educational support, providing education in all accessible formats of education delivery amongst others.

Secondly, Cameroon and Canada practice special and inclusive education in their schools even though they both need more resources to ensure their full implementation for the benefits of children with SLD in schools. From the analyzed documents from both countries, special and inclusive education is practiced through the provision of many resources to ensure that children with SLD interact in a normal school with their peers without SLD by providing the necessary support and/or accommodations needed by the children with SLD like supplying AT for children in need, specialized dictation texts for hearing impaired children, rehabilitation services, special instruction and assessment methods, modified educational programs per child, using sign language interpretation experts amongst others.

Thirdly, both countries have enacted some laws, policies and legislations on AT access and provision for children with disabilities including children with SLD. These laws, policies and legislations guide the access and provision of AT in each jurisdiction in both countries. From the analyzed documents from Cameroon and Canada, these policies lay down all the resources available for assisting the people with disabilities including children with SLD to get all the necessary support and accommodations they need in their education such as all the financial assistance, implementation of special and inclusive education, providing subsidies to schools, protection of children with disabilities and provision of their disability benefits , how resources allocated to people with disabilities are managed by the competent Ministries of Education and other specialized Ministries in each country which acts as focal points as well as punishment for defaulters of these laws. Furthermore, both countries lack a national assistive technology policy. Both countries enacting this policy would help reduce the inconsistencies which exist in AT access and provision in all jurisdictions as it will ensure that there is equitable distribution of AT.

Fourthly, assistive technology is available in both countries for children with SLD. From the analyzed documents from Cameroon and Canada, some available AT are audio phones, braille machines, wristwatches for the blind, screen magnification software, electronic magnifiers, note takers, digital book players, Braille embossers, wireless handheld device, computer with specialized software, smartphones, smart watch with specialized features, computer, laptop or table with specialized software or other adaptations, recording equipment or a portable note-taking device, device for playing audio books or e-books, textbooks in e-format, or closed circuit devices amongst others.

Fifth, Cameroon and Canada have unmet needs of AT for children with SLD. Both countries have assistive technologies in their inclusive schools even though there are variations

and inequities in AT access and provision in both countries. Thus, leading to unmet needs of AT in both countries.

Sixth, both countries provide social assistance for children with SLD in their education by providing their needs for AT as well as other disability-related costs. From the analyzed documents from Cameroon and Canada, the social assistance is in the form of individual and collective aid, disability pension, exemption for school fees for children with SLD, various emergency services, assistance in acquiring equipment and other school aids, school-based student support services which provide classroom support, AT, student-specific needs, transition planning, lending of AT, support for new accessible technology projects to develop new assistive technology for children in need amongst others.

Seventh, both countries have various funding sources for the access and provision of assistive devices for children with SLD. From the analyzed documents from Cameroon and Canada, the funding sources are made up the government, federal, provincial and territorial governments, parents or family member payment as well as non-governmental or non-for-profit or charity or service organizations. Their various funding packages give financial assistance which help in the payment, loaning, repairing of an AT needed by a children with SLD.

Eighth, both countries provide some form of financial assistance to the children with SLD for the procurement of assistive devices and other education-related expenses. From the analyzed documents from both countries, this financial assistance is in the form of aid, relief funds, student grants, school loans, tuition, books, accommodations, school financial assistance, assistance for children with severe disabilities program which provide monthly financial support used for assessment of an AT, repairs for AT amongst others.

And lastly, both countries have enacted respective laws and policies which strive for tax exemptions for goods and services (such as assistive devices) for children with SLD. From the analyzed documents, it can be seen that there exist some laws which prohibit duty, brokerage fees and taxes from the goods and services supplied to people with disabilities including children with SLD. This tax exemptions are needed to help reduce the cost of imported AT and also to help make AT readily available for use by all who need them.

4.2.2 Differences

Despite the commonalities that existed between Cameroon and Canada documents which were analyzed above, there also had some differences which will be discussed below.

Firstly, Canada has no federal legislation relating directly to AT as legislation related to AT is a provincial and territorial responsibility and it varies across the 13 jurisdictions whereas in Cameroon, there is a national disability law in relation to AT (though not explicitly) for all the children with SLD in the ten regions of the country as a whole not each region with its own laws like in Canada. Furthermore, AT legislations in Canada are more developed and explicitly mentioned in the analyzed documents than those in Cameroon regarding AT access and provision for children with SLD.

Secondly, there exist Assistive Devices Programs for most of the 13 jurisdictions in Canada meanwhile in Cameroon; there are no Assistive Devices Programs for children with SLD to help in the financial assistance of the acquisition of assistive devices needed for their education and community life. From the analyzed documents, Canada has Assistive Devices Programs like the March of Dimes Canada Assistive Devices Programs and the Ontario Ministry of Health and Long-Term Care Assistive Devices Programs which provide financial assistance for people with disabilities including children with SLD to get the AT they need. For example,

the Ontario Assistive Devices Program fund 75% and sometimes up to 100% of the cost of an

AT needed by children with SLD.

And lastly, from the documents analyzed from Cameroon, it shows that Cameroon does

not have enough funding sources to help fund the provision of AT for children with SLD. In

contrast, Canada has better funding sources for AT provision for children with SLD with the aim

of making AT readily available for all children from AT providers, government grants, charity

and non-for-profit organizations than Cameroon.

Table 8 shows a summary of the commonalities and differences between the two

countries.

Table 8

Commonalities and Differences between Cameroon and Canada

Commonalities between Cameroon and Canada		
Both countries have enacted some laws, policies, and legislations on AT access and provision for children with disabilities including children with SLD but lack a national AT policy.		
Both countries have assistive technologies in their inclusive schools even though there are variations and inequities in AT access and provision in both countries.		
Cameroon and Canada have unmet needs of AT for children with SLD.		
Both countries provide social assistance for children with SLD in their education by providing their needs for AT as well as other disability-and education-related expenses.		
Both countries have various funding sources for the access and provision of assistive devices for children with SLD.		
Cameroon and Canada have embarked on special measures to ensure that education is accessible for children with SLD.		
Cameroon and Canada practice special and inclusive education in their schools even though they both need more resources to ensure their full implementation for the benefits of children with SLD in all schools.		
Differences between Cameroon and Canada		
Units for Comparison	**Differences between**	
	Cameroon	**Canada**
National Disability Laws	Has a national disability law for children with SLD for AT access and provision.	Has provincial and territorial policies and legislations for AT access and provision for children with SLD.

144

Assistive Devices programs	Have no assistive devices programs.	Have assistive devices programs for most of the jurisdictions.
Funding Sources	Does not have many funding sources to help the children with SLD in AT access and provision like Canada.	Has better funding sources to make AT readily available to children with SLD from government grants, AT providers, charity and non-for-profit organizations than Cameroon.
AT laws, policies and legislations	Does not have any specific AT laws, policies and legislations only on AT access and provision.	Have specific AT laws policies and legislations only on AT access and provision for all their jurisdictions.

4.3 Summary

In this chapter, the analysis and results of the study were discussed. The study found out that AT is available for the school based instruction of children with SLD in Cameroon and Canada through various means. Additionally, the study also found out that, there are laws, policies and legislations in both countries which guided the access and provision of AT for people with disabilities including the children with SLD. Furthermore, within-case and cross-case analyses were done with sample tables showing the commonalities and differences between Cameroon and Canada. In the next chapter, the Summary, Discussion, Conclusion and Recommendation are discussed.

<center>**Chapter 5: Summary, Discussion and Recommendations**</center>

5.0 Introduction

The ensuing pages of this chapter discuss this research in nine parts: summary of the study, summary of research results, discussion, lessons learned, conclusion, implications for policy and practice, recommendations to the various stakeholders, limitations of the study and recommendations for further research.

5.1 Summary of the study

Assistive Technology is important as it provides all children with SLD the ability to access the curriculum and support them to bypass their areas of difficulty in the learning process, amongst other benefits. The overriding purpose of this study was to critically explore and compare the use of assistive technology in the school-based instruction for children with SLD in Cameroon and Canada. Two research questions were used to guide the study. The study used the qualitative comparative case study research design. The two geopolitical locales were selected using critical case purposive sampling technique in order to assess the availability of AT as well as laws, policies and legislations for AT access and provision. Twenty-four national governmental documents were selected for the study which met the inclusion criteria as outlined in chapter three. The selected documents from both countries were analyzed using document analysis to answer the two research questions of the study.

5.2 Summary of Research Results

The salient findings or results of the study are as follows:

5.2.1 Assistive Technology is available in both countries for the school-based instruction of children with SLD.

From the examination of the analyzed documents from Cameroon and Canada, it is evident that assistive technology is available in both countries for the school-based instruction of

children with SLD such as audio phones, braille machines, hearing aids, wristwatches for the blind, screen magnification software, electronic magnifiers, Braille embossers, note takers, digital book players, wireless handheld devices, computer with specialized software, smartphones, smart watch with specialized features, computer, laptop or table with specialized software or other adaptations, recording equipment or a portable note-taking device, device for playing audio books or e-books, textbooks in e-format, or closed circuit devices amongst others (Cameroon, 1990, 2010a, 2010b, 2018; Canadian Assistive Technology Limited Team, 2021; Innovation Science and Economic Development Canada, 2021; Statistics Canada, 2008b; Statistics Canada, 2017).

5.2.2 There are laws, policies, and legislations which have been enacted to control AT access and provision for children with SLD in both countries.

From the examination of the analyzed documents from Cameroon and Canada, it shows that the governments of Cameroon and Canada have enacted many laws, policies and legislations to control AT access and process for children with SLD but these laws, policies and legislations need revision and improved implementation. In Cameroon, for example, the government enacted *Law No. 2010/002 of 13th April 2010* (Cameroon, 2010a) amongst others. Meanwhile in Canada, 13 Canadian jurisdictions have enacted policies and legislations such as in the province of Alberta; the jurisdiction has enacted the *learning and technology policy framework* (Alberta Education, 2013) amongst others.

5.3 Discussion

5.3.1 Research Question 1: What are the available assistive technologies for use in the school-based instruction for children with SLD in Cameroon and Canada?

In answering this first research question, findings from documents analyzed from both countries showed that AT is available for use by children with SLD in Cameroon and Canada

even though there are still unmet needs of AT. This finding is consistent with the work of other researchers who found out that AT was available for children with SLD in Cameroon (Eboutane, 2010; International Centre of Evidence in Disability, 2014; Tani & Nformi, 2016) and Canada (Bernardi et al., 2020; Mattison et al., 2020) although there were unmet needs which could be attributed to multiple barriers such as: high costs, insufficient funding, lack of awareness, affordability and availability of AT, lack of trained personnel, policy and resources available to the government (Borg & Östergren, 2015 ; Jolley et al., 2018; WHO, 2018); lack of availability of assistive devices and limited access to government-funded programs or restricted number of vendors providing the equipment (Gordon et al., 2007) amongst others. This finding is also consistent with the World Health Organization (2018) and Rohwerder (2018) who argued that in many low-income and middle-income countries, only 5–15% of people who require assistive devices and technologies have access to them. With the availability of AT in the classroom, teachers are urged to use the various theoretical models of technology integration proposed in this study such as the technological pedagogical content knowledge (Mishra & Koehler, 2006; Mishra, 2019); the substitution, augmentation, modification and redefinition (Puentedura, 2006) and the engagement and technology integration theory (Gunuc, 2017) to integrate AT into their lessons to enable children with SLD to be competent users of AT and to excel in their studies.

To further expand on this finding, from the analyzed documents from Cameroon and Canada, various measures (government and other AT suppliers, assistive devices programs, funding sources, social assistance, financial assistance and tax exemptions) were used to show how AT was made available for people with disabilities including the children with SLD. These measures will be briefly discussed below. Firstly, both governments and other AT providers provided the AT needed by children with SLD as shown from the analyzed documents from both

countries (Cameroon, 1990, 2010a, 2010b, 2018; Canadian Assistive Technology Limited Team, 2021; Innovation Science and Economic Development Canada, 2021; Statistics Canada, 2008b; Statistics Canada, 2017). This finding is consistent with the works of Maclachlan et al. (2018a), McColl et al. (2017), Schreiber et al. (2017), and Zuurmord et al. (2019) who all agreed that AT is provided for children with SLD by the government, non-governmental and charity organizations, public funding, third-party insurance, out-of-pocket payment, financial means, family members, or a combination of these methods.

Secondly, another source from where children with SLD could obtain AT as shown from the analyzed documents in Canada was from the assistive devices programs present in most of the jurisdictions in Canada. In contrast, Cameroon does not have any documents which mention any assistive devices programs present in any part of the country. So, in Canada, for example, the Ontario Assistive Devices Programs funded by the Ontario Ministry of Health and Long-Term Care helped to provide up to 75% of the cost of the needed AT and covered the cost of 8,000 separate pieces of AT (Ontario Ministry of Health and Long-Term Care, 2016). Sometimes, the Assistive Devices Programs covers 100% of the cost of an AT if the child or family received support from the Ontario Assistance for Children with Severe Disabilities, Ontario works or the Ontario Disability Support Program (Ontario Ministry of Health and Long-Term Care, 2016). Furthermore, the March of Dimes Canada also funds assistive devices programs and their assistive mobile technology initiative programs which help to provide the financial assistance needed to purchase AT for children with SLD in Canada (March of Dimes Canada, 2016).

Also, various funding sources exist to support access and provision for AT from the analyzed documents from Cameroon and Canada. In Canada, various sources such as federal, provincial and territorial programs for funding, family member or parent payment, other

government, charitable, non-governmental and non-for-profit organizations amongst others, provide funding for assistive devices (Statistics Canada, 2008b; Gordon et al., 2007; Government of Yukon, 2020). For example, the government of Yukon and Yukon First Nations governments provided $950,000 to purchase 1300 devices to improve student access to technology from K-12 (Government of Yukon, 2020). Similarly, in Cameroon, the government, charity and non-governmental organizations with their foreign partners also helped in the provision of AT for children with SLD even though not explicitly mentioned in the analyzed documents. This finding is consistent with the study of Zuurmond et al. (2019) who found out that non-governmental organizations helped to provide support for people with disabilities including AT devices. Further, the family members or parents of the children with SLD or public funding are also other means for the provision of AT for the children which is consistent with the works of Socio-Economic Empowerment of Persons with Disabilities (2011) and Cameroon Baptist Convention Health Science (2016). This finding is also in line with the World Health Organization (2018) which argued that in countries (even in high-income countries), assistive products are often rationed or not included within health and welfare schemes, leading to high out-of-pocket payments by users and their families. This finding is further supported by Gordon et al. (2007) who argued that government-funded programs don't always cover the full cost of AT and often don't cover repairs and maintenance, necessitating people with disabilities to pay the remainder of such ongoing costs.

Similarly, comparing this study with the study of Bratan et al. (2020) who did a comparison of four European countries (Hungary, Portugal, Sweden and Germany) with regards to AT availability, also found out that these four countries made sure that AT were available for people with disabilities including children with SLD. For example:

In Hungary, assistive technologies are mainly provided by non-governmental organizations and the budget available is a fixed amount. In Portugal, very little public funding is available for assistive technologies and persons with disabilities and their families are expected to cover the costs. In Sweden and Germany, on the other hand, financial resources dedicated to assistive technologies are not limited per person but dependent on the needs of the individual. (Bratan et al., 2020, p.18)

Moreover, from the analyzed documents in Cameroon and Canada, it is evident that both countries provided social assistance to children with SLD. This social assistance from Cameroon documents is in the form of individual and collective aid, various emergency services, durable relief which is linked to needs requiring sustained assistance as AT, school aids and so on, material and educational support to help in the acquisition of AT as well as other education-related expenses (Cameroon, 1984, 1990) while in the analyzed documents from Canada, social assistance was provided in the various school-based student support service units in all jurisdictions such as Manitoba student service unit which provides a lending library for AT, consultation support, borrowing AT through alternative formats services and Manitoba Education (Manitoba Education, 2015) and the government of Canada carrying out 25 funded projects for support for accessible technology programs which will support the development of assistive, adaptive devices and technologies in order for people with disabilities including children with SLD to have access to high-quality, assistive and essential equipment for use in schools (Innovation, Science and Economic Development Canada, 2021).

Yet another way of making AT available for children with SLD in both Cameroon and Canada from the analyzed documents is the financial assistance offered by both countries. This financial assistance is in the form of special aid to education, financial support, school aid,

allocation of subsidies to schools, various grants, full expenses for services and equipment, educational aid, allocation of aid and relief as shown from the Cameroon documents (Cameroon, 1984,1990, 2010a, 2010b). Similarly, from the analyzed documents from Canada, it was found out that financial assistance was also provided for children with SLD in the form of grants of $20,000 for a loan year for services and equipment (Government of Canada, 2021) ; $25-$500 per month for contribution for assistive devices under the assistive devices programs which all helped to provide the finances for purchase, repair, loan and assessment of AT for use by the children with SLD amongst other education and disability-related costs (Ontario Ministry of Children, Community and Social Services, 2021). This finding is in line with the study of Van and Tönsing (2015) who argued that the availability of financial resources and formalized support are only two of the factors to consider when providing appropriate AT to people with disabilities including children with SLD. And lastly, from the analyzed documents from Cameroon and Canada, it also showed that exemption of duty, brokerage fees and taxes for goods and services for people with disabilities including children with SLD will make AT readily available for them as AT are not used for luxurious purposes but are important for the education and community life of these children (Cameroon, 1990; Gordon et al., 2007).

So, it can be concluded from the findings from the analyzed documents from Cameroon and Canada that AT is available for the school-based instruction of children with SLD in Cameroon and Canada even though there are still unmet needs. When AT is readily available for children with SLD, it supports learning and help to bypass a challenging task such as handwriting (Young & McCormick, 2014) and for AT to be effective, it needs to be embedded within quality instruction. Thus, teachers should be trained in the use of AT for quality instruction. There are various theoretical models that teachers can use to integrate AT into their

classrooms and these models help teachers to understand how AT could be used to provide children with SLD with success in their academic pursuits. Teachers are to carefully select the appropriate AT needed for the lesson as per the specific needs of the children with SLD using any of the models of AT selection (such as Student Environment Tasks and Tools, Zabala, 2005; Functional Evaluation for Assistive Technology, Raskind & Bryant, 2002; Matching Person and Technology, Scherer et al., 2007 amongst others). Teachers will then use any of the theoretical models for technology integration explained in chapter 1 in their instruction such as the technological pedagogical content knowledge (TPACK); substitution, augmentation, modification and redefinition (SAMR) and the engagement and technology integration theory (ETIT) models combined to form the unified framework of technology integration.

Mishra and Koehler (2006) proposed the TPACK model of technology integration in the classroom which was later updated by Mishra (2019) whereby teachers needed to acquire the knowledge of pedagogy, content, context and technology on how to blend them to teach children with SLD in their classrooms. Teachers should purposefully blend and apply each form of knowledge into the various learner-centered activities of their lessons (Mishra, 2019) while ensuring the affective, behavioural and cognitive engagements of the children with SLD following the ETIT model (Gunuc, 2017). These learner-centered activities will ensure that teachers teach concepts to children with SLD in ways that will enhance their learning experiences. Furthermore, teachers will also use the SAMR model to reflect on how they are integrating technology (AT) into their instruction (Puentedura, 2006) following the enhancement and transformation steps. Teachers use AT in the enhancement steps (substitution and augmentation) to provide a digital medium for learning to take place which may enhance learning for children with SLD while in the transformation steps (modification and redefinition),

153

AT is used to transform the way in which learning can occur (Puentedura, 2006). With these models, teachers will be in a better place to integrate AT into their classrooms.

5.3.2 Research Question 2: What laws, policies, and legislations have been enacted by Cameroon and Canada for AT access and provision?

In answering this second research question, findings from the analyzed documents from Cameroon and Canada showed that there exists some laws, policies and legislation in both countries regulating the access and provision of AT to people with disabilities including children with SLD. Findings further showed some laws, decrees and circulars from the Ministry of Social Affairs website in Cameroon (Cameroon Ministry of Social Affairs, 2018) whereas in Canada, there were laws, policies and legislations enacted in all the 13 jurisdictions to guide access and provision of AT for people with disabilities including children with SLD . For example, Alberta Education (2013) enacted the learning and technology policy framework which explains how technology should support student learning in the K-12 education system in the province of Alberta. It could be deduced that in relation to access and provision of AT for children with SLD, Canada offers an interesting counterpoint to Cameroon even though both countries have made concerted efforts to enact laws, policies and legislations which are in line with some of the articles recommended by the Convention for the Rights of People with Disabilities but much still needs to be done by each country.

Canada has policies and legislations for each of the 13 jurisdictions differently which is consistent with the study of Courtad and Bouck (2013) and Edmunds and Edmunds (2014). Meanwhile Cameroon has the same national disability laws, decrees and circular letters for all the ten regions of the country governing the access and provision of AT even though not explicitly mentioned in the analyzed documents. This issue leads to disparities and inconsistent resulting in the way that AT is used to support children with SLD in all the jurisdictions in

Canada as a result of the lack of a federal national policy and in Cameroon with a lack of a national assistive technology policy. This finding is in line with the work of Courtad and Bouck (2013) who reiterated that in Canada, legislations related to the access and provision of AT to people with disabilities is a provincial/territorial responsibility and thus legislations vary across the 13 jurisdictions. This finding is also consistent with the work of Durocher et al. (2017) who argued that having a federal universal policy on AT in Canada would be easy for accountability and checks for AT access and provision in all jurisdictions thereby reducing the inconsistencies discovered across jurisdictions in Canada. This finding is further reiterated by WHO (2018) who argued that very few countries have a national assistive technology policy or programs and in many countries, access to assistive technology in the public sector is poor or non-existent.

As AT is mandated by laws, policies and legislations in both countries from the analyzed documents, teachers are required to use AT to teach children with SLD using any of the models for the integration of technology into the curriculum and classroom. This study proposed some models of technology integration cited in Chapter 1. After the careful selection of the specific AT for the unique needs of the children with SLD as specified in their IEPs using the various models for AT selection, the teacher has to have a learner-centered focus in order to integrate AT into the classroom. Mishra and Koehler (2006) and Mishra (2019) proposed that teachers need to acquire the technological pedagogical content knowledge made up of all the knowledge of pedagogy, content, context and technology which is needed to teach the children with SLD using AT. When teachers acquire the required knowledge for technology integration, they need to use learner-centered activities to ensure the children's affective, behavioural and cognitive engagements using the engagement and technology integration theory (Gunuc, 2017). Teachers are to develop meaningful, authentic and challenging yet achievable tasks to ensure children's

engagements in the lessons. Teachers should also use the SAMR (Substitution, Augmentation, Modification and Redefinition) model to evaluate how they are incorporating AT into their instructional practice (Puentedura, 2006). Is AT integrated in their instruction an act of Substitution? Augmentation? Modification? Or Redefinition?

The SAMR will support the creation of tasks that promote higher-order thinking while also finding meaningful uses of technology in the classroom (Puentedura, 2006). Further, the teachers use the SAMR framework in two ways: for enhancement, where traditional learning is enriched by the AT, and for transformation, where AT's integration has fundamentally changed the process of learning (Puentedura, 2006). The enhancement is through substitution and augmentation while the transformation is done through modification and redefinition (Puentedura, 2006). Also, the integration of SAMR and Bloom's Revised Taxonomy outlines a clear set of steps that help guide the teacher in the introduction of technology in the classroom (Puentedura, 2014). With the combination of the universal design of learning (UDL) to the TPACK, SAMR and ETIT models, the AT will create multiple means of engagement, representation, action and expression for all the children including children with SLD who are taught with AT in an inclusive classroom (Benton-Borghi, 2015; Ndlovu, 2021; White & Robertson, 2015). This study proposed the unified framework of technology integration which will help the teacher to better instruct children with SLD in their classrooms from a UDL perspective.

Furthermore, from the analyzed documents from Cameroon and Canada, there are laws, policies, and legislations which have also been enacted to make education accessible to children with SLD. For example, in Cameroon, there are laws like the Law of 1983 which contain provisions of various grants to support special education schools and special didactic materials

adapted to children's needs amongst others (Cameroon, 1984) and Law 2010 which laid down provisions through various support such as granting of scholarships and provision of adapted teaching material amongst others (Cameroon, 2010a) are provided for children with SLD to enable them to have access to education. Meanwhile, in Canada, there exist several policies and legislations for Canada-wide as well as most of the Canadian jurisdictions on accessibility for all aspects of Canadian life including education of children with SLD such as the Accessible Canada Act which ensures that all education should be made accessible to all children in all accessible formats (Employment and Social Development, 2019). Also, the Ontario's Human Rights Commission (2018) came out with a policy to ensure that all children with SLD have access to education in Ontario in all accessible formats (such as alternative format of text, fonts, and so on) appropriately in the accommodation process in an inclusive environment. Children with SLD need support to be included in an inclusive setting and so education must be made accessible to them to benefit in the accessible digital environment based on the principles of the universal design. This has led to many Canadian jurisdictions enacting accessibility acts such as the new legislation-Newfoundland and Labrador's Accessibility Act (2021) (Newfoundland and Labrador Ministry of Children, Seniors and Social Development, 2021) which will improve accessibility by identifying, preventing and removing barriers that prevent persons with disabilities from full participation in the community.

So, from the analyzed documents from Cameroon and Canada, it is clear that both countries have laws and policies on special and inclusive education which ensures that special programs and services are provided for children with SLD which consists of support and accommodations such as provision of assistive devices (Cameroon, 1984; 2010a; New Brunswick Department of Education and Early Childhood Development, 2013). But in both

countries, these laws, policies, and legislations need to be updated and well implemented. Moreover, in Cameroon and Canada, some children with SLD are placed in inclusive schools while others are placed in segregated settings with special and /or inclusive education being practiced as such education provides all the services and supports in all the jurisdictions to help such children with the provision of all their needs (Cameroon, 1984, 2010a; New Brunswick Department of Education and Early Childhood Development, 2013). To provide the needs of children with SLD in inclusive schools, the government has to equip each public school with resources, support and accommodations like AT devices and services to assist the children to learn with their peers without SLD and reach their full potentials. This finding is consistent with the Manitoba's government aim of increasing the funding for public schools system for special needs funding for school divisions and also through the Student Services Unit along with other grants which supports students with SLD, providing student specific supports determined by school teams such as education assistants or assistive technology (Manitoba Education, 2015).

On the other hand, in Cameroon, this is not the case as most public schools in the country have insufficient AT to meet the needs of children with SLD as can be confirmed from the works of these researchers (Cameroon Baptist Convention Health Service, 2016; Ebontane, 2010; International Centre for Evidence in Disability, 2014) except the 68 pilot inclusive schools all over the national territory. This has led most parents with children having severe SLD to enroll them in special schools such as the Bulu Blind Centre in Buea for the children with visual impairment and the Yaoundé Special School for children with hearing impairment because in these schools, AT is readily available for all of them. Similarly, Canada also has a special school, for example, the school for the blind, low vision and deaf-blind called William Ross Macdonald School. The school is located in Brantford, Ontario and it strives to provide an excellent, well

rounded educational experience for all the children enrolled in the school. It runs a full academic

program with a wide range of extra-curricular activities, and focus on the expanded core

curriculum, for example, one to one lessons in orientation and mobility, life skills, technology

and braille (Ontario Ministry of Education, 2018). All the teachers are specialist teachers of the

blind or deafblind with small classes and programming is individualized for each student,

depending on his or her specific needs and thus provides all the materials needed by a child in

whichever format is required (Ontario Ministry of Education, 2018). Not only do children

receive daily classroom instruction on reading strategies and braille or print reading skills,

depending on their needs, but they are also exposed to a wide variety of assistive devices and

technology that is available in the school (Ontario Ministry of Education, 2018).

Similarly, this study is consistent with the comparative study carried out by Bratan et al.

(2020) with the four European countries who also found out that each of these countries had anti-

discrimination laws and other laws, policies and legislations on AT access and provision for

people with disabilities (including children with SLD) showing favourable regulatory framework

for further inclusion of such children with the help of ATs. For example, these laws, policies and

legislations mentioned in the countries were: "Germany: National Framework Act; Hungary: Act

on National Public Education (2011); Portugal: Disability Law (2004) and Decree-law 54/2018

and Sweden: Swedish school law and Discrimination Act" (Bratan et al., 2020, p. 34). All four

European countries had AT available in their countries supplied partly by their governments and

more by the non-governmental organizations with still unmet needs of AT just like their

counterparts (Cameroon and Canada) with great variations between these countries. A problem

present in all the countries which also has an impact on the availability and usability of ATs is

that the alignment between the regulatory measures in place and their implementation in practice is sometimes poor (Bratan et al., 2020) which is similar to this study.

Summarily, the results of this study show that AT is available for the school-based instruction of children with SLD and that laws, policies and legislations have been enacted to control AT access and provision for these children which implies that teachers are required to use technology (AT) to teach these children using any technology integration model. In this study, I proposed the unified framework of technology integration which teachers could use in the school-based instruction of children with SLD. Teachers are to make sure that they have acquired the required technological pedagogical content knowledge (Mishra & Koehler, 2006; Mishra, 2019) while using learner-centered activities that will ensure the affective, behavioural and cognitive engagements of the children during lessons (Gunuc, 2017) and introducing AT in simple and effective steps to better incorporate AT in their instruction. The teacher can use AT as a one-to-one replacement for traditional tools on one end and on the other, AT enables experiences that were not possible previously without it (Puentedura, 2006). It is essential for the teacher to be purposeful in how he/she integrates AT into his/her instruction using the UDL perspective. When AT is successfully integrated into the lesson by the teacher, this will lead to competent children with SLD who can now learn easily with the use of AT. It is in this light that I urged teachers to be trained and proficient in using this framework or other frameworks for technology integration in the classrooms for the school-based instruction of children with SLD.

5.4 Conclusion

This study looked into the use of AT in the school-based instruction of children with SLD as a comparative case study using document analysis and arrived at four conclusions:

Firstly, that AT is available for use in inclusive schools in both countries but there are still unmet needs by children with SLD which the governments should look for more strategies and funding to curb the ever increasing need of AT. So, each country should make AT available for all the children with SLD in need of them and the AT should be of high quality and affordable at a lower cost according to their local realities.

Secondly, both governments and the their various non-governmental, non-for-profit and charity organizations and their foreign partners, international donors, philanthropists and other AT providers nationally and internationally should help to provide AT free of charge to children with SLD because AT is expensive and have many ongoing costs such as costs for maintenance, repair, replacement, and training of teachers and children on the use of AT amongst others.

Thirdly, laws, policies, and legislations have been enacted by both countries for AT access and provision but not implemented to the fullest in all jurisdictions. For example, in Canada, each province/territory has its own policies and legislations which affect AT availability, access and provision and these variations causes inconsistencies across jurisdictions. Thus, a national AT policy well implemented would resolve this issue in Canada while Cameroon needs to revise its laws and policies and also enact a national AT policy which should be well implemented.

And lastly, continuous research in AT is therefore needed to make AT readily available and affordable at a lower cost for school-based instruction for children with SLD to remediate their learning problems, promote personal independence amongst others. As children with SLD have different needs for AT, it is imperative that the various barriers to AT access and provision be identified and solutions provided depending on the local realities.

5.5 Lessons learned

From the comparison of Cameroon and Canada through some selected documents analyzed, I learned some few lessons which are discussed below.

Firstly, I learned that AT is available in each country but those available cannot meet the needs of all the children with SLD who need them. These unmet needs in both countries may be due to many barriers which hinder the children with SLD from acquiring these devices. So, countries should make sure that they acquire high quality low cost affordable AT for all the children with SLD in need of one as specified in their individualized educational plan or related documents specifying their needs. So, if any country does not have enough AT for the children with SLD, they should strive to make theirs as recommended by the CRPD and suggestions provided by the World Health Organization's Global Cooperation on Assistive Technology initiative according to their local realities.

Secondly, I also learned that each country has some laws, policies and legislations that govern the AT access and provision for children with SLD but there are many factors which affect them from being fully implemented. These laws, policies and legislations on AT access and provision align programs and services that are really needed to assist children with SLD in their education by improving their access to AT. Thus, countries need to have a national policy on AT access and provision as well as assistive devices programs to provide AT to children with SLD for their education. Both countries are making sure that inclusive education is being practiced in their schools and the governments should also provide enough funding and create assistive devices programs to help finance the provision of AT to all children needing it following the data (of children with SLD needing AT) got from each jurisdiction.

And lastly, I learned that AT used by children with SLD should be tax exempted and not levied duty and brokerage fees. These taxes and fees affect the price of the AT and so it is good that the taxes and fees be removed as many countries have not started manufacturing their own AT nationally but for a few and so depend largely on the importation of AT from other countries. The various governments should give tax incentives for AT as this will make AT to be readily available for children with SLD who need them.

5.6 Recommendations to the various stakeholders

From the results of the study, recommendations would be given to both Governments; AT service providers; Associations/Organizations for People with Disabilities; Non-governmental, Not-for-profit and Charity Organizations and Donors.

5.6.1 Recommendations to both Governments

The government of Cameroon should ratify the CRPD and implement all its resolutions concerning AT access and provision as it has not ratified the convention yet, and is not likely to implement all its articles especially those linked to AT. Similarly, Canada should increase her response in the implementation of the CRPD's articles related to AT as it has signed and ratified the CRPD.

Both governments should use a multi-sectoral approach in the supply of AT for children with SLD in their countries and make sure that AT is available in sufficient quantity, affordable and accessible to all the children with SLD in schools in all jurisdictions. They should also develop laws, policies and legislations which support AT access and provision at the national levels for all children with SLD especially enacting a national assistive technology policy. The Ministries in both countries dealing with the affairs of children with SLD should be proactive in the formulation and implementation of the laws, policies and legislations regarding AT and inclusive schools for sustainability.

Also, the governments should include AT provision in their health care programs and services in their countries to enable that the children are provided with the required AT as they are diagnosed as having SLD. Both governments should also ensure the provision of essential AT for children with SLD by removing import or custom duties and taxes on AT that are not locally produced as AT are not used for luxurious purposes. They should also put in place monitoring and accountability mechanisms regarding the availability, access and provision of AT to evaluate the adequacy of support given to children with SLD. Furthermore, both governments should ensure that there is ongoing training for all teachers to teach children with SLD using AT and the new technologies that are being developed daily to support these children in their learning.

Both governments should ensure that all the children with SLD in need of AT should have access to them by providing sufficient funding to improve the availability and affordability of AT for their use. Increased funding will also help to fund the development of locally-made high quality low cost AT for children with SLD in all jurisdictions.

And lastly, both governments could place an order to the UNICEF supply division for AT needed by children with SLD as UNICEF and WHO through global tenders have been able to negotiate low-cost prices to make high cost AT which can be quickly and easily available for use by children with SLD in order to curb the unmet needs of AT.

5.6.2 Recommendations to AT Service Providers

AT service providers could use community-based rehabilitation strategies in order to provide AT for children with SLD. The community-based rehabilitation programs will help to know what AT are available in other countries and collaborate with them where possible as well as develop strong links with international and national non-governmental organizations who are

often active in producing and providing AT with a view to the development of sustainable service provision.

AT service providers could reduce the cost of AT to ease access and affordability for children with SLD in need and also raise awareness to the various countries on how countries could develop low cost high quality affordable AT within their national territories to suit their local realities. AT service providers could also contact the government and other funding agencies to assist them in the production of low cost high quality affordable AT for children with SLD.

5.6.3 Recommendations to Associations/Organization for People with Disabilities

Associations/Organizations for people with disabilities could carry out a survey of children with SLD in their jurisdictions and advocate for their AT needs from their various governments and other philanthropists. These associations and organizations could also apply for funding of AT for children with SLD from the many non-governmental, not-for-profit, charity and other well-wishers organizations available in their jurisdictions.

5.6.4 Recommendations to Non-governmental, Not-for-profit and Charity Organizations

Non-governmental, Non-for-profit and Charity organizations could also help in acquiring funding to ensure the provision of AT for children with SLD by seeking aids from foreign partners, well-to-do schools, well-wishers and other philanthropists. They could also advocate for the children with SLD and help in providing AT for children with SLD free of charge to help the children to support their learning in schools.

5.6.5 Recommendations to Donors

Donors could help to pay for AT for children with SLD in many countries through funds for purchase or donation or delivering the AT or through financial coverage for devices and services. Furthermore, donors could also help the governments to develop sustainable funded AT

service delivery and support systems to make sure that AT is readily available for use by children in need. Lastly, international donors could work with both governments collaboratively to ensure the provision of AT for children with SLD in all schools.

5.6.6 Recommendations to the Teachers

Teachers should attend seminars/workshops/training on the available AT and how to integrate them in their teaching and the learning process of the children with SLD. Teachers should also be knowledgeable in the various theoretical framework of technology integration (TPACK, SAMR and ETIT) and how to successfully integrate technology (AT) into the curriculum and classrooms to ensure effective teaching and learning for all children using the UDL perspective.

5.7 Limitations of the Study

This study was limited to the use of AT in the school-based instruction of children with SLD in Cameroon and Canada only. As this study was limited to document analysis, some essential government documents, legislations and reports revealed only what the governments allowed the general public to know about AT. Care should be taken in the transferability of the results as this study was the work of one researcher and lessons learned are only from Cameroon and Canada. The documents used were valid and reliable as they represented the official perspectives of AT use in both countries. Due to resources and time constraints, I consulted a limited number of documents and used only two case samples. All the documents analyzed in this study were in English Language while French Language documents were not used because they were not found during the online searches using the search terms in both countries. Also, due to time constraints, documents were not selected from all the 13 Canadian jurisdictions but those selected and analyzed from Canada were illustrative of the others in other jurisdictions despite some patterns, commonalities and differences between jurisdictions and the federal

system of Canada. Although, there were limitations in this comparative case study, the data collected was enough to reach a valid conclusion.

5.8 Implications for Policy and Practice

Both governments should enhance equitable access and provision of AT to children with SLD as this will ensure that the AT policy priorities align with those of the United Nations' Convention for the Rights of Persons with Disabilities on AT. Also, there is a need for both governments to develop a list of essential AT for the education of children with SLD in their countries as most countries have already done so following the recommendation of the World Health Organization.

In policy development, both governments should consider a universal design for providing AT for children with SLD. Both governments should also create policies, legislations and programs that address existing and new issues of equitable access and provision of AT while optimizing the opportunities offered by new technologies.

Both governments should create a commission to monitor the revision and effective implementation of the laws, policies, and legislations on AT access and provision for maximum impact on the lives of children with SLD in schools.

5.9 Recommendation for Further Research

Further research should be carried out to compare AT availability in different countries in the Global North and Global South for the school-based instruction for children with SLD using mixed methods. Further research could also be conducted to compare the role of AT in the teaching of children with SLD as seen by teachers, school leaders and parents in countries in Global North and Global South using mixed methods.

Further research should also be carried out to compare AT access and provision for children with SLD in more than two countries from the Global North and Global South. This research would enable the assessment of how AT is provided between these countries.

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Appendix

Appendix A

Selected documents from Canadian Jurisdictions (CJ)

Code	Title of Document	Author, year	Purpose of Document	Aspects of AT mentioned	Links
CJ1	Learning and Technology Framework Policy	Alberta Education, 2013	It provides a guide for educators in understanding how technology in the classroom increases opportunities and support for students.	It involves five policy directions which provide comprehensive structures to enable the innovative use of technology in learning, teaching, leadership and administration. It also discusses how technology should support student learning in the K-12 education system.	https://education.alberta.ca/media/1046/learning-and-technology-policy-framework-web.pdf
CJ2	Student Services Unit (SSU)	Manitoba Education, 2015	It has a team of consultants who help provide support for children with SLD.	SSU works with student support teams to provide the needed supports and services including AT devices and services.	https://www.edu.gov.mb.ca/k12/specedu/programming/
CJ3	Policy 322	New Brunswick Department of Education and Early Childhood Development, 2013	It is a provincial legally-binding policy that sets out the requirements of an Inclusive Education system for all public schools.	It provides support and accommodations for students with SLD including AT devices and services.	https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/policies-politiques/e/322A.pdf

CJ4	Special Education in Ontario, Kindergarten to Grade 12: Policy and Resource Guide	Ontario Ministry of Education, 2017	To support school boards and schools in their effective delivery of programs and services for students with special education needs.	Provides or purchase from another board, special education programs and services for their students with SLD including AT devices and services.	http://www.edu.gov.on.ca/eng/document/policy/os/onschools_2017e.pdf
CJ5	Assistive Devices Program	Ontario Ministry of Health and Long-term Care, 2016	To help people who have a long-term disability in paying for equipment and supplies when they qualify for the Assistive Devices Program.	Provide 8,000 assistive devices and other vital services to persons with disabilities who qualify for them.	https://www.ontario.ca/page/assistive-devices-program
CJ 6	Assistance for Children with Severe Disabilities (ACSD) program	Ministry of Children, Community and Social Services, 2021	This program provides monthly financial support (between $25 and $500) for low-income and moderate-income families to cover some of the extra costs of caring for a child who has a severe disability	Children receive coverage for an assessment for an assistive device and/or the consumer contribution for a device provided under the Assistive Devices Program, hearing aids amongst others.	https://www.ontario.ca/page/assistance-children-severe-disabilities-program
CJ7	The Joint Education Action Plan 2014-2024	Government of Yukon, 2020	The plan focuses on ways to improve educational outcomes for First Nations students in Yukon by improving access to AT.	Provided $950,000 to purchase 1,300 devices to improve access to technology for Yukon First Nations students in Kindergarten to Grade 12.	https://yukon.ca/en/improved-access-technology-first-nations-students

CJ8	The Policy on Accessible Education for Students with Disabilities	Ontario Human Rights Commission, 2018	The Policy provides practical guidance on the legal rights and responsibilities as concerns disability in education.	The policy deals with the provision of support that student with disabilities need and thus making education accessible to students including maintaining accessible, inclusive and harassment free environment.	. https://www.ohrc.on.ca/en/policy-accessible-education-students-disabilities#