AN EXPLORATION OF TEACHERS' USE OF ASSISTIVE TECHNOLOGY IN INCLUSIVE CLASSROOMS WITHIN THE CONTEXT OF UNIVERSAL DESIGN FOR LEARNING AND STUDENTS' RESPONSE TO THESE METHODS AND TOOLS

by

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Abstract

Teachers must employ instructional approaches and tools that assist all students in accessing the curriculum, engaging in learning activities, and demonstrating their achievements. Universal design for learning and assistive technology make the curriculum and instructional practices accessible and engaging for all students. As there is little research examining the use of assistive technology in inclusive environments, this exploratory study uses semi-structured interviews with teachers, focus groups with students, and classroom observations to examine how elementary teachers implement assistive technology in general education classrooms within the context of universal design for learning and the supports and challenges that influence these practices.

Keywords: assistive technology, instructional technology, universal design for learning, inclusive education

Dedication

I would like to dedicate this study to my supportive partner, Trevor Greeley and my inspiring daughter, Kendra Greeley. Without your unconditional love and infinite support, completion of this project simply would not have been possible.

This Master's thesis is also dedicated to my loving mother, Margaret, who has always been my greatest advocate and a vital part of my educational journey.

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Introduction

Newfoundland and Labrador's Department of Education and Early Childhood Development promote their Inclusive Education Initiative. Inclusive education requires teachers to employ instructional approaches and tools that assist all students in accessing the curriculum, engaging in learning activities, and demonstrating their learning. Today's teachers are being asked to teach a broad range of learners in their classrooms, and as such, a traditional one size fits all instruction will not suffice (Rose & Meyer, 2000). Universal Design for Learning (UDL) and assistive technology have the potential to make curriculum and instructional practices more accessible and engaging for all students.

The diversity found in the 21st-century classroom presents numerous challenges for teachers. Today's general education classroom might include students who are second language learners, working below grade level, have emotional or attention problems, or who are cognitively or physically disabled or gifted. Ensuring that each student is having their learning needs met may be quite challenging in a class with a wide range of learners. Traditionally, students with learning needs or exceptionalities received supports in the form of accommodations, modifications, alternate programs or courses that are typically delivered to students as an add-on support. With inclusive education becoming the new norm, this retrofitting approach to service delivery may not align with the realities and challenges of inclusive classes. A more proactive approach to meeting students' learning needs may more suited for inclusive learning environments. That is, educators can design lessons to be more universal to allow all students to access learning in a way that best meets their unique learning needs. There has been a shift in other industries such as architecture and software development in employing Universal Design. Architects design buildings to allow access for a wide range of individual differences

and needs. Software developers are designing programs to more accessible for diverse populations. Perhaps it is time for educators to apply the Universal Design approach as well in order to meet the needs of their diverse students.

In order to overcome the challenges of teaching in an inclusive learning environment, teachers need to move toward more flexible teaching methods and materials that will help students achieve high standards by maximizing learning opportunities for all learners (Rose, Hasselbring, Stahl, & Zabala, 2005). Universal Design for Learning (UDL) is a theoretical framework and set of principles that guide the design of instructional goals, methods, materials, and assessments to enable all students to access and learn from the curriculum (Rose & Meyer, 2002). A universally designed curriculum stresses proactive, intentional lesson planning to address the needs of the broad range of learners found in the classroom. There are three underlying principles that support the implementation of UDL: multiple means of representation, multiple means of expression, and multiple means of engagement (Rose & Meyer, 2002). At its essence, UDL recognizes that students learn in multiple ways, for multiple reasons, and have multiple ways of demonstrating that learning, while also recognizing that most students will at times encounter a barrier to learning.

Within the framework of UDL, technology is one of the tools available to help support students' diverse learning needs (Edyburn, 2010). There are three main types of technology that may be used to support student learning: mainstream; instructional; and assistive technology (BC Ministry of Education, 2016). Mainstream technologies are products purchased by typical consumers (e.g., laptops, tablets, iPods, mp3 players, digital cameras, Smart phones, etc.). Instructional technology is used to facilitate student learning and attainment of learning goals (e.g., SMART Boards, online tools, multimedia, document cameras, etc.). Assistive technology

is used to help a student compensate for some type of physical or cognitive difficulty and is more customizable for individual users (BC Ministry of Education, 2016). Assistive technology can be any device, software, or teaching strategy that is specifically implemented to help a student with learning or functional disability adapt to the learning environment (IDEA, 2004). For students with high-incidence disabilities, this may include general instructional technology (e.g., SMARTBoards), as well as computer software that supports the reading and writing process through text-to-speech (e.g., Kurzweil), speech-to-text (e.g., Dragon Naturally Speaking), graphic organizers (e.g., Inspiration), and word prediction programs (e.g., WordQ). Research demonstrates the effectiveness of assistive technology for students with disabilities (Higgins & Raskind, 2004), with specific emphasis on its ability to increase academic achievement (Hetzroni & Shrieber, 2004), and improve students' reading and writing in all content areas (MacArthur, 2009). However, nearly one-third of assistive technology devices are abandoned (Todis, 1996). Students may abandon their technology for fear of looking different from their peers (Todis, 1996). While assistive technology benefits students with disabilities (White, Wepner, & Wetzel, 2003), it can improve access to the curriculum for all students (Silver-Pacuilla, 2006). Providing all students with the opportunity to use assistive technology may lead to a decrease in assistive technology abandonment and an increased learning benefit to all students.

For many people, mainstream technologies such as tablets and Smart phones have become an integral part of daily life. According to Ludlow (2014), education is beginning to witness the "convergence of assistive and mainstream technology" (p. 1). Technology can provide teachers with a wide range of tools to make inclusion both possible and easier. Many "built-in" assistive technology features are advantageous for a broad range of individuals, not just those with special needs. King-Sears and Evmenova (2007) encourage teachers to find

opportunities to implement innovative technologies with all of the students in the class. However, the abundance and redefining of assistive technology may leave teachers feeling unprepared to effectively use the technology in their inclusive classes.

Research Design

This study utilized a qualitative research methodology. According to Savin-Baden and Major (2013), qualitative research focuses on understanding the participants' perspectives and their circumstances. These authors also state that qualitative research occurs in the participant's natural settings as the research strives to understand the phenomena in context. A qualitative research design allowed me to obtain in-depth descriptions, essential insights, and interpretations of how classroom teachers design and implement lessons that enables access to assistive technology based on the principles of UDL.

An exploratory case study research design, which utilized an appreciative inquiry approach, was implemented for this project. Appreciative inquiry focuses on the positive aspects of the research setting (Reed, 2007). Case study research provides a detailed account and analysis of one or more cases, with a case being defined as a bounded system or clearly defined context (Merriam & Tisdell, 2015). For this study, a case was defined as teachers who are proficient with implementing technology within inclusive classes. This study focused on teachers in the Eastern Avalon of Newfoundland and Labrador who were recognized for their effective implementation of technology as a tool to support student learning. Case studies are used to explore a phenomenon (the 'case') within its real-life context, and suited for situations where it is impossible to separate the phenomena's variables from their context (Yin, 2009). The current study provides an in-depth exploration of how teachers in one region use assistive technology within the context of UDL, and provides an in-depth exploration of three teachers' instructional

practices. As teachers have different teaching techniques, I examined the instructional practices of three teachers. Examining three classrooms and numerous sources of evidence assisted in understanding the findings and added confidence to the research as a whole (Miles, Huberman & Saldaña, 2014).

To gain a better understanding of teacher's instructional practices, this study used a two-tier, purposeful sampling technique to identify teacher participants who were recognized for their proficiency in using technology within inclusive classrooms. The first sample was for the interview portion of the study where teachers were identified using snowball sampling. These participants were nominated to participate in this study by other educators or administrators in the Newfoundland and Labrador English School District. These teachers were selected to participate in the interview because they were recognized for using technology as a tool to support the diverse learning needs of their students. Using the UDL framework as criteria, three teachers were selected for further investigation based on their interview responses and how they indicated they use technology to provide students with multiple means of representation, multiple means of expression, and multiple means of engagement. In order to triangulate the findings, and add depth to the study, this study employed semi-structured interviews with teachers, classroom observations, informal conversations, and student focus groups to explore the research questions.

Rationale for the Research

There is little research examining the use of assistive technology in inclusive, regular education classrooms (Watson, Smith, & Anderson, 2010). Quinn, Behrmann, Mastropieri, and Chung (2009) found the use of assistive technology in schools to be low, but especially low for students with high-incidence disabilities in general education environments. There is a gap in the

research literature surrounding instructional practices that employ assistive technology to provide learning environments that are accessible for all learners (Basham et al., 2010). This study was exploratory in nature and used case study methodology, participant-observer techniques, and ethnographic tools, to examine how teachers implement assistive technology in general education classrooms within the context of universal design for learning and how students respond to these methods and tools.

The main goal of this study was to explore how teachers who are proficient with technology implement assistive technology in their inclusive learning environment. The study aimed to answer the following three sub-questions:

1. How do teachers develop instructional practices that incorporate assistive technology within the context of universal design for learning?
2. What supports and challenges influence instructional practices that incorporate assistive technology?
3. What are students' perceptions of utilizing assistive technology and universal design for learning?

Significance of the Research

There has been little research conducted on the implementation of assistive technology in inclusive classes (Watson, Smith, & Anderson, 2010). There is a need for more research on how teachers are using assistive technology to provide learning environments that are accessible for all learners (Basham et al., 2010). A review of the current literature on assistive technology use is sparse. The studies are limited by focusing on specific disabilities and a narrowed range of assistive technology devices are investigated (Quinn et al., 2009). The current study takes place in a real-world setting, the inclusive classroom, and includes both teacher and student voices.

The study focused on teachers who were recognized for their strengths in implementing technology to: a) provide multiple representations of information, b) provide multiple ways for students to show their learning, and c) engage and motivate their students.

This study is unique in that it employs appreciative inquiry - a research approach which focuses on what works, rather than trying to fix what does not. Appreciative inquiry emphasizes the positive aspects of the research setting, so that individuals may recognize their strengths and continue to build upon them (Reed, 2007). The Appreciative inquiry perspective allowed the researchers to highlight what is working well for teachers as they integrate technology to enhance and diversify instruction. It is my hope that sharing these best practices will have positive and practical implications for teachers as they recognize their own best practices and continue to build upon them.

Role of the Researcher

Because we have our own perspectives and experiences, it is inevitable that subjectivity will impact one's research. In order to make their research credible, it is imperative for qualitative researchers to clarify their role in the research. The qualitative researcher is interested in perspectives, rather than absolute truths or laws as in quantitative research. As such, it is the obligation of the researcher to provide information about themselves and their experiences (Unluer, 2012). In the text that follows, I strive to identify my personal values, assumptions, and biases, so that at the outset of the study, the reader is equipped to understand the viewpoint of the writer.

As a student, I always achieved academic success; however, success never came easy. Most of my learning would happen when I got home, where I was able to work at my own pace, and get help from my parents and siblings. As a student, I recognized early on that "chalk and

talk", reading paragraphs aloud from a textbook, and completing worksheets were not effective ways for me to learn. I sometimes wonder if my teachers had access to the technologies of today, such as interactive whiteboards, iPads, Google Apps, or YouTube, would learning have been more easily achievable? Would it have made learning more enjoyable? Would it have helped me complete assignments faster? My sense is that yes, it probably would have been helpful because it would have allowed me to receive and present information in a variety of ways. However, my formal schooling took place during the 1980-1990's and the educational approach was still quite traditional and before personal digital technologies were invented. It was common for lessons during this time to be teacher-led and content-driven. My learning experiences consisted of my classmates and I sitting down in our seats, seated in rows, listening to the teacher while he or she talked and gave examples of the chalkboard. We would then proceed to do some individual seatwork to practice what was just taught. Learning basically involved memorizing and recalling information. Since that time, the teacher's role has evolved and education has shifted away from this passive style of learning to a more constructivist type of approach where students are more engaged and active in their learning.

My interest in assistive technology and universal design for learning was ignited from several projects during my special education program. One of my course's final assignments was to create a presentation about UDL and differentiated instruction's role in providing inclusive education. As I researched the literature on these topics I became more intrigued as it made sense to me on a personal and professional level.

Currently, I am an Instructional Resource Teacher (IRT) with the Newfoundland and Labrador English School District. I have experience working with regular classroom teachers in implementing lessons based on the fundamentals of differentiated instruction. From a teacher's

perspective, I see students struggle to achieve learning outcomes and students who feel defeated before they even walk into class. My passion is to find ways that will enable students to overcome their learning obstacles and feel like they can successfully complete any learning activity. It is my goal to make learning easier and more enjoyable for all students. I have used a variety of assistive technologies with students in inclusive classes and pervasive needs classes as a way to assist students achieve their goals. I enjoy learning how other teachers use technology. I always find it very valuable as it inspires me build upon my own repertoire of strategies.

While I believe there are benefits to using technology as a tool for learning, I am cognizant that teachers have countless hurdles to overcome in order to use it effectively. Integrating technology can be very time-consuming and can be a source of frustration when it does not function properly. When I want to learn how to set up and use assistive technology software and devices for my students I need to turn to Google and YouTube videos for support. I know from my own experience there have been times when the technology became more of a hindrance to students' learning. Whether it was because the computer took long to load, the program was too confusing to use, a student could not find where she saved her assignment, or there was no WIFI connection in certain parts of the school, sometimes there would come a point when it was just easier to abandon ship and move on.

As technology continues to be used in schools, I am interested in learning how teachers are using digital devices to support the wide range of students' needs in their inclusive classes. Many devices and programs have assistive technology features built-in or easily available for download. Specialized assistive technology is becoming more available in common technologies such as tablets and Google Docs. Instead of individualized assistive technology for specific students, the technology can be used by any student, to provide compensatory or remedial

support. As such, it seems that assistive technology is no longer solely a tool for students with exceptionalities.

Outline of the Text

The text which ensues is organized as follows: 1) Introduction - Chapter one introduces the topic, addresses the purpose of the current study, presents the historical background, and discusses the reform of educational practices. It also highlights the relevance of the study to the province of Newfoundland and Labrador, provides the theoretical framework for this research project, and notes the importance of studying inclusion. 2) Literature Review - Chapter two provides a literature review of research on universal design for learning and assistive technology. This chapter highlights the benefits of assistive technology in regards to literacy, math, and overall engagement, as well as barriers to implementing assistive technology in inclusive classrooms. 3) Methods - Chapter three outlines the methods used to recruit participants for the study, provides an overview of the participants, and discusses the methods used to analyze the data. 4) Results - Chapter four presents the results and reports on their practical significance. 5) Discussion - Chapter five provides a discussion of the results noting the relevance to current research findings, considers the limitations of the study, and recommends areas of concern to be addressed in the future.

Literature Review

The current study is designed to explore how teachers use assistive technology within the context of Universal Design for Learning (UDL) in their inclusive classroom and student's response to these instructional methods. This research hopes to contribute directly to the literature regarding the use of assistive technology within the framework of UDL in general education classes. The text that follows presents an overview of the research on UDL, as well as assistive technology, and identifies gaps in the research literature. The current study utilized the UDL framework as a lens through which to examine technology use, and utilized a mindset of appreciative inquiry when selecting the research participants and examining the data. These concepts will be further explored so that the reader can better understand the research methodology and analysis of the data.

Universal Design for Learning (UDL)

Universal Design for Learning (UDL) is a theoretical framework and set of principles that guide the design of instructional goals, methods, materials, and assessments to enable all students to access and learn from the curriculum (Rose & Meyer, 2002). A universally designed curriculum is one that has been designed, from the outset, to be flexible and supportive of all learners, including those with disabilities or those who are from culturally and linguistically diverse backgrounds.

Universal design originated from guiding principles in architecture to design buildings and spaces for independent use by people with a wide range of physical and cognitive needs. For example, ramps and curb cuts were initially designed for people in wheelchairs but are used by people without disabilities, such as parents pushing strollers or people moving heavy furniture. As it turns out, everyone could avail and benefit from this proactive design feature. Architect

Ron Mace thought of the concept of universal design in order to eliminate the need for retrofitting buildings by instead developing designs to work effectively for as many users as possible. This proactive design avoids the need for costly and oftentimes inefficient add-ons and modifications (Hitchcock, Meyer, Rose & Jackson, 2002; Rose & Meyer, 2002).

David Rose, Anne Meyer, and colleagues at the Centre for Applied Special Technology (CAST) extended the concept of universal design to apply to the field of education. CAST aligns the principles of UDL with neuroscience research that has identified three interconnected brain networks (Rose & Meyer, 2002): the *recognition network* that enables the learner to identify and make sense of information and patterns, the *strategic network* that enables the learner to act upon the information and patterns, and the *affective network* that enables the learner to make emotional connections to the information and patterns. CAST posits that by providing multiple and flexible methods of representation, expression, and engagement, barriers can be minimized for students with disabilities and learning opportunities can be enhanced for all students (Rose & Meyer, 2002). Based on the identified brain networks, Rose and Meyer, and their colleagues at CAST developed principles that serve as the core components of UDL:

- Multiple means of *representation* to give learners various ways of acquiring information and knowledge
- Multiple means of *expression* to provide learners alternatives for demonstrating what they know, and
- Multiple means of *engagement* to tap into learners' interests, challenge them appropriately, and motivate them to learn (CAST, 2011).

These principles and guidelines are meant to prompt teachers to design instruction so that learners can access, engage with, and demonstrate understanding of information in ways that suit

individual learners. According to the National Centre on Universal Design for Learning (2014), "UDL provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone – not a single, one-size-fits-all solution but rather flexible approaches that can be customized and adjusted for individual needs" (para. 2). UDL proposes that the curriculum is made to be flexible from the outset so that it fits the strengths and preferences of a diverse group of learners rather than expecting the learners to adapt to a curriculum with rigid parameters (Rose & Meyer, 2002). According to UDL's basic premise, learning problems stem from an inflexible curriculum, rather than an individual's learning capacity. As such, UDL emphasizes the need for a curriculum that adapts to student needs instead of expecting students to adapt to an inflexible curriculum (Meyer & Rose, 2005). Instead of prescribing strategies for struggling learners after failure in the general curriculum has occurred, a UDL approach aims to make the curriculum accessible for all learners from the outset. This method is a contrast from traditional approaches of identifying learners as disabled or gifted then tailoring instruction to differences as a reaction to the diversity (Rose & Meyer, 2002). Special education services use accommodations and modifications to enable students with disabilities to learn within the general education curriculum. The student is at the centre of the problem and needs the "fixing" in order to learn. However, it is becoming apparent the barriers exist within the curriculum itself and are what need to be remedied (Hitchcock, et al., 2002).

Planning curriculum that meets the needs of all learners is a challenge given the diversity found in today's classrooms. Meo (2008) states that dividing students into either the regular or special group is an oversimplification of the diversity found amongst students and does not accurately represented the diversity in the student population. According to Meyer and Rose (2005), change in curriculum design is necessary in order to meet the increasingly diverse range

of learners in today's classrooms and current curriculum's inability to meet the needs of a wide range of learners. It is not only students with exceptionalities that face barriers in accessing the curriculum. Many students without exceptionalities also struggle to succeed when faced with a curriculum that is inflexible and is geared towards the traditional 'average' student. UDL has the potential to benefit all students by enabling individuals to learn in a way that works best for them.

Research on Universal Design for Learning. There is limited empirical data that demonstrates UDL's effectiveness in regards to the academic performance of students with disabilities. There is a need for additional support for UDL via publication of peer-reviewed research (Kennedy, Thomas, Meyer, Alves, & Lloyd, 2014). Conducting research on UDL presents numerous challenges in that there is no reliable or valid tools to measure universally designed instruction (Kennedy et al., 2014, p. 72). In addition, there is no clear definition as to what constitutes an intervention that is universally designed. There is no consensus on how UDL principles should be applied, nor is there agreement as to how much or in what combination the principles or guidelines of any model need to be present for educational intervention to be considered universally designed.

Rao, Ok, and Bryant (2014) undertook a systematic review of UDL literature in education to determine how UDL principles are applied to interventions from pre-kindergarten through post-secondary and included 13 studies in which UDL interventions were identified. Only a few of these studies focused on UDL's effect on student learning after implementation. Some studies failed to provide adequate detail about the UDL intervention and did not clearly state which UDL principles and guidelines were being addressed in their study. As such, analysis and interpretation of the effectiveness of a UDL intervention proved to be challenging due to this

lack of detail connecting the principles of universal design to their interventions, and the use of different measures and varied results. Rao Ok, and Bryant (2014) provide three recommendations for reporting on UDL research. First, the authors called for consistency when describing UDL interventions by explicitly connecting the UDL principles to the intervention components (Rao, Ok, & Bryant, 2014). Rao et al. recommended that researchers provide specific participant information such as information surrounding their diagnosis of exceptionality and achievement levels in order to determine generalizability among different groups of learners. It was also suggested that researchers disaggregate learning outcomes in order to determine the differential effects of UDL treatment on students with diverse learning needs. Third, the authors indicated the need for more definitive information on how specific UDL interventions affect student learning (Rao, Ok, & Bryant, 2014).

Several research studies surrounding UDL have been published since Rao et al.'s (2014) literature review. Kennedy et al. (2014) studied the impact on integrating UDL with vocabulary and concepts in high school history classes. Kennedy et al. developed Content Acquisition Podcasts (CAPs) to determine the differential effects of learning world history definitions for high school students with and without disabilities. The researchers compared the students - one group learned via CAPS and one group learned using more traditional methods, such as using the textbook's glossary, copying terms, and engaging in review activities. The study took place over an eight-week period covering two concurrent social studies units, and the researchers found that students with and without disabilities who used CAPs, a multimedia tool that combines evidenced-based practices for vocabulary instruction, UDL, and Mayer's instructional design principles, learned significantly more than their peers in non-CAPs classes.

Marino et al. (2014) compared the effects of UDL aligned units of study to traditional curriculum methods in middle school science classes. The researchers supplemented the UDL units with use of video games and alternative text. They found that students with learning disabilities who participated in the video games and used the alternative text did not perform better than peers with LD in control groups. However, the UDL aligned units were effective in their ability to provide students with multiple means of representation and expression as well as increased levels of engagement (Marino et al., 2014).

King-Sears et al. (2015) performed an exploratory study in order to determine if students with and without high incidence disabilities, who were taught using a UDL treatment, were better able to solve a two-step chemistry problem compared to the students who were taught using the traditional method of instruction. High school chemistry students were randomly assigned to a UDL treatment group or the comparison control group. The UDL principles in this study were operationalized for treatment. All students completed a pre-test, post-test, and a 4-week delayed post-test. The results showed no significant differences for condition. This study found that the UDL Mole Module treatment was not more effective compared with typical instruction when analyzing the group means for all students in the treatment and comparison group. However, when results were analyzed in their subgroups, High Incidence Disabilities (HID) or General Education students (GED), disaggregated findings suggest that students with HID in the UDL condition scored substantially higher on the post-test than students with HID in the comparison condition.

Katz (2013) developed the “Three-Block Model” of UDL, which goes beyond the traditional emphasis on technology and differentiation to explore both the social and academic practices of the classroom. Katz’s model of UDL is broken into three blocks and provides

teachers with a method for creating inclusive environments and improving student engagement. Block One examines *Social and Emotional Learning* and details ways to build compassionate learning communities in which all students feel safe and valued, and develop a positive self-concept, sense of belonging, and respect for diversity. The second block, *Inclusive Instructional Practice*, includes a framework for planning instructional environments, and explains instructional and management practices for teaching, assessing, grading, and reporting in UDL Classrooms. Katz (2013) refers to essential understandings within the curricula and inquiry activities that promote higher order thinking, enabling the mastery of complex concepts through differentiated and evidence-based instructional practices (p. 159). Block Three is called *Systems and Structures* and it suggests strategies for creating inclusive learning communities, and explores ways in which resource teachers, student services personnel, and school administrators can support and create socially and academically inclusive schools and classrooms. Katz (2013) investigated the effects of the implementation of the Three-Block Model on student academic and social engagement. This Canadian study investigated 631 students from Grades 1 to 12 in Manitoba using control comparisons. Results from this study found that students in the treatment UDL group were significantly more academically and socially engaged than those in the typical inclusive classroom. Katz (2013) reports that the Three Block Model produces significantly positive results for students in Grades 1 to 12 in terms of student engagement, autonomy, and positive interactions with peers and teachers. Thus, the evidence is mounting that the Three Block Model of Universal Design for Learning can be effective for all (Katz, 2013), and may provide an instructional framework that supports both teachers and students in inclusive education classrooms.

Assistive Technology

Assistive technology refers to the devices and services that are used to increase, maintain, or improve the functional capabilities of a student with a disability (Dell, Newton, & Petroff, 2012). The Human Function Model of assistive technology organizes assistive technology into seven categories that define an individual's need: existence; communication; body support, protection, and positioning; travel and mobility; environmental interaction; education and transition; and sports, fitness, and recreation (Kentucky Assistive Technology Project, 2002). Assistive technology devices range from low-tech to high-tech. Low tech devices are generally inexpensive, widely available, and easy to use such as pencil grips and line guides (Parette, Wojcik, Peterson-karlan, & Hourcade, 2005). Mid-tech devices such as audio recorders can be useful without the cost associated with high-tech devices (Young & MacCormack, 2014). Other examples of mid-tech devices include, concept maps, portable note takers, mp3 players, calculators, and pentop computers. Mid to high tech tools include specialized software such as text-to-speech software (e.g., Kurzweil 3000), speech-to-text software (e.g., Dragon Naturally Speaking), word prediction software (e.g., WordQ), and graphic organizer software (e.g., Inspiration). These high-tech devices are complex, multifunctional, and require a computer or tablet.

Assistive technology offers both compensatory and remedial approaches to facilitate learning and it can be used in a variety of situations within the school and classroom settings. For example, the results of a study using three different word prediction programs found increased spelling accuracy for all participants, writing performance improved for at least one program for each student, and composition rate increase for four out of five students for at least one program (Evmenova et al., 2010). The purpose of assistive technology is to enable students with

disabilities to participate in and complete tasks they would otherwise not be able to complete (Simpson, McBride, Spencer, Lodermilk, & Lynch, 2009). Assistive technology is used to assist students in meeting the goals outlined in their Individual Educational Plans (IEP) (Blackhurst, 2005), and it can help by supporting a student to complete tasks and by enabling a student to bypass an area of difficulty such as handwriting (Young & MacCormack, 2014). In addition, assistive technology is a tool that can enable students with disabilities to be more independent in completing tasks and achieving academic success (Hasselbring & Bausch, 2005).

Research on assistive technology for students with disabilities. The research findings that have accumulated demonstrate the effectiveness of assistive technology for students with disabilities. In regards to literacy research, the literature identifies several assistive technology software applications that support the writing of students with learning disabilities. Graphic organizers, word processors, word prediction, spell checkers, speech recognition software, and text-to-speech software are common forms of computer-based tools used to support the writing of students with learning disabilities (MacArthur, 1998, 2009; Peterson-Karlan & Parette, 2007). Evmenova and King-Sears (2014) claim assistive technology can support any stage of the writing process and writing in all subject areas. Batorowicz, Missiuna, and Pollock (2012) conducted a review of 28 studies regarding the use of technology to support the written productivity of children with learning disabilities. While the researchers found the evidence to be moderately low, they suggest there are some positive influences from some technology on students writing performance and behavior. The findings from this review suggest that using technology may positively impact student's attitudes, independence, and motivation to write (p. 222).

Evmenova, Graff, Jerome, and Behrmann (2010) examined three different word

prediction programs and their effect on the length, spelling accuracy, and rate of students' journal writing and students' expression of their opinions. The study also gathered the students' thoughts on each program. There were six students who participated in this study, and they were in Grades 3 through 6. These students were identified as having severe writing and/or spelling problems. The study used a changing conditions single-subject design and replicated the procedure for each student. The three word prediction programs that were compared included Co:Writer, WordQ, and WriteAssist. All three of these programs included additional features such as text-to-speech and the spell check feature. The researchers established a baseline level of student performance where students used Microsoft Word for their journal writing. For the treatment condition, students used the word prediction programs for a week, then alternated to one of the other programs. The results indicated that the students demonstrated improvements in spelling accuracy across the three different programs. One of the students increased the total number of words using each of the three programs and the five other students increased performance using at least one of the programs. For one student, the rate of composition noticeably increased using all three of the word prediction programs. Four of the students increased their composition using at least one of the programs. There was no change in rate for one student. The interviews indicated students and teachers enjoyed using the prediction programs and found them beneficial, with the majority of respondents indicating a preference for WordQ over the two other programs (Evmenova et al., 2010). The results of this study should be interpreted with caution as student's keyboarding skills could have impacted the results. As this study occurred during a four-week technology-based summer writing camp, the researchers were unable to test maintenance level and continued progress. In addition, as the research setting was a summer camp; the generalizability of the skills to the general education classroom is limited.

There is some evidence surrounding assistive technology having positive outcomes on reading skills for students with learning disabilities. Chiang and Jacobs (2009) investigated the effects of Computer-Based Instruction (CBI) on the academic self-perception and functional ability of high school students with learning difficulties. The participants included 50 high school students with learning difficulties who were assigned to either the CBI group or the comparison group. The students in the CBI group used the assistive reading software, Kurzweil 3000 (K-3000), intensively for 10 weeks. This program provides students with reading, writing and study strategy support. It serves as a speech synthesis system (e.g., a talking computer with its text-to-speech capabilities), a scanning software, a writing support, a note maker, and an organizer. Before and after the intervention period, the study used standardized measurements and self-developed questionnaires to examine students' academic self-perception and functional task performance. The study found that the CBI group made more progress than the comparison group on the reading and general competence subtests. The results suggest that the assistive reading software Kurzweil 3000 improves academic self-perception and functional task performance of high school students with learning difficulties.

Text-to-speech technology was examined as an instructional method in the general education classroom. Parr (2012) conducted a classroom case study where text-to-speech was integrated into the class's daily instructional practices. Text-to-speech is typically categorized as a type of assistive technology for reading for students with reading disabilities. This technology transforms the text of print or digital materials into a text that is read aloud by a computer-synthesized voice. The researcher used ethnographic inquiry and appears to have performed the study within her own class. The investigation took place over a period of eight months and involved 28 student participants. All but one of the students had a 98% decoding accuracy. The

students were observed before, during, and after the text-to-speech integration. The researcher used participant observation, interviews, archival documents, photos, and formal/informal conversations to obtain data. Text-to-speech was not provided to individual students as an accommodation; instead all students had access and the option to use this technology for reading support. From this case study, the researcher suggested that text-to-speech supports the development of metacognitive strategies, student dialogue and collaboration, spontaneous reader response and self-efficacy and self-advocacy. Parr (2012) proposes a re-envisioning of text-to-speech, in which it is no longer used as an added on, isolated, compensatory support for individual students. She recommends that this type of reading technology be embedded as an "integral and flexible component of inclusive reading education that incorporates the principles of universal instructional design" (p. 1427). The results from this study are difficult to generalize to other populations because the focus was on one class of students with unique learning needs. However, this study has significant value as it took place in the inclusive classroom and the findings from this study are transferable to other inclusive learning environments. As a teacher, this study confirms my own inclination that, in the inclusive classroom, text-to-speech would be a nuisance for some students, an equitable choice for others, and an essential learning tool for a few struggling readers.

Marino (2009) investigated technology-based tools used to support an inclusive middle-school science class. The study's aim was to determine if there was a relationship between students' reading ability, use of cognitive tools, and their comprehension of scientific outcomes. Marino's study involved 16 general education teachers who implemented the UDL-based curriculum in 62 inclusive classrooms. Groupings of students was based on their reading performance as opposed to disability classification. Students used Alien Rescue as a tool to learn

an astronomy unit. This technology-based tool utilized problem-based learning and tools that scaffold the learning process such as illustrations, pictures, animations, videos, and graphic organizers to allow students to learn at their own pace. The results indicated that the low ability readers benefitted from using these tools, even though they did not use them as frequently as the proficient readers.

Barriers to Assistive Technology in Inclusive Classes. While teachers may be familiar with technology use in their everyday lives that does not mean it easily translates into implementation in classrooms. Teachers have to overcome major obstacles in order to effectively implement technology as a tool for teaching and learning practices. A recent study by Okolo and Deidrich (2014) revealed interesting aspects surrounding technology use in schools and the common obstacles that are faced by educators in implementing technology. This study surveyed educators to provide a snapshot of their knowledge, skills, and perceptions of technology use for students with disabilities. The study took place in a large Midwestern state and the 1,143 participants were a diverse sample that encompassed K-12 general and special education teachers, related service personnel, administrators, and technology coordinators. One of the open-ended questions respondents were asked was, “In your school or district, what are the top three ways technology could be used to have an impact on the learning and success of students with disabilities?” Sixty-seven percent of educators indicated improved access to curriculum, which included increased access to text, ways to respond, access to oral information, captioning and described video, and Universal Design for Learning. Other frequent responses for technology’s impact on teaching and learning included: positive impact on academic outcomes; improved teaching practices (differentiation, individual feedback, pacing, more interactive or relevant instruction and support for individual learners); and better-quality functional outcomes,

such as improved opportunities to communicate with peers (Okolo & Deidrich, 2014). Educators were also asked to identify three of the biggest barriers to using technology to support the education of students with disabilities. Seventy percent of educators named staff knowledge as a barrier to technology use. Respondents pointed to the need for more training to improve the knowledge and skills of educators. The second most common barrier to technology use was related to lack of student access to adequate technology. Sixty-one percent of respondents were not satisfied with the quantity, quality, and type of technology available for use by students and teachers. Educators mentioned a general dissatisfaction with the technology, as well as specific problems such as how the technology was distributed, the broadband speed, lack of technology-related resources, and outdated technology. Funding was cited as the third most common barrier, followed by issues with implementation that included factors relating to infrastructure, support for technology, lack of time for teachers to learning about how to implement technology, and staff allocation of technology support personnel.

Flanagan, Bouck, and Richardson (2013) conducted a survey to explore the use, effectiveness, and factors impacting the use of assistive technology for literacy teaching and learning. The findings revealed while teacher's believed assistive technology supported student literacy skill development, it's use was very minimal and more likely limited to low-tech assistive technology options which are less costly. The results suggest providing effective training to teachers during per-service education or professional development sessions may support teachers' use and understanding of assistive technology.

Relationship between Assistive Technology and Universal Design for Learning. New technologies are transforming education for students with disabilities. Within the framework of UDL, technology is one of the available tools to support the diverse learning needs of students

(Edyburn, 2010). Assistive technology and UDL are complementary to each other, but they are distinct from one another. Rose, Hasselbring, Stahl, and Zabala (2005) distinguish assistive technology and UDL by describing them as two approaches on a continuum, both with the goal of overcoming barriers. The distinguishing feature is that on one end of the continuum, assistive technology is used to reduce barriers for people with disabilities, and on the other end of the continuum, UDL involves reducing barriers for everyone. While assistive technology and UDL are on varying ends of the continuum, it is in the middle of the continuum that the two approaches overlap and share commonalities. Rose et al. (2005) emphasize the interactions between assistive technology and UDL, explaining that a comprehensive solution is likely to involve an effective integration of both approaches.

Assistive technology differs in its approach and perspective, as UDL is not designed for a specific student or disability; rather it anticipates the range of needs and provides a flexible learning environment where barriers are reduced from the beginning. Assistive technology was traditionally designed for an individual to overcome barriers in his or her environment and enable greater independence (Rose et al., 2005). For example, a student with a reading disability may struggle to read content in his social studies program. From an assistive technology perspective, the deficit or the problem is his reading disability. This disability interferes with his ability to read the social studies content and demonstrate his knowledge. An assistive technology approach to this student's deficit would be to prescribe a tool, such as a text-speech device, to overcome the child's difficulty with reading. On the other hand, a UDL perspective would see the learning environment, which is overreliance on printed text, as the problem not the student. A UDL approach would anticipate this barrier to learning the curriculum and devise a solution from the outset, such as a digital multimedia text that provides options for viewing and manipulating

content and expressing knowledge (Rose et al., 2005). The student with the reading disability would benefit from this UDL solution, but it also can support his classmates and accommodate their diverse learning needs. Rose et al. (2005) advises that both assistive technology and UDL solutions are needed.

Inclusive classrooms utilize instructional and assistive technology (King-Sears & Evmenova, 2007). Instructional technology is more general in nature. Unlike assistive technology, which is geared toward a single child's strengths and needs, instructional technology supports teaching the curriculum and facilitating learning (Parette & Peterson-Karlan, 2007). In spite of these differences, in this era of accessible technological devices, the lines that distinguish instructional and assistive technology are beginning to blur. Some technologies, such as digital textbooks, may be considered both instructional and assistive (King-Sears & Evmenova, 2007). High-tech assistive technology tools are becoming more common as specialized technology becomes increasingly available to classrooms and all students. A vast array of instructional technology contains the same attributes as assistive technology. For example, speech recognition software is highly beneficial for students with difficulties in reading and writing, and is routinely acknowledged as assistive technology for students with disabilities. However, this same technology is ubiquitous on current smartphones and other mobile devices that people without disabilities use on a daily basis. Therefore, Marino, Sameshima, and Beecher (2009) argued that the majority of assistive technology and instructional technology products are symbiotic in nature. As such, educators should focus on the efficacious aspects of the technology rather than defining it as assistive or instructional technology.

Rethinking Assistive Technology. Traditionally, there were individual programs or devices, such as Dragon Naturally Speaking, WordQ and Fusion Writers. In order for students to

have access to this assistive technology, the teacher had to do an assistive technology trial and apply to get one copy of the program. Students had to have an Individual Education Plan (IEP) and their Record of Accommodations had to recommend specific assistive technology. While this is still the process for the NLESD, students without IEPs can access assistive technology programs through purchased site licences for assistive technology software such as WordQ/SpeakQ. Mobile technologies have added another element of accessibility to assistive technology. iDevices, Android devices, and word processing software come embedded with numerous assistive technology features such as voice recognition, word prediction, spell check and autocorrect. Schools are moving towards allowing all students to access assistive technology through more universally accessible devices and programs. With personal digital devices being popular, less costly, and widely available for students they can provide an inclusive way to integrate assistive technology into the inclusive classroom.

Bouck, Flanagan, Miller, and Bassette (2012) argue that because today's students are increasing their use of technology in and out of school, teachers need to capitalize on available technologies and find ways to integrate them into their instruction. These authors propose "rethinking assistive technology" as a way of taking advantage of widely available devices to help support student learning, even though they were not intended as assistive technology. Rethinking common technology as assistive technology provides opportunities for schools to reduce challenges commonly associated with their use. Earlier research demonstrated that nearly one-third of assistive technology devices are abandoned (Todis, 1996). Students may abandon their technology for fear of looking different from their peers and stigmatization associated with the device (Todis, 1996; Parette & Scherer, 2004). Student abandonment of assistive technology can be reduced if the technologies they are using are desired and used by their peers (Parette &

Scherer, 2004). Therefore, commercially available technologies such as smart phones, tablets, MP3 players, educational toys which are attractive, familiar, and are already equipped with built-in accessibility features, may lead to a decrease in assistive technology abandonment, and an increased learning benefit to all students. These devices can also help with overcoming the high cost associated with specialized assistive technology as they are lower in cost due to their mass production.

Students and teachers can avail of free tools on their device such as graphic organizer applications (e.g., Popplet), math support applications (e.g., MathSplash), and voice recognition applications (e.g., Dragon Dictation). In addition, students have free access to utility tools such as a dictionary, calculator, and calendar on their device. The use of these ubiquitous technologies supports the premise of UDL. As assistive technology is evolving, it is apparent that assistive technology does not have to be an accommodation for a particular student as an add-on, retrofitted support. Instead, teachers can make use of more natural technological supports, such as mobile devices by designing the instruction, materials, methods, and assessments to be flexible and supportive of a full range of learning styles and abilities. Dell, Newton, and Petroff (2012), caution students and teachers from getting blinded by exciting new mobile touch screen devices. They assert that the technology itself is not going to help students with disabilities to overcome their learning obstacles. The authors indicate students, along with a parent, must receive adequate training on how to use the assistive technology. A detailed plan on how to implement, support, and assess if the assistive technology is having positive outcomes on student learning is required (Dell, Newton & Petroff, 2008).

Rationale for Research and the use of Appreciative Inquiry

Much needs to be done to improve the quality of special education technology research (Edyburn, 2009). Little research has been conducted on the use of assistive technology in inclusive schools (Watson, Ito, Smith, & Andersen, 2010), and only a few researchers are conducting systematic, well-designed research that can lead to confident conclusions on how the use of assistive technology affects learning (Edyburn & Gersten, 2007; MacArthur, Ferretti, Okolo, & Cavalier, 2001; Wanzek et al., 2006). In addition, research cannot be produced quickly enough to match the rate of technological innovations, and as a result, educators tend to rely on the claims of the producers of the technologies rather than evidence-based research (Blackhurst, 2005).

This study utilizes appreciative inquiry as a research framework and lens of analysis. Appreciative inquiry was founded in business as an organizational development tool. It was developed as an alternative to the problem solving method where the focus was on examining and fixing problems in the organization (Reed, 2007). Appreciative inquiry is based on the assumption that every culture has strengths that can be amplified and that these strengths can and should be the starting point for positive change (Reed, 2007). Appreciative inquiry radically shifted the focus away from the negative towards discovering the positive experiences and exploring the vision of organizations. Appreciative inquiry explores ideas that people have about what is working well and then tries to work out ways to build upon those strengths (Reed, 2007). This positive frame of inquiry was used to guide the methodology and analysis of the current study.

Summary

It is recognized that UDL can have a positive impact on the learning and achievement of all students (Rose & Meyer, 2002). However, there is very little research that focuses on the implementation of UDL. The current study provides an in-depth look at how teachers design instruction based on the principles of UDL and utilize assistive technology to support student learning. In addition, this research study seeks to better understand students' perspectives surrounding learning in an inclusive class that utilizes assistive technology within a UDL framework. It is essential to expand the research base to include practices that work in inclusive classrooms, so that teachers can acquire practical strategies to meet the diverse needs of their learners.

Methodology

Today's inclusive classrooms are filled with diverse learners. Teachers are faced with the enormous challenge of meeting the learning needs of each of their students. The Universal Design for Learning (UDL) framework offers flexible instructional materials, techniques, and strategies to help teachers differentiate instruction to meet students varied needs (Rose & Meyer, 2002). Assistive Technology plays a valuable role in the implementation of UDL as it provides multiple ways for students to demonstrate their learning and engage in activities (CAST, 2011). However, little is known regarding how teachers include assistive technology in their inclusive classes (Edyburn, 2011). As well, there is little research that explores how students perceive learning in a class that uses UDL methods and tools.

The main goal of this study was to explore how teachers who are proficient with technology implement assistive technology in their inclusive learning environment. The study aimed to answer the following three sub-questions:

1. How do teachers develop instructional practices that incorporate assistive technology within the context of universal design for learning?
2. What supports and challenges influence instructional practices that incorporate assistive technology?
3. What are students' perceptions of utilizing assistive technology and universal design for learning?

The text that follows describes the selected methodology and methods for conducting this investigation, and provides a rationale for the methodological choices and overall research design. The text also addresses the role of the researcher, and the methods for collecting and analyzing the data, and ensuring the trustworthiness of the findings.

Research Design

A qualitative research design provided the opportunity to obtain in-depth descriptions, essential insights, and interpretations of how classroom teachers design and implement lessons that enable access to assistive technology based on the principles of UDL. This study explored teachers' perspectives and experience with incorporating assistive technology into class lessons. The students' perspectives were also investigated. The study took place in a natural setting, in schools during the school year.

This exploratory study did not aim to uncover absolute truths or universal laws; rather, the goal was to provide a holistic description and understanding of the research questions. According to Savin-Baden and Major (2013), qualitative research focuses on understanding the participants' perspectives and their circumstances and should occur in the participant's natural settings as the researcher strives to understand the phenomena in context.

This study utilized an appreciative inquiry approach within a case study methodology. This strengths-based approach was used to discover the activities and experiences of teachers that were positive and worked effectively. This approach enabled a positive, collaborative rapport with participants where teacher's best practices could be highlighted. Appreciative inquiry emphasizes the positive aspects of the research setting so that others may build upon the strengths or what works well in that context. The data was gathered and analyzed through an appreciative inquiry perspective, where the researchers explored what was working for teachers in terms of technology integration and aimed to highlight these instructional practices as an impetus for change.

A case study is used to provide a detailed account and analysis of one or more cases, with a case being defined as a bounded system or clearly defined context (Merriam & Tisdell,

2015). A case study is a suitable approach when the inquirer has clearly identifiable cases with boundaries and seeks to provide an in-depth understanding of the cases or a comparison of several cases (Creswell, 2012). The current study explored how teachers develop instructional practices that incorporate assistive technology within the context of universal design for learning and the supports and challenges that influence these practices. For this project, a case was comprised of teachers who were known for their effective implementation of technology within a specific geographical area, the Eastern Avalon Region of Newfoundland and Labrador. Interviews were conducted with teachers in this region who were known for their proficiency in incorporating technology to support student learning within their inclusive class. From this sample, three teachers were selected based on their interview responses and willingness to participate in further investigation. Further investigation consisted of classroom observations and focus groups with consenting students in each of the three teacher's classes. Classroom investigations were conducted to examine the instructional practices of three teachers within this region. Examining three teacher's classes provided numerous sources of evidence, which helped the researchers to understand the findings and added confidence to the research as a whole (Miles, Huberman & Saldaña, 2014).

Research Context

This study took place in schools within the Eastern Region of the Newfoundland and Labrador English School District (NLESD). Newfoundland and Labrador comprises a large geographical area with 259 schools located throughout the province. We focused on schools in the Eastern Region, as 118 schools are situated in this area, with most schools within a two-hour driving distance for the researchers. Most of the schools I visited were located within urban and

suburban communities that had fairly large student populations. Only two of the schools were rural.

The NLESD makes various forms of technologies available; thereby enabling teachers to provide options for developing flexible instructional practices that are in line with the principles UDL. In addition, the NLESD provides universal access to the word prediction software program WordQ/SpeakQ, as a site licence has been purchased enabling it to be installed on all computers in the K-12 system. This will allow all students access to use this useful learning and instructional tool as needed. Now students with or without an IEP can avail of this assistive technology at school or home.

The NLESD (2016) supports digital technologies to enhance teaching and learning. According to the NLESD Annual Report 2014-2015, the school district has made Google Apps for Education available for all schools within the district:

> to allow teachers a secure space to communicate and collaborate with students. Every teacher and student will be able to access their digital identity on computers and mobile devices, and Google Apps is now being used by teachers in various schools across the province (p. 21).

The NLESD is attempting to meet the needs of their diverse learners by employing instructional practices that are in alignment with the principles of UDL. The Annual Report points out that the school district has created and uploaded approximately 200 videos to YouTube as an additional support for the Grade 7 math program in order to provide extra support on topics that were considered problematic for students, such as fractions and integers. These video supports are linked to self-assessment that students can use for individualized learning. The district is using Moodle as permanent online site for these resources “to provide teachers and

students with an easy to use system for creating personalized and collaborative learning environments" (p. 21).

Participants

To gain a better understanding of teacher's instructional practices, this study used purposeful sampling, which involves "selecting information-rich cases for study in depth" (Patton, 1990, p. 169). This strategy is used when one wants to understand something about specific cases without needing or desiring to generalize to all such cases. This study set forth to explore how teachers utilize assistive technology within a UDL framework. Since it was necessary to seek participants who were proficient in their ability to implement UDL principles and assistive technology in their inclusive classrooms, this study used an ideal-typical sampling plan. Ideal-typical sampling selects participants based on the closest match to what could be considered the best, most efficient, most effective individual or site (LeCompte & Preissle, 1993).

To help locate possible participants for this research, we first met with several individuals who we considered to be in a position to identify teachers within the region who use technology on a regular basis in their class to support student learning. Next, we invited teachers who were members of or were recognized by an educational technology group in the province to participate in the study. We then emailed school principals to provide them with information about the study and asked them to nominate teachers who they believe to have strengths in instructional design and implementation of assistive technology. Based on the literature on instructional design, universal design for learning, and conferring with experts in this area, specific criteria were developed for individuals to use when considering and nominating teachers. We looked for teacher participants who: (a) present information in a variety of formats,

(b) enable students to demonstrate what they know in a variety of ways, and (c) enable all students in their class to use ministry licensed assistive technology in their class.

Few principals responded to the email requesting nominations. Snowball sampling was then used to identify potential participants for the interview phase of the study. Other participants, educators or administrators in the Newfoundland and Labrador English School District who were aware of this study recommended teachers who were tech savvy and met the above criteria to participate in this study. As well, I contacted teachers who were recognized for their implementation of technology by the Technology in Education Special Interest Group. Furthermore, as an Instructional Resource Teacher within the NLESD, I nominated teachers who I had met throughout my career who met the above criteria and used technology on a regular basis in their classes. These teachers were asked to participate in the interview because they were recognized for using technology as a tool to support the diverse learning needs of their students.

Nineteen teachers were nominated and interviewed for this study. There was a mix of male and female teachers (10 females; 9 males) from elementary, junior high, and high schools within the NLESD. We interviewed classroom teachers, Instructional Resource Teachers (IRT) and Learning Resource Teachers (LRT). The original intent was to focus on the elementary level as teachers in these grades spend most of the school day with the same group of students. However, as there was a limited number of elementary teachers that were nominated and consented to participate, the scope was broadened to include junior high and high school participants.

From the 19 interviews, we selected three teachers whose teaching practices would be the focus of the sub-case examinations. Selection was based on how well their responses aligned

to the guidelines for UDL (CAST, 2011). Using the UDL framework as criteria, interview responses were inspected to see if the teacher was using technology to provide students with multiple means of representation, multiple means of expression, and multiple means of engagement. Through conversations with my thesis supervisor, we identified teachers whose instructional practices utilize assistive technology and align with the principles of universal design for learning; thus making them ideal candidates for further study.

We selected two elementary and one junior high class for the three sub-cases. These teacher's interviews revealed they were developing and implementing UDL-based learning activities that incorporate assistive technology. Each teacher consented during their interview to participate in class observations. Students, parents, and teachers were given a letter describing the research project and consent was obtained before proceeding with the classroom observation and focus group discussions. Upon following up with the teacher to secure the classroom observations, students in their class were given the opportunity to participate in a focus group to discuss their perceptions of using technology for learning. Teachers indicated prior to the observation the subject or activity that would be the focus of their lesson. These teacher's classes were observed. Classes were mixed and represented a mix of males and females with a range of diverse learning needs. The students who provided informed consent were invited to participate in a focus group. In order to protect the anonymity of participants, pseudonyms were assigned to the three teachers and their schools.

School 1: Woodridge Elementary (Mr. Thomas)

School 2: Faircrest Junior High (Ms. Paul)

School 3: Eastwood Elementary (Ms. Ennis)

The Role of the Researcher

This study necessitates that the researcher identify personal values, assumptions and biases at the outset of the study. Being reflective entails the researcher be mindful of the ways in which he or she conducts research, relates to the participants, and represents the participants within the written product (Charmaz, 2006). I consider myself to be a participant as observer throughout the data collection as I see myself first and foremost as a teacher. In my role as participant observer, I am cognizant of my position as a researcher and the implications that my role as both a teacher and a researcher may have on my interpretations and perspectives.

As an Instructional Resource Teacher with the NLESD, I have experience working with regular classroom teachers in implementing lessons based on the fundamentals of differentiated instruction. I have used a variety of assistive technologies with students in regular classes and pervasive needs classes. I am a member of Technology Education Special Interest Council (TESIC), and I have a personal interest in learning more about assistive technology and using technology as a tool to support learning with my own students. I believe that these experiences enhanced my awareness, knowledge, and sensitivity to the issues being addressed in this study and assisted me in working with the participants.

As a researcher, I strived to achieve a mutually beneficial relationship with all those involved in this study. I plan to give back to the school district and participants by providing research briefs that will highlight findings from the study, provide strategies for implementing assistive technology within the context of universal design, and inform educators of my interest in providing professional development workshops which will be offered free-of-charge to all interested schools in the district.

Trainor and Bouchard (2013) assert that reciprocity is more than just providing

incentives, “but rather is woven into the elements of design, participant identification, data collection, analysis, and sharing” (p. 1000). I assured participants that all material will be treated ethically throughout the research process. Research involves collecting data from people, about people, and as such, researchers need to protect their research participants by developing trust with them, promoting the integrity of the research, guarding against misconduct and any offences that might reflect on their organizations or institutions (Creswell, 2012). First and foremost, the researcher has an obligation to respect the rights, needs, values, and desires of the participants. Confidentiality and anonymity was assured when collecting and presenting results (Trainor & Bouchard, 2013). Respondents were provided with the opportunity to confirm the accuracy of transcriptions. Finally, I worked towards attaining a positive working relationship and trust with teachers and students. I demonstrated sincerity, patience, empathy attentiveness and respect for each participant’s views (Marshall & Rossman, 2006).

Data Collection Methods

Interviews with Teachers. Semi-structured, open-ended interviews were conducted with all 19 nominated teachers. Yin (2009) states that interviews are an essential source of information in case studies as they can provide valuable insight into individual’s perspectives and experiences. Semi-structured interviews enabled the researcher to attain comparable data across participants (Bogdan & Biklen, 2007). Most interviews took place at the teacher’s school after classes had ended for the day and took approximately one hour to complete. Teachers were asked 12 questions (See Appendix G - Interview Questions for Teachers), accompanied by probing questions. Interviews were audio-recorded and transcribed by an independent transcriptionist. My graduate supervisor and I conducted most interviews together. Teachers were provided with information about the study and reminded of their ethical rights regarding

participation. Teachers were informed that their information will remain confidential and identifying information would be removed from the transcribed interviews. From the interviews we were able to identify teachers whose instructional practices align with the principles of UDL, three of whom were followed for further investigation and whose instructional practices were used to compose the case studies. The data gathered from the interviews was valuable in understanding teachers' instructional practices surrounding implementing assistive technology and the supports and challenges involved.

As suggested by Patton (2002), an interview guide was used to provide a framework for discussion and allow for consistency in collecting data from each interviewee. Follow up questions, as well as probes and prompts, were asked during natural points during the interview to clarify or gain more information (Bogdan & Biklen, 2007). Interview questions focused on: (a) teachers' understanding of universal design for learning, (b) how teachers became familiar with universal design for learning and its impact on their teaching and student learning, (c) the way information is presented to the class, (d) learning activities and assignments that students undertake, (e) the range of student learning needs in the class, (f) assistive technology recommended for use on students' individual education plans, (g) assistive technology that is available in the school, (h) where technology is located in the school, (i) how technology is used at the individual and classroom level, (j) types of supports available to teachers to implement UDL and assistive technology, and (k) teachers' perceptions of students' adoption and use of technology to support their learning.

Observations. Participant-observation was used in the case studies. As a participant observer, I participated in class activities when appropriate so as to be able experience the lesson from both the teacher and students' point of view. Observations are often employed in case

study research to provide additional information about the topic and add a new dimension for understanding the context being studied (Yin, 2009). Each of the three selected classes was observed in one subject area during two separate lessons. I corresponded with each teacher to decide upon a convenient time for observation. While observing the lessons from the unit of study, I was interacting with the teacher(s), students and participating when appropriate. I wrote what Bogdan and Biklen (2007) refer to as "rich fieldnotes" which provide "a good description and dialogue relevant to what occurs at the setting and its meaning for the participants" (p. 122). I wrote descriptive and reflective field notes on an observational protocol, which had one column designated for specific observations and a column for my reactions and interpretations (Bogdan & Biklen, 2007). My graduate supervisor attended most observation sessions. After each session, we shared our field notes and pointed out interesting aspects of the lesson.

During each observation session, I took pictures and video recorded components of the teacher's instruction that demonstrate students using assistive technology to complete learning tasks. I also recorded teacher instruction which occurred through interactive SMART Board lessons. I took pictures of students using word processors, Google Apps for Education, iPads, spell check features, and text-to-speech and speech-to-text features for writing. I recorded components of teachers' instruction and subsequent recordings only focused on students who had parental consent. Teachers and students were informed that video recordings may be used for professional development purposes.

Informal Conversations with Students and Teachers. As a participant-observer, I engaged students and teachers in unstructured interviews that occurred as classroom conversations. These conversations helped me to acquire additional information stemming from classroom observations. I asked teachers about prior experiences that assisted them in

implementing universal design for learning and the level of planning necessary to do so. I also asked students about their perceptions of using assistive technology and how the lesson format met their learning needs. The responses to these questions were recorded through field notes.

Focus Group with Students. Focus groups were used to explore the students' perceptions and experiences about learning in a UDL context and accessing AT in their regular class. Focus groups are useful in qualitative research to "stimulate talk from multiple perspectives from the group participants so that the researcher can learn what the range of views are, or to promote talk in a topic that informants might not be able to talk so thoughtfully about in individual interviews" (Bogdan & Biklen, 2007, p. 109).

All students who participated in the classroom observations were invited to participate in focus groups, which were audio recorded and conducted with groups of six to eight students during their lunch hour. Focus group questions were developed based on the casual conversations with students. An open-ended interview protocol was used. The questions surrounded students' views on: (a) receiving instruction in a variety of formats, (b) demonstrating their knowledge in a variety of ways, and (c) their experience in using assistive technology to assist with learning activities (See Appendix - H Focus Groups with Students). Focus groups with students provided valuable information surrounding students' perspectives on learning in a class that is based on principles of UDL and provides all learners with access to assistive technology.

Documents and Artifacts. Documents and artifacts pertinent were collected during the course of this study to help provide evidence during classroom observations.. Photographs were taken of displays, bulletin boards, classroom arrangements, and student work that depicted UDL in action. I photographed samples of students' writings, drawings, and computer-generated work

to triangulate the data and illustrate universal design principles. Johnson and Christensen (2004) indicate that secondary data is useful for corroborating the other data collected. I used documents and artifacts to corroborate data collected during classroom observations. With permission, I took pictures of documents, such as student grouping arrangements for group work and lesson plans that illustrated how the teacher planned his or her lessons. I also noted and photographed textbooks, teacher's manuals, curriculum guides or other professional resource books that the teacher used for the UDL-based lesson to develop instructional strategies that implement assistive technology. Immediately following each observation, field notes, video recordings and visual data were typed, dated, and added to the case file. These secondary sources of data were analyzed in conjunction with observation data to provide support for my interpretations and analysis.

Data Analysis

In naturalistic inquiry, the distinction between data gathering and data analysis is less absolute than in experimental research (Patton, 2002). Because data collection is emergent, the researcher needs to analyze data, at least informally, as the data collection progresses. While in the field "ideas for making sense of the data that emerge constitute the beginning of analysis; they are part of the field notes" (Patton, 2002, p.436).

I implemented Yin's (2009) general analytic strategy which involves developing "a descriptive framework for organizing the case study" (p.131). When using multiple cases or observation locations, "a typical format is to first provide a detailed description of each case and themes within the case, called a within-case analysis" (Creswell, 2007, p.63). For each of the three observation locations, I implemented a within-case analysis through detailed description of the case and identification of themes. The within-case analysis was followed by a thematic

analysis across all three observation locations, referred to as cross-case analysis or cross-case synthesis (Creswell, 2012; Yin, 2009), where the themes within each of the three cases were compared.

The interviews were transcribed verbatim from the audio-recordings by an independent transcriptionist and shared with teachers to confirm the accuracy of the data. A preliminary exploratory analysis was conducted for each transcript to attain a general sense of the data (Creswell, 2012). Transcriptions were analyzed using a content analysis approach which involves coding statements based on their key concepts, clustering these concepts into themes, and refining these themes (Lincoln & Guba, 1985). I organized the transcription data according to the interview question. I combined teacher's responses to each of the 12 interview questions into 12 separate documents. To accomplish this, I read through each transcription, divided the interview into sections based on the questions, then copied and pasted all of the teacher responses for each question into the corresponding document. Responses for each teacher were given a participant identifier so as to identify the source of the information. Interview data was coded and similar codes were aggregated together to form themes (Creswell, 2012). Themes were related to how teachers presented information to their students, how students demonstrated what they know, and how assistive technology was implemented in the classroom. These responses were compared to the universal design for learning guidelines (CAST, 2011). Organizing the interview data by question allowed me to compare responses from each teacher and identify teachers whose instructional practices align with the principles of universal design for learning and who would be ideal candidates for further study.

Student focus groups were transcribed verbatim. The coding scheme was created inductively as patterns and themes emerged from the data (Patton, 2002). To minimize bias, my

graduate supervisor validated the emerging themes from the teacher interviews and student focus groups ((Miles, Huberman & Saldaña, 2014)). Data analysis terminated when no new information emerged from the analyses, all excerpts were classified, and categories were saturated (Lincoln & Guba, 1985).

Trustworthiness

Trustworthiness refers to the quality and value of a research study. There are four criteria for establishing trustworthiness in qualitative research: credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). In order to ensure the soundness of this research and to establish the trustworthiness of this study's findings, I incorporated a variety of strategies proposed by Lincoln and Guba (1985), such as triangulation, member checks, peer debriefing, and reflexivity.

The triangulation of different data sources helped build a coherent justification for the themes and added credibility to the research results. Merriam (1998) defines triangulation as "using multiple investigators, multiple sources of data, or multiple methods to confirm the emerging findings" (p. 204). I employed methodological triangulation (Denzin, 1978), by collecting various forms of data: interviews with teachers, classroom observations, focus groups with students, and document analysis. I also employed multiple sources of data by examining three individual cases (Denzin, 1978). I used the process of triangulation to seek convergence in the data and to confirm or disconfirm emerging categories and themes (Denzin, 1978).

Member checks were used for construct validity and to establish the credibility of the data (Mertens, 2005). Respondent validation is useful as participants may suggest a better way to express an issue or wish to qualify points (Cohen, Manion, & Morrison, 2007). At each interview the researchers summarized what was said and asked the participants if we accurately

understood the shared information. To validate my portrayal of the data, teachers were provided with their interview transcription and student participants were provided with a written summary of their data.

In order to establish the transferability of the research, I used thick description when writing about the study (Lincoln & Guba, 1985). Thick description refers to the researcher's task of describing and interpreting observed behaviour within its particular context. According to Stake (1995), the idea is to write up a case study's description in such a way that it gives the readers the vicarious experience of 'being there' so that they can share in the interpretation of the case and make their own judgments.

Peer debriefing was used to enhance trustworthiness. A peer review is often performed by an individual familiar with the research to provide support, act as a "devil's advocate", and enable the researcher to rationalize methodological decisions (Lincoln & Guba, 1985). The supervisor for my Master's thesis reviewed the proposed coding scheme, and the rationale behind the selection and labeling of the emerging themes; this was done prior to the final stages of analysis.

To address the issues of dependability and confirmability, I relied on an independent audit of my research methods by my supervisor (Lincoln & Guba, 1985; Patton, 1990). I maintained an audit trail to provide my rationale for methodological and interpretative judgements. I maintained comprehensive notes from classroom observations in a carefully labeled case file and a digital case file. In addition, I used a journal to clearly document each step of the data collection and analysis process, chronologically arranged activities, and kept a research log of all the data collected (Creswell & Miller, 2000). Google Docs was used to share

interview, observation, and focus group dates with my supervisor as well as to record decisions and interpretations made during data collection and analysis.

Reflexivity is another strategy I used to address dependability and confirmability. Reflexivity is the process of a continual internal dialogue and critical self-evaluation of the researcher's positionality as well as active acknowledgement and explicit recognition that this position may affect the research process and outcome (Savin-Baden & Major, 2013). The credibility of a study rests on the procedures implemented and the self-awareness of the researcher throughout the research process (Houghton, Casey, Shaw, & Murphy, 2013). Throughout this study, I endeavored to be aware of my own potential biases and preconceptions. Although every effort was made to ensure that these notions remained separate from the input of my participants, I am cognizant that my own personal biases may have shaped the way I view and understand the data. I recognized the need to be open to the thoughts and opinions of others and to set aside my experiences in order to understand those of the participants in the study. To help establish reflexivity, I maintained reflective notes throughout the research process to provide a rationale for decisions, document challenges experienced, and note my own personal comments and interpretations (Houghton, Casey, Shaw, & Murphy, 2013).

Ethical Approval

Ethical approval was obtained from the Interdisciplinary Committee on Ethics in Human Research (ICEHR) assistive technology Memorial University, and formal consent was obtained from the Newfoundland and Labrador English School District (NLESD) prior to commencing this study (See Appendix I - ICEHR Ethics Approval and Appendix J - NLESD Ethics Approval). Upon obtaining ethical approval and permission from the NLESD, principals were

provided with the Letter of Information outlining the purpose, procedures and benefits of the research and what participation will entail for themselves and nominated teachers.

Nominated teachers were provided with a Letter of Information describing the research project and their roles and responsibilities relative to the project. Teachers interested in participating in this study signed a teacher consent form prior to participating in semi-structured, open-ended interviews. Students and parents received a separate Letter of Information and consent form indicating the rights of the participants in this study, such as confidentiality of information and their freedom to withdrawal from the study at any time. The consent forms also allowed participants to indicate their preferred level of participation, such as being audio recorded, video recorded, or solely using one's quotes. Participants were informed that recordings and photo data would only focus on those students who have parental consent.

All identifying information (principal nomination forms, teacher interview data, student focus group data, field notes, video recordings of classroom observations, and photographs of student's work) was stored in a locked filing cabinet and on a password protected computer. This information was accessible to my graduate supervisor and myself as the researchers. A professional transcriptionist had access to the audio recordings to type up the interview and focus group responses. This information will be deleted off of the researchers' computers and/or shredded 7 years after publication.

Video data will be used to share practical teaching strategies that arise out of this research. This information will be shared in professional development workshops for teachers within the NLESD, and at conferences for educators and researchers. While the video data prevents me from ensuring confidentiality, video data will only be acquired from those individuals who provided written consent. When reporting on the findings at academic

conferences or in research journals, pseudonyms will be used be used for the all schools, teachers, and students involved.

Summary

This chapter provided an overview of the methodology used in this exploratory study. The case study methodology utilizes interviews, observations, focus groups and documents to examine how teachers implement assistive technology in general education classrooms within the context of universal design for learning and how students respond to these methods and tools. Data analysis strategies were discussed, as well as strategies for ensuring trustworthiness, and ensuring ethical procedures were taken into consideration.

Results

In this chapter, the results are presented in three sections: teacher interviews, class observations, and student focus groups. The first section presents teacher responses to the semi-structured interview questions. The interview responses are reported according to question, ranging from question one to question twelve. The observation results are presented second, and are presented according to the three classroom observation sites. The third section reports the results from student focus groups, which are presented as three separate focus groups, which correspond with each classroom observation site.

Teacher Interviews

Semi-structured interviews were conducted with 19 teachers. Teachers were asked 12 questions along with probing questions to provide further information or necessary clarification. The interviews were conducted to gather information on how the participants developed instructional practices that allow for the use of assistive technology within UDLs guidelines (CAST, 2011). The interviews also obtained information surrounding the supports and challenges that influence instructional practices that incorporate assistive technology. The researchers used the interview data as a means to select three teachers for further investigation. From the 19 interview participants, the researchers selected three teachers whose classrooms were used for observations and focus groups held with their students.

Nineteen teachers were nominated and consented to be interviewed. There was a mix of male and female teachers (10 females; 9 males) from elementary, junior high, and high schools. We interviewed classroom teachers, Instructional Resource Teachers (IRT), and Learning Resource Teachers (LRT). Some of the teachers had multiple roles, such as LRT and classroom teacher. When this was the case we classified the teacher's role according to which position

allotment was the highest. The original intent was to focus on elementary level instructors, as teachers in these grades spend most of the school day with the same group of students. However, as a limited number of elementary teachers consented to participate, the scope was broadened to include junior high and high school participants. Six of the interviewed teachers worked at the same school, and I work with or have worked with some of the participants at some point during my teaching career.

In order to ensure confidentiality, teachers were assigned a numerical label, ranging from participant 1 to participant 19. These labels were used to identify the participants throughout the data analysis process. The interviews with teachers were transcribed verbatim, and similar comments were coded and emerging themes were noted. The graduate supervisor was consulted and she verified the major and minor themes emerging from the interviews. The interviews were then organized according to the interview question, to allow the researchers to determine common themes that were arising within each question.

For further information regarding any of the websites, applications and devices named by participants, please refer to Appendix K - Recommended Resources for Educators.

Table 1

Number of Interview Participants According to School Level and Position

School Level	**Classroom Teacher**	**Instructional Resource Teacher (IRT)**	**Learning Resource Teacher (LRT)**	**Combined Total**
Primary / Elementary (Grades K - 6)	6	2	1	9
Junior High (Grades 7 - 9)	3	1	1	5
High School (Grades 10 - 12)	4	0	0	4
Junior High/High School (Grades 7-12)	0	1	0	1
	13	4	2	19

Table 2

Interview Participant's Years of Teaching Experience

		Teaching Experience		
Participant Number	**School Level**	**< 10 years**	**< 20 years**	**< 30 years**
Participant 1	High School		•	
Participant 2	Junior High		•	
Participant 3	Elementary		•	
Participant 4	High School		•	
Participant 5	Junior High		•	
Participant 6	Junior High			•
Participant 7	High School		•	
Participant 8	High School		•	
Participant 9	Junior High		•	
Participant 10	Junior High		•	
Participant 11	Junior High		•	
Participant 12	Elementary			•
Participant 13	Elementary			•
Participant 14	Elementary	•		
Participant 15	Elementary		•	
Participant 16	Elementary		•	
Participant 17	Elementary	•		

Participant 18	Elementary	•		
Participant 19	Elementary			•

Question 1: What is your understanding of Universal Design for Learning? The majority of teachers were unfamiliar with the term universal design for learning, and most of the teachers stated they were hearing this term for the first time. Teachers attempted to speculate on the meaning of UDL and were often successful in touching upon at least one of the main tenets of UDL. For example, in reference to multiple means of engagement, one teacher said, "I could speculate it is designing educational activities for a differentiated class of students that would suit all levels of students" (Participant 1). Two teachers were able to infer meaning by analyzing the three words that compose the term UDL and they provided a solid explanation. Participant 14 stated, "Universal means for all, design means some sort of pattern or plan, and well learning is how someone gathers information". One teacher described UDL as a more student-centreed approach that embraces everybody in the learning process. This teacher said, "everything comes from the learners and their needs and using that as your guide for developing it versus having the lesson plan and trying to apply it generically to the group" (Participant 5). The idea of pre-planning and designing lessons based on students' needs was noted by several participants.

A number of teachers associated UDL with Differentiated Instruction in that it caters to varying abilities and learning styles of students in the class. One participant responded explained that UDL caters to the different levels of students in your classroom. This teacher stated that lessons are designed to be open ended so that students can identify with the outcomes, and this occurs through getting to know your students and accessing their prior knowledge (Participant 2).

The use of technology was noted by several participants as being one aspect of UDL. One teacher stated, “I would think Universal Design would mean including as much technology in the classroom as you possibly can to allow the students to be integrated and do and work with the best of their capabilities” (Participant 3). This teacher gave an example of how students with written output difficulties could use an iPad for spell check in order to allow him or her to concentrate more on the ideas rather than on the details associated with grammar and punctuation. Another teacher noted that UDL is about designing technologies that are suited for all learners such as Google Apps for Education and mobile devices.

Question 2: How did you become familiar with Universal Design for Learning? After participants contributed their own understanding of UDL, the researchers provided relevant background information and a description of the principles of UDL. While the majority of the teachers interviewed were not familiar with the term universal design for learning; they were cited concepts they perceived to be associated with UDL including differentiated instruction, learning styles, and multiple intelligences. Participant 14 asserted that, “trying to meet each student’s needs should always be, you know, present in your mind when any good teacher plans… It has always been something that I have focused on when planning”. Similarly, another teacher maintained that designing lessons that multiple groups of students can do and be engaged in is “just good teaching practice” (Participant 9).

Most teachers indicated that they learned about differentiated instruction and varying instructional practices through professional development opportunities. The type of professional development was often school based, peer-to-peer, or self-initiated. One teacher stated, “[Our] school has always been at the forefront of exploring new concepts in education. There is a lot of sharing of materials between teachers and grade levels. There are also collegial circles and

professional development days where we can choose to focus on what we are interested in." (Participant 2). Participant 7 described his self-initiated professional development as occurring during his spare time by following educational chats on twitter and reading about current trends and new technologies in education. This teacher realized that he had been unknowingly learning and teaching other teachers about instructional practices that align with UDL principles. "So for the last ten years I have been sort of progressively rolling out educational technologies that fit under the umbrella of Universal Design for Learning and I didn't even realize that" (Participant 7).

Three participants had prior work experience outside of education which contributed to their understanding of UDL. For instance, one teacher had worked in Informational Technology and Software Development and was familiar with the idea of universal design from his previous field of work. This participant compared UDL to being a software developer where it is necessary to carefully consider the demographics of people expected to utilize the program.

Some teachers were exposed to the concept of UDL during their graduate studies. One teacher indicated that during one course a professor spent a couple of classes discussing UDL. Another participant described how students in the course learned the importance of thinking holistically about student needs. In this graduate course, the students had to consider students' strengths and needs, create a class profile, and design lessons based on this information.

Question 3: How has Universal Design for Learning impacted your teaching and student learning? The majority of teachers were providing flexible options for students to achieve learning outcomes. A teacher who considers his teaching style to be very flexible stated that students in his class are provided with choice a lot of the time "to reach or achieve the outcomes in many different ways" (Participant 17). This teacher justified his flexible teaching style,

stating, “I guess being flexible I try and make sure that everyone is able to meet the outcomes and that everyone in my classroom is learning, like I don’t want to move on and leave some person behind” (Participant 17).

Responses indicate that teachers are familiar with individual student’s strengths and needs and they are willing to support the diverse needs of students. The majority of teachers talked about the importance of getting to know their students and various strategies they have used to learn more about individual student’s strengths and needs. Several teachers talked about how they focused on getting to know their students in the first few weeks rather than focusing on curriculum content. One of the teachers used an open-ended “All About Me” power point project each year to get to know his junior high students on a personal level, as well as “help me to identify who is having difficulty with writing, reading, auditory, or any other issues” (Participant 2). Another teacher used a learning styles inventory to create a class profile:

> I usually administer it at the beginning of the year and it gives me a really good indication of where the kids lie. And I know in the past when I have administered it I have gotten some surprises from it. I used it in one class where one student was disengaged and not learning. After administering the learning styles inventory, he perceived himself to be a musical learner only. So what I did then, I started to incorporate music in the classroom into the academic options to do certain things using music. And it was like he turned right on just like it was totally amazing what happened to him in the classroom. I mean when I geared the lesson to his learning style, amazing. (Participant 6)

Teacher’s responses to this question demonstrate they are trying to create a more accepting and inclusive learning environment for students. Several participants noted that they try to develop motivating learning activities that incorporate a variety of materials and assessment

options to support students' varying learning styles. The majority of teachers pointed to using technology as a teaching and learning tool, noting how students seem to be more interested in learning when technology is integrated into the lesson. A number of participants spoke about the importance of supporting students' self-confidence and independence and enabling students who require extra supports to blend in more seamlessly in class activities. Results indicate that teachers are trying to make their instruction accessible for students. Several teachers spoke about how allowing all students to access iPads or laptops during a lesson provided a more seamless type of support for students with and without exceptionalities. For example, a junior high teacher highlighted how she strives to create a learning environment where individual students do not stand out in a way that could negatively affect their self-image. As this teacher explained, when students in her class are completing work using iPads, oftentimes students do not know which of their classmates are using iPads for additional supports as she is able use airdrop to discretely provide scaffolded support to students as needed. In addition, she is able to send out higher level questions or activities to students who require the extra challenge. Furthermore, many of the teachers spoke of the importance of facilitating student autonomy. A number of participants noted how they allow access to the supports available on iPads and computers, such as spell check, dictionaries, and text to speech, to enable students to demonstrate more independence.

Question 4: How is information presented to your students? The teachers in this study presented information to students in a variety of ways. The most popular strategies named by teachers for presenting class content were class discussions, lecture, text, graphics, audio, video, and interactive and hands-on activities. Many of the teachers indicated that they try to present information visually for students. Teacher's responses indicated they provide demonstrations and models for students. In addition, many of the teacher's responses suggested they scaffold

learning tasks and organized information in a logical and manageable manner. A number of participants stated they give clear expectations, use exemplars, and checks for understanding during their instruction.

All of the teachers indicated that they often use some form of technology to present information to students. For example, most teachers named an interactive whiteboard, such as the SMART Board, as a tool they use when teaching or introducing a topic. Participant 13 stated, "I am always using the SMART Board and technology too, it seems to be inserted in everything we do now." Participant 1 described how he uses his tablet to project the screen onto the SMART Board to annotate worksheets or class notes.

> So I am walking around with the stylus using Journal Note Viewer and I am writing on the tablet and the stylus is appearing up here completing a worksheet with students. Or annotating on top of the slide show whilst I am giving it and writing and doing all the little notes. Then save that and put it on my website… (Participant 1)

The majority of the teachers commonly use some form of digital media and digital text during instruction. Some teachers utilize electronic copies of textbooks or prepare their own digital content. One teacher explained how he uses SMART Notebook to create and display information to students.

> If I am making notes or anything like that, that I want them to copy down, I will always use the Smart Board as opposed to using the White Board… because I can save and file them, I can save that file as a PDF and put it on my homework site especially if there is homework. (Participant 17)

This teacher also uses Google Drive to store digital content and resources. “It also helps me as a teacher to keep everything organized… It is a way where I can manage my class’s resources” (Participant 17).

Accessing online videos was commonly cited by teachers as a means to present information. One teacher stated, “they are motivated by video. Yeah for the most part if I put on a little video of how to multiply two digit numbers, they watch… and they respond to it” (Participant 3). A number of teachers responded they are using the school district’s math videos to supplement their lessons and indicated that there are “are a lot of really good videos that are coming online now” (Participant 10).

Posting course materials such as class notes, answer sheets or handouts to a class website was noted by teachers as a way of presenting information. Teachers noted that they provide links to online resources so students can access materials in class or at home in electronic formats as needed. Several teachers commented that they provide notes to students before the lesson. One teacher explained, “I would always give everybody a handout because I found some kids couldn’t write it down. So everybody had a copy…”. Other teachers commented that they allow their students to bring in their own device to use during class.

> I have some students in the class that are bringing iPads and they are downloading a copy of my notes to their iPads and writing it directly into an iPad. It works great for those students that are slower in learning. So I tell them to print them off... The way I got my notes designed online is that they’re gaps so that they have to pay attention. (Participant 11)

One teacher we interviewed uses the Flipped Classroom approach to presenting information for her elementary math class. She uses a combination of Show Me and Smart Notebook to create the videos and

> I post all the videos that I make on our class website and we also use Edmodo to share the videos at home so there are two different platforms for them to access it… we did it to make the videos accessible to everyone. (Participant 18)

The teacher explained the premise is to send home the lower level learning tasks where the aim is to:

> To just get them to learn the basics and then come in and apply the higher order thinking activities in class where we could support them and I must say, as long as the technology cooperated with the kids, they really enjoyed doing that homework versus going home with textbook problems and becoming frustrated with them. (Participant 18)

This teacher also uses station teaching and flexible groupings to present information to students.

> I do a lot of small group introduction when I do a station teaching. I will have a teacher station and at that station I will introduce new information as well, so it is not done as a whole group. I, it is broken down into small groups based on abilities sometimes, sometimes based on just this new concept which we just get into it and see how it goes… I always make sure that I include things that each student can access on their level; make things available to them. Grouping - sometimes I need to meet with the group that is struggling with the concept… Since I have started teaching in that way and instead of what I would begin to teach back when I started, you were so used to coming in and you are in front of the class, and you are lecturing and teaching in that way, but more and

> more I learned about how great it is to take those small groups, based on what they know and teach to that. That's improved my students' learning for sure. (Participant 18)

Question 5: What kinds of learning activities and assignments do students undertake?

Teachers' responses indicate that students participate in variety of activities to engage in and demonstrate their learning. Writing activities, tests and quizzes, foldables, presentations, field trips, hands-on activities, role-playing, videos, cross-curricular projects, choice boards, and stations or centres were all named as some of the types of learning activities and assignments that students undertake. It was also noted that students often work in flexible groupings, such as random groupings or groups based on students' interests or abilities.

The majority of teachers' responses mentioned technology as a means of providing various ways for students to partake in a learning activity. Teachers' indicate they use technology to provide students with choice in how they want to demonstrate their learning. Participant 14 noted,

> the end product a lot of times can look very different, even you know within the same project, or you know the same outcomes. Some students may prefer a written piece, whereas others like to go the visual route, or you know maybe a short recording of themselves explaining something. (Participant 14)

A teacher stated having access to iPads "allows us to do a lot more, we can do the writing activities, we can do videos, and we can do things like different math manipulations." (Participant 14). iPads were commonly reported as being used as a tool for students to complete class work. Teachers indicated that a wide variety of apps are used as learning activities in various subject areas.

Google Classroom was noted by several teachers as a tool to implement lessons and organize student work. For instance, Google Docs was used for writing and peer editing activities. Using this program, all students have the opportunity to use the speech-to-text or text-to-speech features while writing. In addition, students and their teacher can collaborate and provide instant feedback directly into a document when working on shared writing activities. One teacher used Google Forms for math where "[Students] did their forms in Google Forms and they did their charts in Google Docs and sent out their survey to everybody." (Participant 10). Responses indicated that students are creating and designing their own resources. For example, one teacher noted that students are going to make a movie trailer about Aboriginal people for a social studies unit. Three teachers were implementing iBook projects with students. One project was inspired and designed by students and involved creating an iBook about recommended places to visit in St. John's, Newfoundland. Students gathered information and took their own pictures of each site, made audio and video recordings, and compiled this information into an accessible iBook that they will share with a class in Australia.

Technology is being used in assessments. Self-assessments, rubrics, and checklists were some of the types of assessments noted by participants. A number of teachers also indicated that students now keep their classwork and assignments in Google Drive in order to create an online digital portfolio of their school work. Several teachers use the SeeSaw app to take a picture of students' work, add it to a digital file, and even share students' work with parents. Some classes are also using the Class Dojo app as a behavior management system which can be shared with parents. One teacher explained how he uses an iPad app as a means of formative assessment:

> For individual use like apps they have their own desks. I have had them use an app like to Show Me where they can demonstrate a process and they show it in writing but they can

> also use audio tweak to explain it as well. So that would go along. So then I get an idea of you know what they are thinking and see their work as it is going on the page and if they are making mistakes then I kind of see where the thought process can go wrong and then we can discuss that and correct it. (Participant 14)

Question 6: What is the range of student learning needs in your class? Teachers' typically described the learning needs of their class as being very diverse and consisting of a substantial range of student abilities. Classes were often described as including students who were very weak academically to students who were performing well above grade level. Most of the classes consist of students who have accommodations listed on their Individual Education Plans (IEPs). Many of the teachers noted that they had students with various exceptionalities in their class, including autism, learning disabilities, and intellectual disabilities. One elementary teacher stated,

> I have you know a range from extremely weak to very, very strong students… some that are reading at a Grade 1 level and some that are not even reading at a Grade 1 level… some of them can probably write words that have two letters in them… I have some that are very eager and probably reading at a Grade 10 and 11 level. (Participant 4)

This teacher also indicated that she has children from many nationalities and backgrounds. Several teachers had students who were learning English as a Second Language. One teacher indicated that he has six refugee students in his class who have very limited English skills (Participant 9).

Question 7: What types of assistive technology are recommended for use on students' individual education plans? The most commonly cited forms of assistive technology on students' individual education plans included the use of a word processor, text-to-speech

software, speech-to-text software, graphic organizers, calculator, and various alternate format materials, such as electronic texts and audio books. Other forms of assistive technology discussed by several teachers were the use of the assistive and augmentative communication program Proloquo2Go and the graphic organizer software Kidspiration. One teacher stated:

> Some would use WordQ or word processors, speech-to-text, text-to-speech; sometimes via combination. Might just be alternate setting or materials read, notes provided… they might use the E-versions of novels that could be read to them, they could listen to the recording when they do testing… they can read from the PDF file to them, select a section of text and have it read. (Participant 1)

The predictive writing software, WordQ+SpeakQ, was noted by many teachers. The voice recognition software, Dragon Naturally Speaking, was also mentioned by several participants as an accommodation on student's IEPs. Several teachers asserted that WordQ and Dragon Naturally Speaking are not user-friendly. One teacher commented, "I didn't like Word Q. I found Word Q was cumbersome, like it took a long time to learn how to use it, and some of the kids that I know, it was just too frustrating". Teachers also reported issues with accuracy when using Dragon Naturally Speaking. One teacher pointed out, "I just I don't find [Dragon Naturally Speaking] accurate" (Participant 10), and another teacher remarked, "I don't find that to be an effective tool to use with students because you really need to have good grammar skills" (Participant 17). One teacher commented that rather than using Dragon Dictation or Dragon Naturally Speaking, she prefers to have her students use SIRI on iPad for voice commands and speech-to-text tasks.

Several participants pointed out they have Sound Field and FM amplification systems in their classroom for students with hearing impairments. One school currently has one FrontRow

Juno Sound System for a student with a hearing impairment and is fundraising to buy this system for every class in the school. HushUps were noted as a low-tech device, which was commonly recommended for students with hearing impairments. Other low-tech devices mentioned by teachers included visual schedules, visual timers, and slant boards.

Responses indicated that mobile devices such as iPads, Chromebooks, and laptops are being used as assistive technology devices to deliver accommodations to students. Students are using recommended apps or built in features on these devices to receive supports. One teacher described how she uses the SnapType app to provide support for students with writing output difficulties:

> The camera on SnapType will take a picture of [the worksheet] and then allow you to type on it. And you can move it around, so I can move around the word quest… I can delete it, I can make it smaller, I can make the text bigger. They can email it and print it, and not lose it. (Participant 6)

iPads or other tablets, along with earbuds, are being used to provide testing accommodations to students with exceptionalities in the regular classroom.

> Mostly now we use the iPads…We are doing a lot of our testing now using chrome books, so teachers will audio record their tests or their IRT teacher… [students] will come in and sit down and have their headset, have their Chomebook, and can listen to their tests and work at their own pace. (Participant 10)

Question 8: What assistive technologies are available in the school? The responses to this question were similar to the previous question. Word processors, text-to-speech software, speech-to-text software, calculators, and graphic organizers on the iPad were commonly cited forms of assistive technology that were used. Computers and laptops are available for students to

use either in a computer lab, learning resource centre and/or in classrooms. Teachers cited Microsoft Word, WordQ+SpeakQ, Kidspiration/Inspiration, and Dragon Naturally Speaking as some of the software programs installed on school computers.

Teachers' responses revealed that iPads are increasingly being used as support for students. A teacher stated, "really in terms of the assistant tech, our iPads are big" (Participant 5). Many of the teachers indicated that service delivery teams are supplied with a set of iPads for students to use and sign out when needed. These iPads are outfitted with apps that are supported by the school. One of the apps that teachers noted was Dragon Dictation. It was also noted that some students use the iPad's built in features, such as Siri, for speech-to-text and voice commands. A number of teachers pointed out that their school utilizes iPads and headsets for providing testing accommodations in the general education class. A participant commented that students can have their test read aloud to them via the iPad so students

> can complete tests in class with their group… we don't want to have students feeling like they got to be pulled out do, to get the support that they need. So as much as possible, it is all done in classroom in their natural setting with everybody else. (Participant 5)

Many of the teachers indicated that students typically have the option to bring in their own device (BYOD) to use to complete class work. However, it was noted that while many of the schools are outfitted with Wi-Fi, schools do not allow student to access their network. Several teachers indicated that they are waiting on a policy from the local school district in regards to allowing students to access the school's Wi-Fi. In addition to iPads designated for the service delivery team, teachers reported that their school also has at least one mobile iPad cart that classroom teachers can sign out to use in their class.

Google Apps for Education was mentioned by several participants as being used as a tool in their school to provide students with support. These teachers noted how Google Docs allows them to enter a student's document to provide feedback. Students also have the option to use the speech-to-text feature and other built in features such as spell check and instant messaging. Teachers touted that Google Docs saves students' work automatically, which is great for students who have difficulty with memory and organizational skills. In addition, several elementary teachers discussed a number of learning websites, such as Star Fall, Raz-Kids, and IXL, and how they were used to support student's development of literacy and numeracy skills.

Question 9: Where is technology located in the school? Teachers' responses reveal that technology is generally found throughout the school within computer labs, the learning resource centre (LRC), library, and via mobile carts. Most of the teachers said their school has at least one computer lab and learning resource centre that has workstations equipped with personal computers for classes of students. One teacher described how their school is renovating a space into a Multifunction type of room with tablets and laptops that are "designed for collaboration" as opposed to smaller computer carrels (Participant 8).

Participants indicated that teachers generally have the option to bring their students to the computer lab or bring the iPads into the classroom. The responses revealed that teachers are bringing technology into the inclusive classroom. All of the teachers interviewed indicated that their school has at least one mobile iPad cart which is equipped with approximately 30 iPads. Some teachers noted that their school has two iPad carts, one for the bottom and one for the top floor of the school. Mobile Android tablet carts and laptop carts were also mentioned by several respondents. These mobile carts are typically housed in the Learning Resource Centre, Computer Lab, or staff room. Teachers can book these mobile iPad carts in advance and bring them to their

classroom for students to use. It was also noted that some schools supply each teacher with their own iPad and provide a set of iPads to various curriculum groups such a math, English, or French. Service delivery teams are also provided with a set of iPads. Most of the teachers indicated that all or most classrooms in their school are equipped with an Interactive White Board, such as a SMARTBoard or TeamBoard. Responses suggest that technology is being used regularly as "Classes are coming to the computer lab or using the laptops or the iPads or their SMARTBoards or Team Boards daily" (Participant 1).

Participants asserted varying opinions regarding computers, laptops, iPads and android devices. Several participants found the iPads very useful in their classes, noting how students are motivated to use iPads for learning tasks and how it provides a way for students with exceptionalities to have a functional means of participating in class activities.

> I find now that it's kind of getting away from computers, that is almost like old technology now, as opposed to the iPad which is a lot more motivating for children, you know, because you can have 30 iPads in the class, which they do with his particular class, and you know it's the mode that he learns really well with. So he fits right in and so motivating for him and the other students. (Participant 15)

A number of teachers described computers and laptops as multi-functional learning tools that allow students to do so much more in comparison to iPads or tablet devices: "The laptop can do a lot of things the iPad can't do" (Participant 17). Another teacher acknowledged, "you got to have limited ability on your phone but you can still do most of it. You have got more ability on your iPad but nowhere near as much development power as you do on a PC" (Participant 8). One teacher considered the iPad to be a "media consumption device. Right, you look at stuff on it but when it comes to creating something on it you either have to go to a laptop or the hard level

functionality you get from the android device" (Participant 1). This teacher also noted the varying costs of these mobile devices. "We prefer the android tablets because they are, I think that they are more functional but also cheaper and you can buy two android tablets for the price of one" (Participant 1). Another teacher praised Chromebooks as a user-friendly mobile device that has become the device of choice by many at her school. "[Chromebooks] are actually used way more than the iPads" (Participant 10).

Question 10: What types of supports are available for using technology at your school?

The responses provided by participants indicate that teachers are availing of the expertise of other teachers as a support for using technology in their classes. All of the teachers interviewed named other teachers in their school, such as the Learning Resource Teacher (LRT), librarian, technology committee member or a colleague as a support for using technology. One teacher said, "Lots of people will come up and say just I heard you are doing this can you come show me. It is very informal" (Participant 12). Responses indicate that teachers look for help with minor technical issues and seek troubleshooting support. A number of participants commented that teachers will ask one another or the LRT about a certain app, website, or program that another teacher used so they can learn about it and try it in their class. Many of the participants noted they are very open to using technology and comfortable trying out new technologies. One teacher stated, "So it is only a matter of when I hear; I am the type of person if I hear about, if I think it is neat, I will try it out." (Participant 17).

Team-teaching is used to support technology use.

[The LRT] often will come into your classroom and introduce the new apps or if somebody says what's this popular thing I hear about. She will come in and teach the

> class and guide the teacher and then she'll leave and she is there to assist whenever you need her. (Participant 12)

In contrast, one LRT commented that he is "mostly fixing software and making sure that projectors work and computers work. I keep things running pretty good. I'd like to be more integrating technology, but it is what it is with my own teaching schedule and fixing computers" (Participant 2). The majority of teachers mentioned their school has a technology committee; "they usually bring forward any issues pertaining to where they see they need support" (Participant 5). During staff meetings,

> a teacher can take four or five minutes and just say I have been using this and this works really well with my kids and it may be good for you… It is something that we don't get enough of so I think a chance to share with coworkers and with other teachers as well. We do a lot of PD on curriculum and all that stuff but sharing, you know ideas, and you know what works and what doesn't work. It's something I would like to see more of. (Participant 14)

A number of teachers indicated that their school provides a professional learning community or mini sessions in support of technology. One participant said, "we've had after school tech sessions, lunchtime tech sessions" (Participant 16). Another teacher said,

> As supports we offer a volunteer after school Tech Thursday sessions, go down to the labs, take whatever half an hour and let's cover this topic. So that is part of the school development team, there is six of us and we take turns offering sessions and there might be one or two teachers show up or it might be a dozen. (Participant 7)

This teacher explained that they did a survey to get specific feedback on what teachers wanted to focus on. He also commented that he would like to have the opportunity to do more peer-to-peer

learning, “we could be doing a better job of sitting in on classes and pure observation… there is really not the time to make that work.” (Participant 7). Another teacher indicated that their grade level teachers have preparation times scheduled together where they can share ideas and how to use technology for an upcoming lesson or unit. “We do have planning times together. We have a couple of common prep periods and one of them is like formal grade level meeting time and the other is just kind of informal you know.” (Participant 14). One teacher noted that their school has a technology evening for parents. Last year they did a session on social media and to help see devices such as the iPad or iPhone as a tool for learning. This teacher explained that sometimes the parents are “little bit left behind too” and “parents don’t see the technology as a supporting piece, they see it as a toy” but we can “explain to them that if a student is working on a writing piece and has access to Dragon Dictation then the teacher doesn’t need to be standing up next to them spelling worlds for them.” (Participant 5).

> The school district provides support for technology use. One LRT explained, the district has support technicians who support our hardware and such things. So if something is not working, and it is beyond my sort of abilities, I put in a request and they come in and take care of it. (Participant 7)

The district also provides schools with five professional development days each school year, and one of these days is designated for technology. Several teachers mentioned that the school’s technology committee will usually plan and organize the topics for this PD day, and teachers will sign up for sessions that are of interest to them.

Question 11: How is technology used at the individual and classroom level?

Technology is being used as a tool to provide multiple means of representation, action and expression, and engagement.

Provide multiple means of representation.

Teachers are using technology as a tool to provide multiple ways to present information. Teachers commonly cited using an interactive white board, such as the SMARTBoard, to demonstrate concepts, procedures and models in a flexible visual, digital format. This interactive format allows teachers to highlight, annotate, edit, enlarge content, convert writing into typed text, display pictures, charts, tables, and videos. One respondent explained, "Well in terms of my SMARTBoards, they are used every day. So a student can demonstrate how to solve a math problem or you know edit a piece of work and put that up on the board" (Participant 14). In addition, teachers are using tech tools, such as Air Server, Air Drop and Apple TV to display information from their tablet onto the SMARTBoard or onto iPads. A teacher described using Apple TV to do "work from her iPad directly in terms of displaying it and students follow along and then they share the work from their iPads to the board for students to see." (Participant 5). Teacher's are also using screen casting, or recording lessons on their SMARTBoard, to upload to their class websites as a resource for students and parents. One teacher uses Edmodo as a tool so that

> students can watch videos and I can upload files and pictures, study guides that they have. If they miss something in class, take a picture of whatever is on the board and upload it to Edmodo, they can see it at home. (Participant 18)

Provide multiple means of action and expression.

Teachers' responses indicated that students have opportunities to use computer and mobile devices to provide multiple ways to participate in learning activities and demonstrate their learning. Students are using a wide variety of assistive technology in the classroom, such as word processors, spell checkers, word prediction software, voice recognition, audio and

electronic books, graphic organizers, virtual manipulatives, a variety of interactive web sites and iPad applications. In general, all students have access to these tools, as well as the built in accessibility features embedded within current devices and software programs. Interview data highlights that these tools and supports are used in elementary, junior high and high school classes across the curriculum. A teacher explained students use iPads in her class "for research projects, games, QR codes, different apps that support whatever topic they are learning about" (Participant 18).

The majority of schools enable students to use their own mobile devices in class, a practice known as Bring Your Own Device (BYOD). Students have the option to use their own iPads or laptops for class work, such as note-taking, reading course notes, taking pictures of notes, homework and important dates. One teacher summarized how individual students use technology at her school:

> For kids using their own, we have a number of student who have their own iPads and they do bring it to class. When they are using their own we have kids who use the notes on their iPhone on their phones to type up notes in the classroom, to take pictures of notes on the board, that's a real good one. Take picture of homework to download. A lot of teachers have their homework or their notes online through PowerPoints and whatever. So sometimes they will download that onto their phones or their iPads and save them into folders and that kind of stuff. (Participant 6)

The majority of participants indicated that while students are technically able to bring their device to school, many of the students do not have access, or very limited access to the school's WIFI network. It was noted by several junior high and high school teachers that while students have their own mobile devices such as smartphones or tablets with them, in most cases

"it is at the individual teachers' discretion in the classroom how students are allowed to use it" and "if they are bringing in their own device, it has to be strictly for the classroom work." (Participant 2).

Technology is being used to assess student learning. An Instructional Resource Teacher (IRT) explained how her student with autism uses technology to participate in regular class activities and demonstrate his learning to his classroom teacher.

> if I just verbally tell them or verbally ask them you know, 'what were the animals in this story', they can't tell you but if I lay out several options they can tell me what the options are. I use Kidspiration and Bits Board and Write About constantly, like every day, to get what they know. (Participant 15)

She explained how this student was able to show his teacher that he understands the concept of magnetic and non-magnetic. "He could very easily slide into each category in Kidspiration what was magnetic and what was not magnetic and so we knew that from that piece of that assessment" (Participant 15). Several IRTs indicated that students are using mobile devices to assist with completing tests in their regular classroom. Some teachers are enabling students with exceptionalities to complete assessments in the regular class by providing them with an electronic version and/or an audio recording of the test. Students plug their headphones into a mobile device, listen to the test, or use a text-to-speech feature to provide the read aloud accommodation for testing. In addition, teachers are allowing access to speech-to-text features provided by mobile devices. An IRT recounted how she used SIRI for a student with a severe learning disability, who struggles with written output and reading, and was very unmotivated.

> I think he has just got to the point that he has kind of given up. But I had him out doing an English test the other day and he finds typing really, really hard because he can't spell.

> So he gets to one or two words and he has to stop because he doesn't know how to spell out and where to go with it. So I pulled up SIRI and within a few minutes we had a paragraph done using SIRI. (Participant 6)

Provide multiple means of engagement.

Technology is being used to engage and motivate students. Teachers' responses indicate that technology provides students with opportunities for choice, independence, and involvement in relevant learning activities. Teachers also commented that they are able to provide supports or extra challenge to students who need it in a discrete manner. Some teachers are using apps such as Plicker, Socrative, and Kahoot so that students can freely ask or answer questions without fear of embarrassment. Several teachers gave examples of disengaged students who were more motivated to write when they use the iPad. As one elementary teacher stated, "I find it works excellent because those children who don't want to write will bring it in and they will write and they are so proud that they have it there." (Participant 3).

Teachers are using technology to foster collaboration and provide feedback. The majority of participants discussed the use of Google Apps for Education and some noted they are using Google Classroom. One teacher explained that in their junior high school all students have their own computer account and email account:

> they just do file sharing, they will upload their files to Google Drive, if they are doing a writing piece, they will share it with me. I will go in and give them feedback along the way so they don't have to wait until the end to print it. And then they will go in, and I can see when they are working on it, and see all their issues. (Participant 5)

Several teachers noted how Google Docs allows students to work collaboratively on a document through real time feedback and messaging options. Teachers also commented that

students can use the word prediction, speech-to-text and text-to-speech features built in to Google Docs to support their writing and editing. One teacher commented that Google Drive enables students to have an online portfolio of their class work:

> If you move, everything, all your work, goes with you so you get to develop that portfolio and have that as a resource going forward. It's always so powerful for student lead conferencing and in the future students can talk about their progress. (Participant 6)

Several teachers used Edmodo, SeeSaw, and other communication platforms as a way for students to take photos or videos of their work and upload it to their account to be viewed by the teacher and even their parents. One teacher explained they use Edmodo to "share between home and school and then [students] will create questions for Math for one another and post it" (Participant 18).

Teachers are using technology to enhance communication, to provide feedback about student work to parents and caregivers, and provide digital resources for home use. The majority of the teachers stated that they have a class website for students and parents to access at home. Some of the websites contain uploaded class notes, homework, self-assessments, links to learning websites and games that relate to curriculum, pictures of class activities and various items associated with the class calendar, reminders, and important dates. One teacher uses Twitter as a newsfeed to the parents of his students. He sends out class news as well as pictures and videos of students engaging in learning activities. This teacher also used the SeeSaw app to take pictures of student work or quizzes so students and parents can "get direct feedback of how a student did on a quiz right away" (Participant 17).

Question 12: What is your perception of students' adoption and use of technology to support their learning? Teachers' responses indicate that students are motivated and eager to

learn with technology. “I think they enjoy it. I think a lot of times depending on what we are working on they think it is just fun they don’t even realize that they are learning” and “whenever I can utilize technology I find they respond really well” (Participant 17). One IRT remarked,

> Oh the response, you know, they are happier; they are able to communicate what they know. I know that if I didn’t use technology I’d have different, a much different program but a much different child, a more frustrated child… these kids are able to bring that technology into the regular classroom when they go. Right? To help demonstrate what they know. To help to show the teacher and other students. (Participant 15)

Several teachers remarked that technology is a learning tool and that it is important to balance it with other instructional practices. “They are moving more away from the exercise book and things like that and using technology a bit more but I think we really need to find a happy medium... I guess it is a healthy dose of integration” (Participant 17). Another teacher shared this sentiment and speculated about the long-term effects of continuously providing students with the visual stimuli and immediate gratification that comes with technical devices.

The majority of participants commented that technology is a part of everyday life for students, stating it is like “second nature” for many children. Students use these devices outside of school and often times have their own mobile devices. “I think a lot of kids in our building now have either an iPhone or an iPod or an iPad. They have laptops. Every kid wants to use it, it is not an issue.” (Participant 10). One high school teacher explained how his students are using their technology:

> They use the computers for so much other things, for they are playing games, social media, and their communication that it seems a natural extension for them to start using it for their education. So then you want to get them to take notes on it and they are happy to

> have it there and take their notes. And now that we are getting more into the Google Apps for education the entire course could be right there on their laptop. So it becomes a very multi-purpose device. So, they take to it like a duck to water so to speak. (Participant 1)

A number of interviewees noted that students still need to be taught how to use the technology to learn basic skills. One participant commented that, "tech savvy doesn't mean that they know all there is to know." This junior high teacher explained how sometimes as teachers we assume they know all the ins and outs, but has also been surprised when he had to show students how to copy and paste or double click the mouse (Participant 2). Another teacher added that students "need to get the message that it's for meeting curriculum outcomes" (Participant 5). It is important to note that it may not be the technology itself that is motivating students; rather, as one teacher stated, "The tasks are designed for students to be relevant to students lives… the tasks are motivating for students and that's what is bringing them in" (Participant 5).

Students are recognizing the value of using technology as a learning tool. Several teachers commented on how students develop learning strategies and independence when they use technology to support their own learning. A number of participants gave examples of how students responded positively to using Google Apps and how it allowed students to take more responsibility and accountability for their work. A teacher discussed an instance of a high school student who benefitted from the file management and organization of Google Drive. This student said, "Sir, I can never keep stuff organized… This is excellent, like if this existed last year I would have passed such and such course." (Participant 7). Teachers commented that technology provides students with more autonomy and accountability. Students know that their teacher can go into their Google Doc to see their contribution to the writing as well as the revision history. An IRT gave an example of how a group of Grade 8 boys admitted they enjoyed and benefitted

from using the speech-to-text feature in Google Docs for completing a demanding writing assignment. She explained the students were hesitant at first but then by the end of the assignment they were saying, “this is really cool.” The teacher explained that “they don’t love it, but when they see how it helps them, then it is beneficial.” (Participant 10).

Observations

Three teachers who were interviewed were selected for classroom observations. These teachers were selected based on how their interview responses aligned with the principles of UDL (CAST, 2011). We selected two elementary and one junior high class for the three sub-cases. These teacher’s interviews revealed they were developing and implementing UDL-based learning activities that incorporate assistive technology. Each teacher consented during their interview to participate in class observations. While numerous teachers were acceptable for further investigation, not all teachers provided consent for classroom observations or the collection of picture and video data in their class. I had originally planned to investigate one teacher from elementary, junior high, and high school to represent each sub-case. One high school teacher was selected and consented to participation in classroom observations; however, zero students provided consent to participate in the study. It was then decided to focus more on consenting teachers who meet the UDL criteria and would be using technology in different subjects or units of study.

Each observation focused on one subject area: Math, Social Studies, and Language Arts. In order to ensure confidentiality, the teachers and their schools were assigned pseudonyms:

School 1: Woodridge Elementary - Mr. Thomas (Math)

School 2: Faircrest Junior High - Ms. Paul (Social Studies)

School 3: Eastcoast Elementary - Ms. Ennis (Language Arts)

School 1: Woodridge Elementary - Mr. Thomas - Math Lesson - Variables and Equations. This observation took place in a Grade 5 class and the researchers observed a morning math lesson on variables. There are 18 students in this class; 16 students were in attendance. The teacher informed us that there are several students in this class who have Individualized Education Plans.

The class started with whole group instruction. The teacher introduced the topic by reviewing key points from previous lesson and noted the goals for this class. The objective of the lesson was for students to be able to solve problems using a two-variable equation. He used the SMARTBoard to introduce variables and write a math expression. As an instructional strategy, the teacher reviewed the vocabulary and gave an example of a variable and expression on the SMARTBoard. He explained, using visual and oral representation, that letters represent numbers and provided multiple examples. He then used a previously developed math lesson that contains a picture of calendar and questions to provide a visual for students to use when developing their own math expressions. The teacher highlighted key text and made the images and text larger for the class to see more easily. This was followed by the teacher posing questions based on the visual on the board and randomly selecting responses to ensure participation by all students. When a student answered incorrectly, the teacher did not respond dismissively. For example, he said, “I understand where you are coming from.” The teacher also helped to guide a student away from choosing a more advanced question to one that was more on his level, suggesting that the student “pick another event”.

The students level of engagement was high; students were looking at the teacher and the board, and students were raising their hand to volunteer answers. The teacher continuously checked in with the whole class, saying, “Some of the confusion lifted any?” Based on student

feedback, the teacher demonstrated his approach to the problem. He modelled a strategy saying, "I know a week is 7 days, 2 weeks equals?" In order to meet the needs of his students, the teacher customized the display of information, supplemented auditory information with visuals, clarified vocabulary, activated background knowledge by reviewing last class's introduction to variables, highlighted key parts of the example and text on SMARTBoard, and provided emphasis and cues which provided critical information to solving the problem.

Following the introductory activity, the class moved onto a whole group guided practice activity using the teacher's iPad, the Plickers app (See Appendix K - Recommended Resources for Educators) and a QR response card for each student. Students were given their own response card which was a piece of paper that had been printed with a unique QR code to identify each student. The students held the card upright and turned the paper 90 degrees in order to indicate their response by selecting answer A, B, C, or D. The teacher had prepared 10 questions in Plickers in advance. The teacher read aloud a question and displayed it on the SMARTBoard. The teacher then scanned students' response cards using his iPad. While he scanned the iPad around the class, he was able to see how each student responded. The students could not view this information; instead they could only see the results on the SMARTBoard which provided a graphic view of whether student's responses had been recorded. Once all students responded, the teacher changed the view to a bar graph, which represented the number of people who chose A, B, C, or D. Students were engaged and enjoyed seeing the correct response and engaging in discussion as to why they may not have selected the correct response. The students cheered upon all receiving the correct answer. Students were excited to see they had the correct answer. One student exclaimed, "I got it right!" when the teacher revealed the answer.

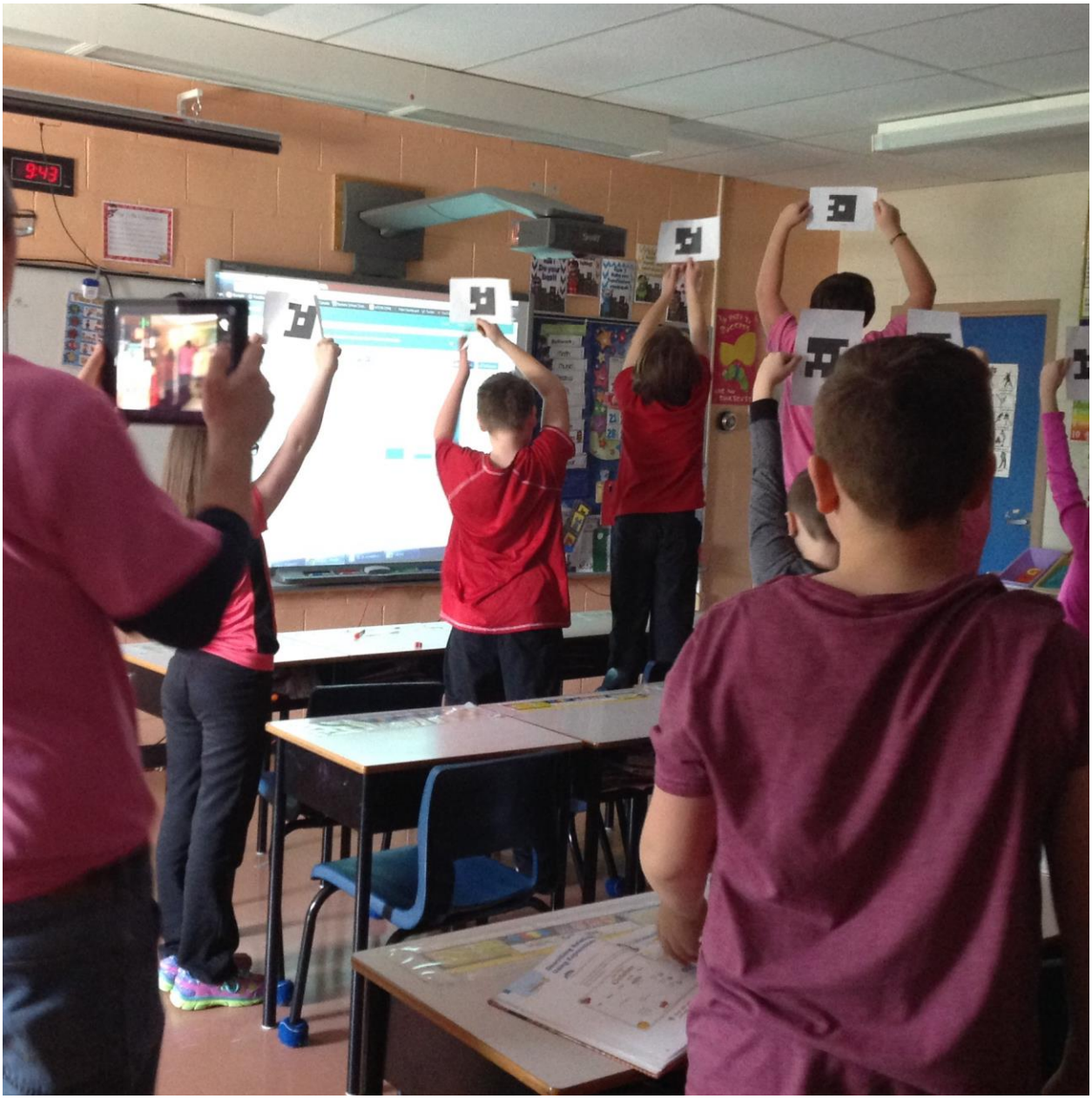

Figure 1. Plickers in Action. Students are answering questions the Plickers app in a Grade 5 math lesson on variables and expressions. The teacher is scanning the students' QR codes to see their individual responses to the question displayed on the SMARTBoard.

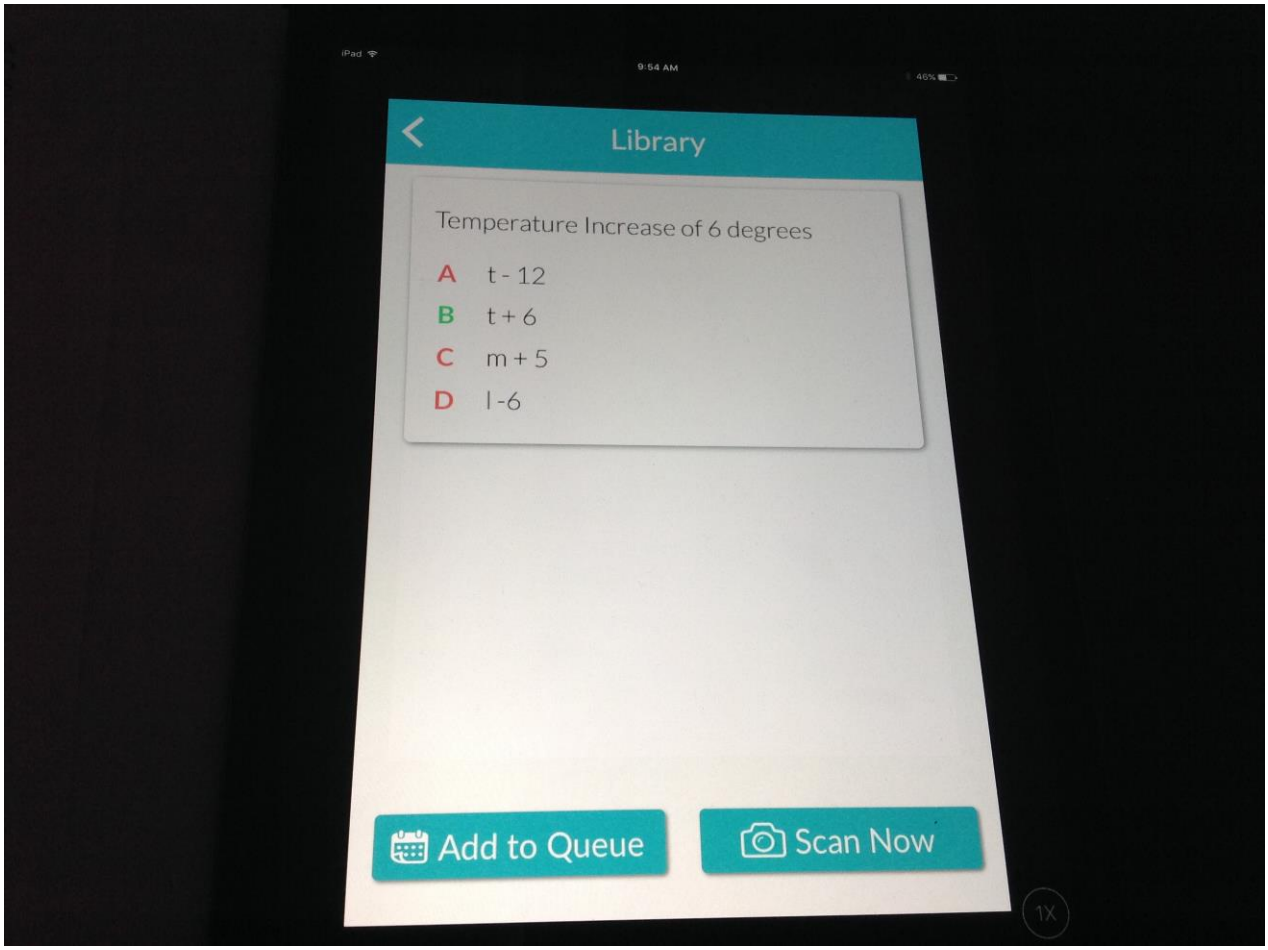

Figure 2. Plickers Math Question. A math question made by grade 5 teacher using Plickers.

As an instructional strategy, the teacher used students' names when posing questions. The teacher gave a clear explanation, clarified misunderstandings, and wrote the correct response on the board for each answer. For one response, the teacher informed students that they could walk around the class until they were ready to respond. In addition, the teacher continued to comment on the class' progress saying, "It seems like the fog is beginning to lift". A student responded commenting, "The lights are turning on". Towards the end of the class, the class helpers were asked to collect and return all of the response cards to the teacher.

In this lesson it was observed that rather than typical pencil and paper seatwork, the teacher provided an alternate way for students to demonstrate their knowledge by using the

response cards to answer questions. The activity allowed for movement and used both oral and visual modalities to pose questions and provide students with an opportunity to answer. This was an enjoyable class activity and students showed enthusiasm and engagement throughout the lesson. This activity provided a great way to enable all students to participate in a non-threatening environment. The students did not have to worry about being embarrassed about the answer they chose because only the teacher could see their response. The teacher could then use this information to inform his instruction. This activity would be especially helpful for students with learning difficulties, anxiety, or shy students, as it would enable them to participate in an enjoyable, non-threatening manner.

After the Plicker activity, students began their individual activity, which was to answer three questions that were displayed on the SMARTBoard. The teacher demonstrated how to date and place numbers in margins of their exercise book by writing on lined paper, similar to a sheet of loose-leaf, on the SMARTBoard. The teacher read the first question aloud and the class worked on it together. The teacher wrote the response on the board and then notified students that they had two minutes to finish the next question. He set the timer on his iPhone and the students scrambled to start. The students were engaged in the task and eager to finish within the allotted time period. The alarm, which was a popular rock song, went off two minutes later. As an instructional strategy, the teacher corrected the problem with the whole class. He made sure everyone was participating and had a chance to respond. He modeled responses, highlighted text, and explained how to verbalize the responses.

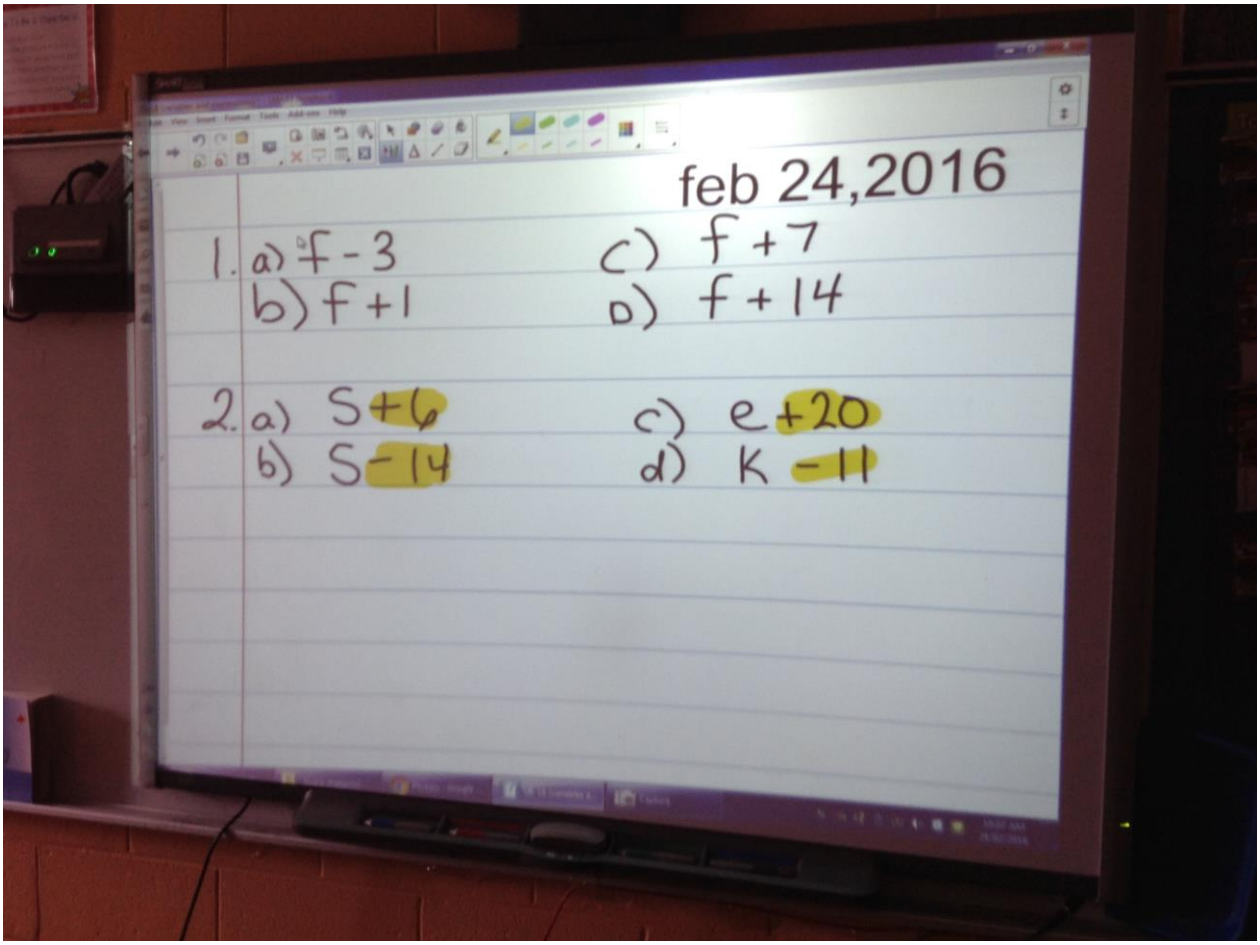

Figure 3. SMARTBoard Display. The SMARTBoard display was used to model the format for answering questions on loose leaf and to highlight important information.

School 2: Faircrest Junior High - Ms. Paul - Social Studies - Tourism iBook Cross-curricular Research Project. Observations surrounded a Grade 7 Late French Immersion class with 17 students. In collaboration with the students, the Language Arts teacher and Homeroom teacher developed a cross-curricular project that met outcomes in Language Arts, French, Social Studies, and Technology Education. The teachers described the students as being very eager to learn, well behaved, with great home support. Two students are on IEPs, where accommodations include extra time and quiet space for tests; however, neither of these students chose to avail of these accommodations.

The teacher and students explained how they developed the idea for this project. The teacher and students decided to create a Tourism iBook based on Newfoundland as homage to their former classmate who moved back to her native country, Australia, during the school year. In a previous class, the Grade 7 students interviewed, via Skype, the classmate's older sister in Australia. This sister had also lived in St. John's, Newfoundland. The students asked her about the memorable places she visited while she was in Newfoundland. The interviewee cited eight places that she visited that were particularly memorable for her during her stay in the province.

The students used the eight sites the sister recommended as the basis of their project, and provided information about each location as a chapter in the iBook. Students were placed in groups of two and randomly drew which site they would be responsible for researching. Using iPads and computers, the partners researched key information regarding each site. They used the Internet to gather information about the site, went on field trips to each location, and took pictures and videos of items of interest during their visit. When possible, the students also interviewed people who worked at the site. The pairs wrote a paragraph about their assigned location using Google Docs and Google Drive to store their information. They also stored pictures and videos to their class's Google Drive where they were separate folders named for the eight sites. As a measure of collaboration and sharing, students were encouraged to add picture or other information to a folder on any site to assist another pair.

Before creating the chapters in the iBook, students were instructed to think about the different needs people may have, and strive to make their document accessible to a wide range of readers. The students learned about various components which make up an interactive book, and why it is important to have those accessibility features. They wrote a chapter in the iBook about each location in English and French. They also provided closed captioning for their videos. The

students added features so that when a reader moves their mouse over an icon there is a popup to provide further information. The students hope that their former classmate will share this iBook with her classmates in Australia, and that her class may make a similar type of iBook about their country to share with the students in Newfoundland.

While in the school's computer lab, I observed the students typing up key information about their site. Each pair of students worked side-by-side and used their own computer. The students used Google Drive to access their saved files and started working on their documents. I observed students editing their document simultaneously using Google Docs. Students used an online website "WordReference.com" to assist with translating words into French. Once students were busy writing and translating their document, the teacher sat at a computer to accesses project folders on the class's Google Drive account. He opened up several groups of students' Google Docs, provided feedback and edited some grammar mistakes. Several students chuckled when they noticed their teacher had accessed their document. The students seemed to appreciate the real-time feedback they received and several students asked for clarification. Periodically, the teacher walked about the lab to check on students' work. He answered questions and provided help as needed to students. He assisted students with translations by giving examples and reminders. He also prompted students by asking questions. The teacher noticed that students were having difficulty remembering the shortcut keys for French symbols, so he put a list of French keyboard shortcut keys in their Google Drive and directed students to access that file if needed.

The teacher showed me the outline and outcomes for the assignment. He also informed me that students were writing their content for the site based on an outline that prompts students to use the 5 W's strategy (What, Where, When, Who, Why and How) in order to identify and

record the most salient information about their site. During the first hour of the session, the students were engaged in completing the task, using WordReference, and asking questions to other students and the teacher or intern. Students were very relaxed, giggling, and appeared to be having fun. Occasionally, the teacher redirected several students who were talking loudly or laughing to stay on task. Half way through the second period class, the teacher announced a stretch break time. Most students participated in the stretch break and appeared to have performed this type of stretch break activity before as they knew to do specific stretches to help with prolonged sitting. Most students moved about or held a plank position for a period of time. The teacher quietly redirected a student who was off task and asked if she would like to go for a two-minute walk. The student accepted the offer and went for walk by herself. She returned to class more settled and continued on with her work. Students continued to work collaboratively writing, editing and translating their text. The teacher continued to check-in on students' documents and gave feedback via Google Docs, and also walked about the computer lab to help students with spelling. He reminded students about good ergonomics. He also kindly verbally redirected a group of students were talking and laughing.

After class, I spoke to the other teacher who is working on this project with the class. She indicated they will be using iBeacon, a device that creates an app on students' devices, during their field trips to each of the sites in order to send messages to students, to point them to specific details, remind them of what they are supposed to be looking for, and to keep students on task.

Figure 4. Students Using Google Docs. Each student works on a computer using Google Docs to collaborate with their partner on writing background information about their site.

Figure 5. Field Trip. Students visit The Rooms to take pictures and gather information about this site.

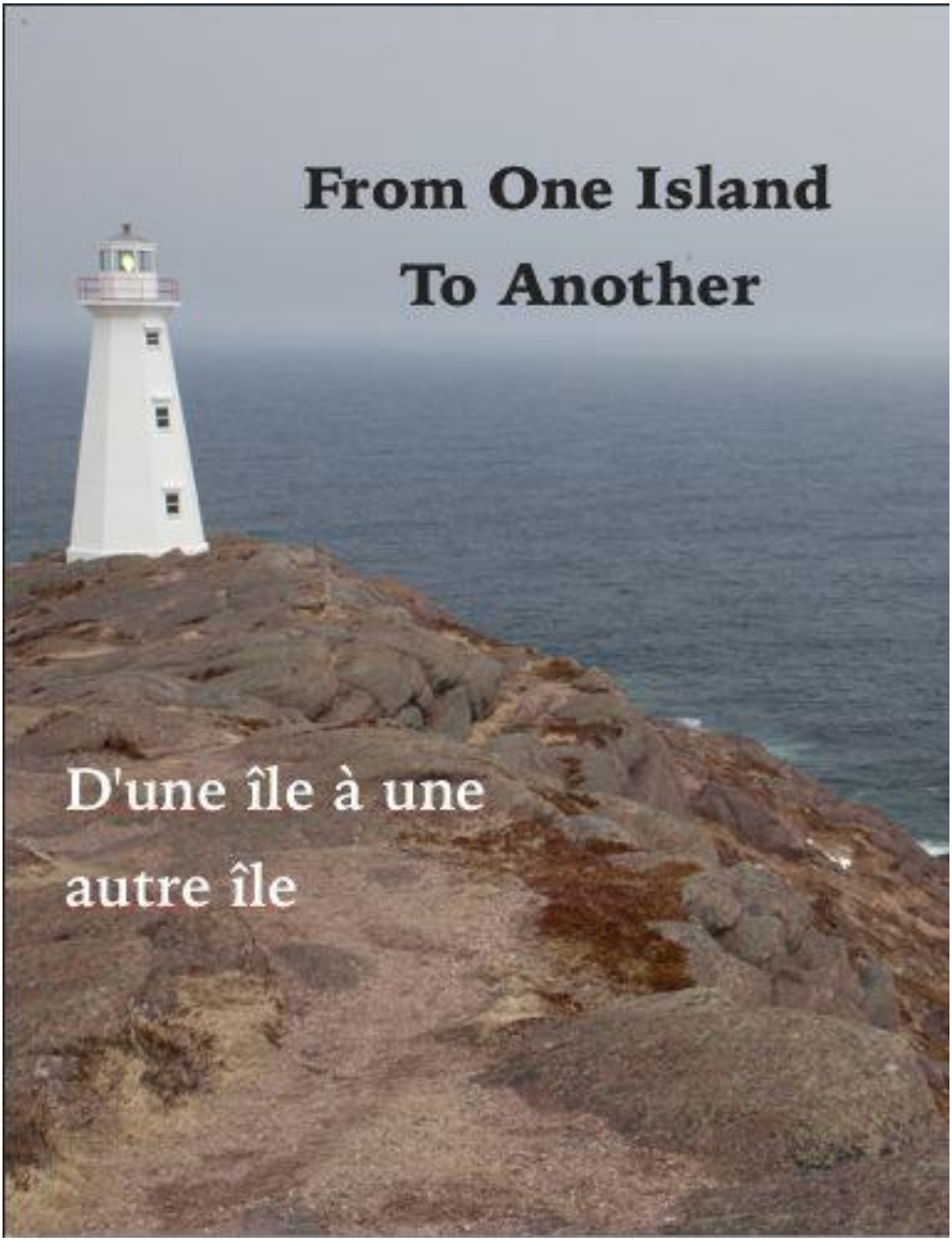

Figure 6. Tourism iBook. Cover page of the students' tourism iBook.

School 3: Eastcoast Elementary - Ms. Ennis - Language Arts – Daily 5. I observed a Grade 4 class participating in the Daily 5 as a part of their Language Arts class. There are 25 students in this class; a diverse mix of boys and girls with a wide range of learning needs. There are several students on Individual Education Plans, including a student with autism, and two students with learning disabilities. There also students from a variety of ethnic backgrounds. The students' desks were set up in groups of four or five.

The lesson started with whole class instruction. The teacher displayed a previously prepared list of the centres on the SMARTBoard. The centres included: Listening, iPad, Reading, Writing, Google Docs, and Guided Reading/Writing. She described each centre and the expectation for each group. The teacher then assigned three to four students to each group and posted their names alongside the centre in which they were beginning their work. The teacher instructed students to switch groups when the students at the listening centre were finished. The students went to their assigned centres without hesitation and began their centre work.

The first centre I observed was the listening centre. The students retrieved their own earbuds from their individual bins. At the centre, there was a CD player, four books, and a teacher written note instructing students to put in the CD, plug in their headsets, set to number 3, and press play. There were also four highlighting strips for students to use to follow the text if needed. The students sat in a circle around the CD player, followed the instructions and began to listen to the audio book. The students were following along with the text, turning the pages at the same time, and appeared focused on listening and reading the book. One boy was sitting on a Disc' O'Sit cushion (See Appendix K - Recommended Resources for Educators) while at the centre; this was likely used to provide added sensory input while listening and reading.

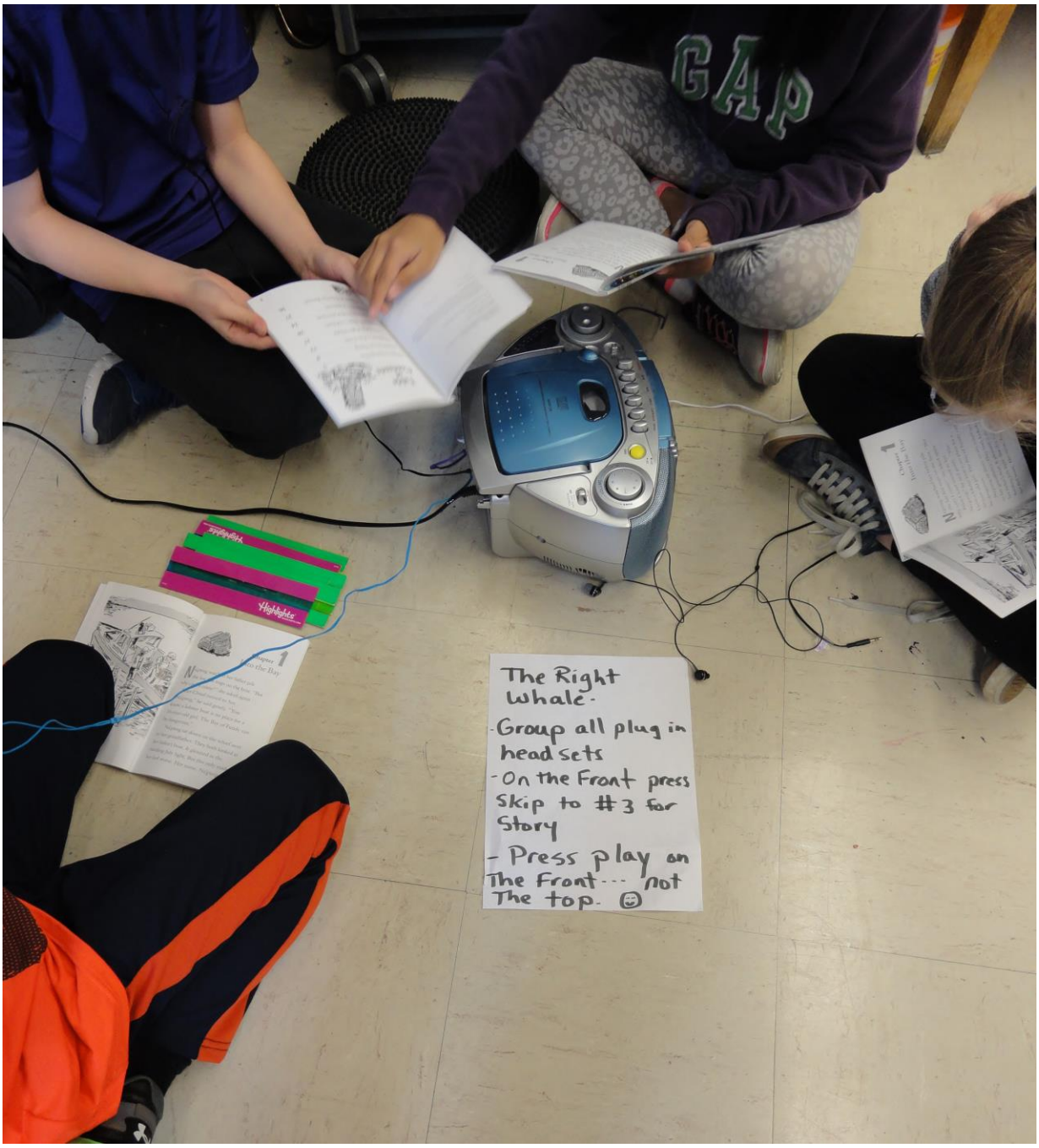

Figure 7. Listening Centre. Students are listening to the book on CD. They are using their own set of earbuds to plug into the CD player. Students are provided with easy to read directions and highlighting strips to use if they want.

At the iPad centre students were using the Spelling City application (See Appendix K - Recommended Resources for Educators). This app provided students with options to practice

spelling and vocabulary words by playing one of the seven engaging learning games using a word list selected by the students. At this centre, the students were free to work at their own level with differentiated spelling lists and levels of activities. Some students worked on more basic tasks, including games similar to Hang-man, whereas others could work on more difficult tasks such as spelling a word as it is read aloud. The students were observed playing the various spelling games and displayed excitement when they completed the level or achieved a perfect score. One student was working on a spelling test consisting of high level words, achieved seven correct out of ten, and was eager to see which words he had misspelled. He then attempted the spelling test again to try to spell all of the words in the list correctly.

Figure 8. Word Work Centre. Students are using the app Spelling City to engage in a variety of spelling activities. They can choose from 7 different spelling games to play and use customizable word lists.

The students at the writing centre were writing a menu for their imaginary restaurant. The students were free to choose any kind of restaurant and design a menu according to their restaurant. Students had already written the first draft of their menu and were completing their final copy in a menu-styled template. One girl had a Pet Restaurant and the menu items included a variety of animal treats. She drew pictures of dog bones, dog bowls, and fish on her menu. A boy had designed a space themed restaurant named ‘Spaced-Out!’ and included items such as Jupiter Hamburger and Saturn Onion Rings on his menu. The students referred to a variety of examples of menus in their Language Arts book, which were provided a reference. During the observation, the students were very busy working independently on their menus.

At the Google Classroom centre, there were two students each working on a computer. They were already working on answering questions in Google Docs for the Health unit on drugs. They were answering questions based on an image of a prescription label. Some of the text on the label was difficult to see so I showed them how to enlarge the picture by clicking on and

dragging the corners. The students commented that the enlarged image was easier to see and continued to work on typing answers to the questions. I noticed the boy was using a headset and using the speech-to-text feature in Google Docs. The teacher had informed me prior to class that this student has Dyslexia and uses this assistive technology and his iPad as recommended in his Individual Education Plan. The student commented that is was “very easy and helpful” for him to “speak his answers into the microphone.”

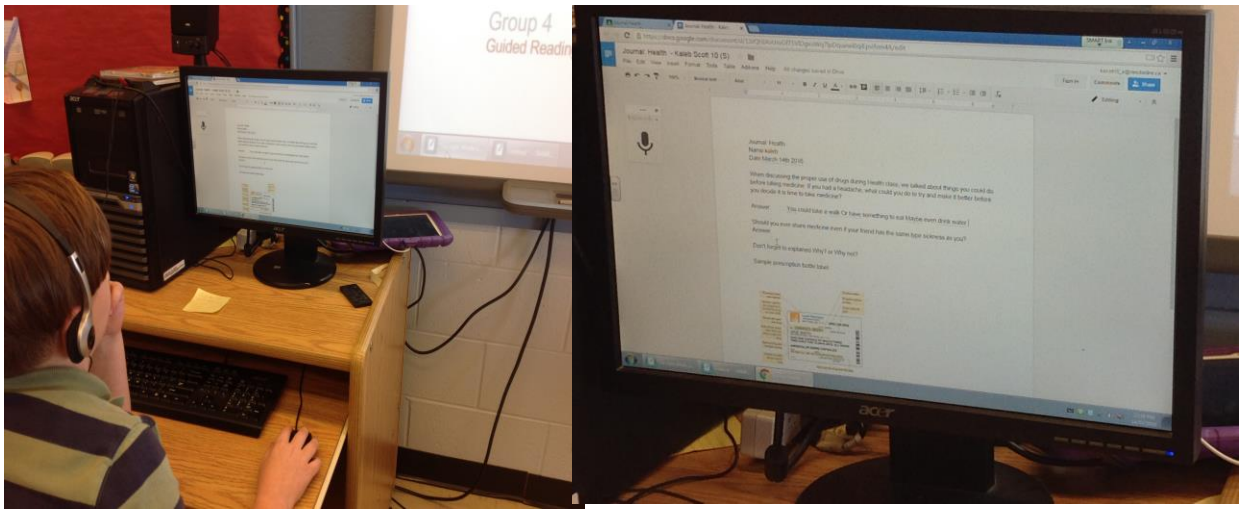

Figure 9. Google Classroom Centre. A student is completing questions using Google Docs' speech-to-text feature.

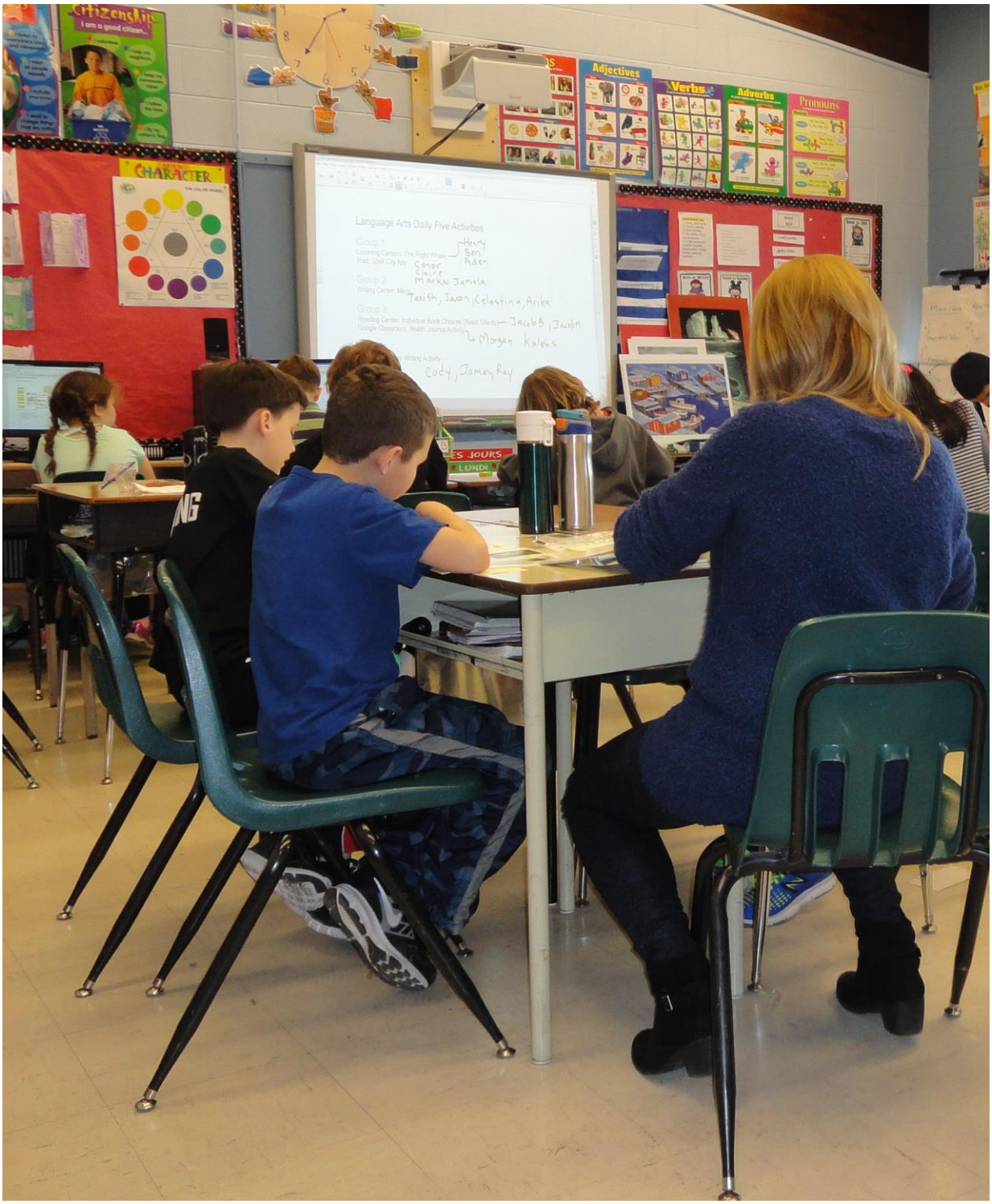

Figure 10. Guided Reading Centre. A student in this group is using his own iPad to type his responses to the questions about the story.

The two students at the Reading Centre were independently reading a book of their choice from their own Book Boxes. The students' Book Boxes contained a variety of reading materials, such as magazines, joke books, and short novels. Each child was quietly reading the book of their choosing and looked to be highly engaged as neither looked up as I walked by their desks.

The last centre was the Guided Reading/Writing group. The teacher was sitting with a group of three boys. After class, the teacher indicated this group of students was at a similar reading level. The teacher was teaching the strategy of making connections between text and self. The teacher read the story aloud. Then the boys took turns reading aloud parts of the story. When the story was finished, the teacher posed questions of varying degrees of difficulty to the group. The students were able to answer the questions with some prompts from the teacher. The students then proceeded to write the answers to the questions in their notebooks. One of the boys chose to record his answer on his iPad that be brought from home. The teacher indicated that all students have the option to use their own device, such as an iPad, to complete classwork. This particular student often uses his iPad for written tasks because he prefers typing and having the access to spell check so that he can spell words correctly.

Focus Groups

The researchers explained the purpose and procedure for participating in the focus group session. Students were provided with a document, which displayed the three questions that were going to be asked, as well as the Rules of Engagement, and the researchers explained the questions and guidelines for participation (See Appendix H – Focus Group with Students) for Focus Group Questions). Students were seated in a circle and provided with a talking stick to use when it was their turn to speak. Students passed the talking stick to the person sitting next to

them when they finished their response. For each of the three questions, students were given two opportunities to provide an answer. Students were notified that they could pass their turn and would have another opportunity to speak once the talking stick had been passed around to all participants. Each focus group took approximately 30 minutes to complete and there was mix of male and female students in each group. The focus group was audio recorded and transcribed and the transcriptions were carefully examined and subjected to content analysis. A colour coding scheme was used to classify comments that expressed similar explanations and ideas among the participants.

The focus group questions are listed below, and the responses to each question are presented in the text that follows.

Question 1: What are your thoughts on learning in a variety of ways (i.e., the teacher speaking, using the SMART Board, using the iPads etc.)?

Question 2: What are your thoughts on being able to demonstrate what you know in a variety of ways (i.e., speaking, writing, using technology)?

Question 3: What are your thoughts on being able to use technology to assist with learning and demonstrating what you know?

School 1: Woodridge Elementary - Grade 5 Students. Student responses indicate that they enjoy using technology to support their learning and demonstrate what they know. There was a general consensus from students that technology makes learning easier and helps to support their understanding of the presented information. Students noted that using technology to provide a visual representation of concepts improved students' accessibility and comprehension of the material presented. One student commented, "I think that technology really helps me learn and understand things better than I do on paper… because you see things in a better way".

Another student added that having information presented on the SMARTBoard supports her learning, “I feel like it gives me better understanding of what learning is about… on the SMARTBoard you can actually bring stuff over, you can draw certain objects in certain ways, then it is easier”.

Focus group data indicated that students are using technology as a resource tool to support their learning in school and at home. Responses indicated that students will access the Internet to search for information on a topic. One student said,

> “I think it is easier to learn from technology because if you are doing your homework and sometimes you don’t get stuff, you go on your iPad or whatever, and you can search up the instructions on how to do that math or spelling.”

Another student enjoyed using an iPad to ask SIRI questions and access information using simple voice commands. As one student stated, “If you are having a problem you can search up on the internet what your problem is and it will tell you anything you need to know”.

Students were motivated by learning with technology and having options for participating in learning activities. A number of students reported that they enjoyed using various apps on iPads to demonstrate their learning. One student noted how her teacher used an app called Plicker to allow students to provide answers anonymously, “I like using technology to show what I know because the apps we use are really cool and the kids don’t usually see your answer but the teacher always knows who gets it right and who gets it wrong”. Another student indicated that he benefits from the immediate feedback provided by “some math apps like IXL Math that you can put in your answers, and after when you hit done you could see how well you did on it, see the questions you got right”. One student commented how using a pencil causes fatigue that is overcome through using an iPad or computer. Students appreciated having a variety of ways to

demonstrate knowledge. As one student stated, “I like being able to use technology because it makes me want to learn more than just using a pencil and paper all the time”. In addition, some children noted that they enjoy being able to share classwork with their parents electronically using an iPad app. One student reported, “the benefit of using SeeSaw is like when you do like Art or Math your parents can see what you are doing… you can put your work on SeeSaw and your parents can see everything that you do”.

School 2: Faircrest Junior High - Grade 7 Students. Focus group data indicated that the majority of students find using technology helpful because it provides an easier and quicker way to complete writing activities. Some students use technology to compensate for difficulties with handwriting and spelling, with one student commenting that he finds technology beneficial for his writing and spelling. Students also commented on how using technology allows for quicker writing and note taking. Students said things like:

> “I think it is good because I am not the best writer so when I type I don’t really have to care about how my writing is so people can read it.”
>
> “I like it because my handwriting is really bad, and it also has auto-correct, so if I spell something wrong it fixes it for me.”
>
> “if the teacher is saying something they usually say it faster than you can write it, so if it is on the Smart Board you know you have time to write.”
>
> “Well it is kind of helpful for getting things done a little bit faster because I am faster typer than I am a writer. I am a really slow writer.”

Students noted how using technology makes it easier to organize class materials. The following is a list of student comments:

"I think it is way better than writing down things because I always lose my things so when I put it into like Google Docs or something, I always know it is not going to be lost and it is going to be right there."

"We use Google Docs that way we can all keep our work in the same place."

"[Teacher] always puts our booklets up online because I lose them." "I find it helpful because it is so simple to send finished work to your teachers."

"I think projects are more organized when we use technology."

"I feel like I am more organized when I use technology to present something or do a project."

"When I use technology for my projects it keeps me much more organized because just say if you have a phone you can just keep all the files on a phone."

Student responses suggest they find using technology for learning activities and projects to be both motivating and engaging. Students may find technology motivating because using it may come naturally to them and they may be motivated by what they are able to create, accomplish, and share with others as a result of using the technology. Students commented:

"I like using technology because you can represent things in so many different ways."

"I think it makes projects more exciting because you can put photos and videos in it and you can't do that on paper."

"I like using technology more than I like putting down notes."

"I think it makes project like go much quicker because you can do stuff a lot easier and faster."

"I think it is good to use technology because you can learn faster because you can play like different games and stuff to help you learn."

"I think it is like good because it is easier to understand and get like all the information."

Students noted several challenges that are associated with using technology in their class. For some students typing may not be their preferred modality to take notes or present their ideas. As such it is important for teachers to provide choice in how students complete activities.

"I don't like using the technology because it always glitches up and gets really confusing."

"I like it when I have a choice to use technology because some things are easier with it but other things are just not very good with it."

"it is hard to like type with such a small little device and it is just a bad idea."

"I think that we should be limited because we use so much technology at home."

"A lot of teachers don't know how to use it so it is just a waste of time".

School 3: Eastcoast Elementary - Grade 4 Students. Focus group data indicated students view technology as a helpful learning tool. Several students noted how technology can be helpful for writing and spelling tasks. Students commented:

"Sometimes people have troubles with writing and pencil, so writing and computer can help them, and then they can just print it so it looks neater. And then you can type, when I hold a pencil it really hurts my fingers …"

"Technology like helps us learn because with autocorrect you can like right click on the mouse, and then it'll show up a bunch of words that it could be, and then you click on the right one that you try and spell. And when our teacher uses the Smart Board I like it because it's big and everybody can see it."

"Technology helps me learn because it helps me spell and learn different facts."

> "I like using it because it helps me a lot in spelling and learning new things like words that are harder for me, it could help me learn, it could help me learn those words faster and other words that I don't know."

Focus group data indicated students view the use of technology for learning as motivating and engaging. Students pointed out that using technology to learn adds variety and makes learning interesting. Students also noted they like watching learning videos, using the interactive whiteboard, and having a choice to use various types of technologies for learning activities. Students said things like:

> "I feel great about using technology to help us learn because it helps us learn in different ways than writing with a pencil."
>
> "I like technology because it gives another variety or way to learn."
>
> "I like using technology because it gives us something different to do instead of sitting and writing every day. It gives you a chance to do things and it's just very helpful."
>
> "Sometimes I enjoy it when my teacher uses technology because she is making it interesting instead of just standing up and talking. Sometimes she will put on a video for us to watch and learn from and we'll show information on the Smart Board, important information up on the Smart Board."
>
> "We use a lot of videos to learn different concepts in Math, most of the time, and [our teacher] always makes up these interactive things on the Smart Note Book that we use."
>
> "[Our teacher] gives us a really big variety of choices to make, we can go on the computers and iPads and we use a lot of technology."

Students also commented that technology is fun to use. A number of students indicated they enjoyed playing learning games on iPads and on the interactive whiteboard. Students commented:

> "Our teacher, she uses a Smart Board instead of just writing that information and giving us to do a sheet up on it. She sometimes lets us play games and she makes games and we get to play them and it makes learning more interesting in my opinion."
>
> "I like using it for Math because it is like there are a lot of fun games for Math."
>
> "I also like using it in Math because on the iPads it helps me learn how to multiply or divide and the new numbers that I learned the better I get."
>
> "I'm lucky that we can have technology to use these days like Google Classroom and when we use the iPads we play learning games and it helps us learn more and know more facts about whatever the subject is."
>
> "I like technology because it is fun to use; you can kind of make things and do cool stuff."

Focus group data from all three schools reveal students find it helpful to use technology for learning, and find it more engaging than pencil and paper tasks. While not all students viewed using technology for learning as beneficial, the majority of students responded that technology use was helpful for learning. The results from the focus group data also reveals that students are motivated to use technology for learning. Students stated that technology makes learning easier and adds interest to learning activities. Students commented they enjoy playing learning games and using technology to engage in tasks that are relevant and of personal interest.

Summary

This chapter presented the results of the teacher interviews, class observations, and student focus groups. The first section presented teachers' responses to each of the twelve interview

questions. The observation results were then presented according to the three classroom observation sites. The third section reported the results from the focus groups for the students in these three classes.

Discussion

Inclusive education has made its way into many of today's classrooms. As a result today's teachers are being asked to teach a broad range of learners in their classrooms. Inclusive education requires teachers to employ instructional approaches and tools that assist all students in accessing the curriculum, engaging in learning activities, and demonstrating their learning. The diversity found in the 21st-century classroom presents numerous challenges for teachers. Teachers may feel overwhelmed as they strive to ensure that each student's learning needs are being met within a class of students with such varied abilities and needs. The current approach of retrofitting lessons with accommodations or added supports may need to be re-examined as it does not match the logistics and challenges of teaching in an inclusive classroom. Instead, a proactive approach that has built in supports and anticipates the learning needs of all students may be warranted. Some teachers in inclusive learning environments are using assistive technology as a tool to provide students with multiple paths to learning and enable students to learn in a way that best meets their unique learning needs. Providing all students with access to technology to support learning can also lessen the stigma associated with assistive technology and perhaps reduce its abandonment by students for whom it is necessary.

The main goal of this study was to explore how teachers who are proficient with technology implement assistive technology in their inclusive learning environment. The study aimed to answer the following three sub-questions:

1. How do teachers develop instructional practices that incorporate assistive technology within the context of universal design for learning?
2. What supports and challenges influence instructional practices that incorporate assistive technology?

3. What are students' perceptions of utilizing assistive technology and universal design for learning?

This study utilized interviews and observations to investigate how teachers develop instructional practices that incorporate assistive technology within the context of universal design for learning (UDL). This study also reported on the types of supports and challenges that influence instructional practices that incorporate assistive technology. There is little research examining the use of assistive technology in inclusive, regular education classrooms (Watson, Smith & Anderson, 2010). Quinn, Behrmann, Mastropieri, and Chung (2009) found the use of assistive technology in schools to be low, but especially low for students with high-incidence disabilities in general education environments. There is a gap in the literature surrounding instructional practices that employ assistive technology to provide learning environments that are accessible for all learners (Basham et al., 2010). The current study explored how teachers implemented assistive technology in general education classrooms within the context of universal design for learning and how students respond to these methods and tools. Teachers' and students' voices are represented. The insights from both groups of participants are significant and valuable as individuals view assistive technology differently. The data was gathered and analyzed through an appreciative inquiry perspective, as the researchers explored what is working for teachers in terms of technology integration and highlighted how these practices are currently being used in today's diverse classes.

Redefining Assistive Technology in the Inclusive classroom

Teachers are redefining assistive technology as we currently know it. Many teachers in this study referred to current technologies, such as iPads and Google Apps for Education, as assistive technology. This finding suggests general education teachers may be using the

accessibility features embedded in these technologies as a means of providing remediation or compensation for some students. Many of the features of assistive technology, such as speech recognition, text-to-speech, spell check and word prediction are embedded into mobile devices, online digital texts and software applications to provide more open access for diverse users. There are a variety of apps available for mobile devices that provide these supports for free or low cost. The findings from this study indicate that teachers are harnessing the features in newer technologies, such as tablets and Google Apps for Education, to provide flexibility in instructional practices and options for students to access and demonstrate learning outcomes.

Responses from educators in this study suggest current technologies are being used to provide inclusive learning environments for students. The interview results indicated that teachers provide all students with access to technology in order to provide a more "seamless" system of supports. This universal access prevents putting a spotlight on students with special needs who use technology as an accommodation and may prevent a student from abandoning his or her technology. Several teachers regarded mainstream devices, such as iDevices and android devices, as a way to provide supports for all students in a more inclusive manner. Students can use the iPad for note-taking, rather than a Fusion Writer, and students may prefer to do so as iPads are widely available and free from negative stigma. Some teachers reported how their schools were using iPads or Chromebooks to enable junior high and high school students, who would normally be pulled out to receive their testing accommodation, to complete their evaluations in the regular classroom. Several teachers referred to this as providing "seamless" support that it is available to all students.

Findings from this study suggest that teachers are presenting information in a variety of ways, providing students with multiple ways to demonstrate their knowledge, and providing

motivating engaging lessons for their students. While educators in this study demonstrated instructional practices that were in alignment with the principles of universal design, it is interesting to note that the majority of the teachers we interviewed became familiar with the term universal design for learning through their participation in this study. The teachers who had some knowledge about UDL had learned about it during their graduate studies. Many of the teachers we spoke to were very humble about their classroom practices and would be unlikely to self-identify as a teacher who exemplifies best practices. However, the findings suggest that these teachers were implementing tenets of UDL, and were likely doing so without realizing that their instructional practices align with the principles of UDL. The results from teacher interviews, class observations, and focus groups with students reveal that the teachers were using technology as a tool to support the range of diverse learning needs found in inclusive classrooms. Teachers in this study used assistive technology to provide flexibility and multiple paths for students to access learning. Many of the teachers indicated that they use technology to provide students with choice in how they complete class activities, which is indicative of UDL's flexibility. Teachers interviewed were more familiar with concepts such as differentiated instruction. This is likely a result of the Inclusive Education Initiative, which began implementation in 2009 and has since provided teachers with training in inclusive practices, such as differentiated instruction (Newfoundland and Labrador Department of Education and Early Childhood Development, 2016).

Professional Development through Continuous Communication and Collaboration

One theme that emerged from the results of this study is how teachers' professional development is supported through dialogic discourse with colleagues. Teachers are drawing upon the expertise of other teachers at their school to learn how to implement technology in their class.

The results of this study suggest that teachers learning from one another can be a valuable way to support teachers' knowledge and use of technology in their classes. This peer-to-peer professional learning and collaboration appears to be translating into teacher action when it comes to using technology to support assessment and instruction. The majority of the teachers interviewed revealed that they learn about instructional practices surrounding technology integration from their colleagues. Sharing and learning from one another appears to play a significant role in how teachers learn about and use technology in their classes. It is hypothesized that this just-in-time type of training model is more effective than the traditional workshop approach to offering professional development because teachers have continuous support and are able to try out new instructional practices in a real-life job-embedded context (Kooy, 2009). In schools where friendly dialogic discourse among colleagues is common practice, teachers are likely aware that if they need help with using the technology, help is not too far away. This sharing of information and instructional support may take the form of an informal chat during lunch in the staffroom, or visiting another teacher's class at the end of the day, during grade or departmental meetings, or through scheduled small-group technology sessions after school. Some teachers reported how their school provides small technology learning groups for teachers to participate in during lunch or after school. One school held "Tech Thursdays" where teachers could meet to learn new ways to incorporate technology into their lessons. This peer-to-peer professional development appears to be an effective way for teachers to learn about technology and feel more comfortable incorporating technology into their classes.

A number of teachers are partaking in self-initiated professional development activities by keeping up to date with the latest instructional technology trends through various websites, such as Edutopia and Educational Technology, and forms of social media. Some teachers are

early adopters and will try a new app that they read or heard about in their classes. These teachers will often share this experience with their colleagues and provide support if another teacher is interested in trying the same technology in their class. Many teachers are sharing ideas, experiences, and resources with other teachers. In conversations with their colleagues, teachers talk about how they used an app for teaching fractions or how their students created an iBook for a Social Studies unit. This sharing of knowledge may spark another teacher to take on the same type of activity in their class. Teachers talk about new things they are doing with technology, and how it worked for them, with the hope that it will work for other teachers as well. This collaborative dialogue amongst teachers appears to be motivating colleagues to take this information and try it in their own classes. Drawing upon the experiences of another teacher provides a level of support and comfort for those educators, especially for those who are stepping outside their comfort zone to incorporate the technology into their lessons. This type of collegial sharing of technology should create a learning environment within the school where teachers feel supported to learn about technology as a teaching and learning tool. Schools need to be able to create an atmosphere that respects all teachers' levels of knowledge and comfort with technology. Teachers should never feel pressured to use technology nor should they feel badly if they are not a tech savvy teacher.

The sharing of knowledge and ideas provides teachers with professional discourse and is supported by research as an effective method of obtaining professional development. Kooy (2009) describes the transformative power of teachers working in professional learning communities and the benefits of teachers being responsible for their own learning and professional development. Research indicates that communication and collaboration among teachers is an effective means of providing professional development. "A community of learners

provides a prime route to sharing knowledge constructed by teachers and, thus, offers a particularly suitable context for effecting teacher and school change" (Kooy, 2009, p. 9). Allowing teachers to focus on topics of interest and providing opportunities to collaborate with colleagues is an effective strategy to enable teachers to have input into their professional learning. Kooy (2009) asserts that teachers who participate in a dialogic learning community are more likely to take risks and translate their knowledge into practice. This type of professional learning opportunity can help teachers to become more comfortable and take more instructional risks by integrating assistive technology in their classes.

Challenges with Implementing Assistive Technology in Inclusive Classes

This study explored how teachers develop instructional practices that incorporate assistive technology in their classes, and investigated the supports and challenges that influence these instructional practices. The findings from this study demonstrate that teachers want to try new technologies to support student learning but are inhibited by many obstacles. One obstacle is the overabundance of technology that is marketed as learning tools. Traditionally, learning about and deploying assistive technology was the responsibility of the instructional resource teacher or special education teacher, and there were far fewer forms of assistive technology to choose from. At present, classroom teachers, Instructional Resource Teachers, and Learning Resource Teachers have an exhaustive list of programs and devices that could be used as assistive technology. As technology continues to evolve, a number of the traditional features of assistive technology are now embedded into current devices and programs. Tablets (Apple and Android), iPods, Mp3 Players, computers, laptops, notebooks, Chromebooks, and e-readers can be used to provide supports to students. In addition, there are hundreds of educational apps, websites, and programs available. It can be overwhelming for teachers to keep up to date with the latest

technological and educational trends. Teachers in this study indicated it is impossible to find the time to learn about and try out all of the different tools and keep up to date with the ever-changing forms of technology and learning tools.

Teachers indicated that there are many factors surrounding technology implementation that have yet to be adequately addressed. A number of the teachers questioned how technology support is deployed within the district and schools. Teachers also voiced concerns over how the district appears to be playing catch-up in terms of its technology implementation and support policies. Some schools are having difficulties upgrading the infrastructure to provide wireless internet throughout the building, while other schools may have the required set-up to provide access to a wireless network, but are grappling with whether or not to allow student access to the network. Schools and teachers are left to decide whether or not to allow students to BYOD as a learning tool in classes. Teachers would like guidance from educational stakeholders, such as the School Board and Department of Education, in regards to guidelines and policies on how their school should proceed with encouraging students to BYOD and access the internet on their own devices.

Much of the responsibility falls on classroom teachers to implement educational initiatives involving technology. Schools fundraise so they can provide a class set of iPads or other types of devices to students, and teachers took it upon themselves to write proposals for grants or funding for various devices or projects that involve technology. A number of the teachers we interviewed see themselves as forward thinkers and early adopters of technology. These individuals expressed frustration that it takes time for higher-level administration to catch up with their uses of technology. Some of the teachers felt their voice was not being heard and provided instances where they had submitted proposals for technology projects, but their

proposals were not accepted by higher-level administration. One recommendation would be for the School Board to hire staff who would be responsible for listening to the ideas of innovative and forward thinking teachers. This individual could work with innovative teachers in developing professional development materials, which could be used to help teachers at their school and others learn how to use the technologies available to them to support student learning.

Several Learning Resource Teachers expressed they would like to have more time to help teachers use technology in their classes, in a team-teaching type of collaboration. However, Learning Resource Teachers appear to be used for more technical type of support rather than support for technology integration. Learning Resource Teachers are spread thin as they support and maintain a large number of devices and programs. Some of the Learning Resource Teachers in this study also had other forms of teaching responsibilities. Some schools have Apple configurators, and some do not. Some schools have Learning Resource Teachers that are responsible for this task; while other schools rely on tech savvy teachers who have stepped up to the task. Some teachers who teach content heavy courses, such as Math, feel that in comparison to their colleagues who teach elective courses, they do not have freedom to explore or time to take on new instructional approaches that use technology.

Student Perceptions of Using Assistive Technology as an Educational Tool

In total, 41 students from three classes that were observed participated in the focus groups. Students were asked for their opinion in regards to being able to use technology for learning and being able to demonstrate what they know using technology. Focus group data indicated that students viewed technology as having a positive impact on their learning and enjoyed using various assistive technology features to support and demonstrate their learning.

Most students indicated that technology makes learning easier and more enjoyable. A number of students gave examples of how technology makes writing easier for them. One student noted how he has terrible handwriting and he uses word processors or the iPad instead of writing. He feels more comfortable typing than writing. We know that there is no such thing as a typical student and that students respond to technology in different ways. Not every student is comfortable using technology. Some students noted they did not prefer to write with technology. One student indicated that she is often more frustrated when using technology, technology is only good when it works, and that she does not like typing on the iPad. Teachers need to remember that using technology, as a learning or assessment modality, will not motivate all students. Teachers need to consider the goals of the lesson, and whether technology can benefit the task at hand, as technology is not the only tool which should be used, nor will it provide guaranteed success without being embedded within quality instruction.

Implications of the Results and Associated Recommendations

This study provides valuable information on how teachers develop instructional practices that implement technology within a UDL context. Educators, school district officials, and policy makers can use this information to support teacher's professional development.

The results from this study highlight the importance of providing teachers with professional development to purposefully integrate technology as a means to provide multiple ways for students to learn and demonstrate their learning. These findings are significant because using technology as a tool to provide a more flexible curriculum can make learning more accessible for students with and without exceptionalities. Dell, Newton, and Petroff (2008) assert

> A school simply purchasing an expensive site licence for a software program will not lead to student gains. Providing students who have disabilities with the latest, most

> dazzling devices in the world will not make a difference in their lives – unless the initiative integrates the technology into the curriculum and addresses the details of implementation. (p. 13)

Teachers in this study indicated that they have not received professional development from the school district in regards to UDL. At present, teachers in NL are voicing concerns about meeting the demands of inclusive classes, and as a result, the department of education and school district should consider implementing professional development for teachers surrounding UDL in order to assist teachers in making the curriculum more accessible from the outset. The UDL framework provides specific guidelines that can assist teachers in intentionally selecting and implementing instructional strategies that provide students with multiple paths to learning. Assistive technology is one tool that facilitates UDL. Teachers need to learn how to harness the power of ubiquitous technologies to provide a more flexible and inclusive learning environment for all students.

This investigation revealed that teachers are learning about technology implementation through dialogic discourse with other teachers. Interviews with teachers highlighted that there is value in enabling teachers to engage with other teachers in sharing how they are using technology as a tool to help students with diverse learning needs access and learn from course material. School and district administrators should provide teachers with more opportunities for teachers to engage in continuous and collaborative professional development and teachers should be provided with the opportunity to learn from each other within communities of schools. Groups of teachers could work together on self-identified learning goals involving technology implementation. Teachers should have the opportunity to learn from teachers at their own school, and collaboration amongst a communities of schools should be encouraged. School districts need

to provide more opportunities for collaboration among schools where small groups of teachers share best practices, experiences, or even co-plan lessons for a collaborative technology project.

This study highlighted the practices of innovative teachers who are using technology to effectively support student learning. Many of the teachers in this study did not self-identify as being innovative technology users, and they often did not recognize how they were using technology effectively to provide students with various paths to learning. Allowing teachers to work together in learning about implementing technology enables teachers to feel supported and helps them to develop more confidence in their ability to use technology to support student learning. Teachers need to be involved in the shaping of their own professional development so they can insure it aligns with their goals. Professional development should bring teachers and administrators into a co-development process in order to create a disposition of sharing and supporting colleagues for continuous professional learning.

This study reveals that teachers need to be taught about technologies that are available and how those technologies can be used to support students in accessing and learning the curriculum. Knowing about assistive technology does not equate to teachers knowing how to incorporate the device, app, or program into their lessons to support student's learning outcomes. Often assistive technology training focuses on learning to use devices, not on using the devices to learn. "Training does not typically include using assistive technology to access the general-education curriculum, which is a key component to the successful use of assistive technology" (Bausch & Hasselbring, 2005, p. 9). A teacher may be aware of Kidspiration or WordQ, but that does not mean they will try it out for an upcoming Language Arts lesson. Research indicates teacher self-efficacy is a powerful predictor of future behaviour, especially for classroom instructional practices (Smylie, 1988). If teachers are provided with a supportive learning

environment to learn how to use and integrate the technology to support the diverse needs of students, teachers may feel more confident in their ability to use technology to effectively support student learning. Teachers need opportunities to learn from one another, time to practice, and be able to draw upon the knowledge of supportive colleagues as they step outside their comfort zones and take on new challenges.

This study highlights the need for a clear and consistent vision surrounding the use of technology in schools and classrooms. Without direction, encouragement or clearly defined expectations, teachers are left without the added benefit of guidance and support from their school and/or district. There needs to be a unified vision for technology support and implementation. Technology used to support teaching and learning cannot be effectively implemented in schools without an explicit vision, mission, and policy initiatives surrounding technology integration. School districts can look for ways to include student and teacher voice as they are valuable resources in regards to how technology can and should be used to support teaching and learning. Administrators should enable and encourage teachers to position themselves as regulators of their own professional learning surrounding technology. Administrators can look for non-intimidating, welcoming ways that enable teachers and students to have input in regards to how technology is implemented and supported throughout schools. Teacher voices need to inform how technology professional development is structured and delivered.

Administrators can work to develop strategies to enable more effective and widespread use of the school district's communication platform. Administrators can encourage more widespread collaboration, sharing of resources, sharing of best practice and facilitate teacher involvement in virtual professional learning communities within First Class or other

communication platforms. Schools districts could also consider hiring an Assistive Technology specialist to oversee technology implementation and professional development among schools. A vision of technology use that is supportive in its ability to provide teachers with opportunities to explore technology as a tool for learning will help teachers to step outside their instructional comfort zones. It is vital to provide teachers with continuous and consistent support and professional development, through co-planning, team-teaching, and observing classes that use technology to support learning.

The adoption and implementation of assistive technology by teachers is dependent on whether teachers believe it will have positive effects of student learning outcomes. Means (2010) states, "Most educators will expend the effort needed to integrate technology into instruction when, and only when, they are convinced that there will be significant payoffs in terms of student learning outcomes" (p. 258). In order to facilitate and improve how technology is used to support learning, educators need guidance on how to use the technology that supports and improves student learning outcomes (Means, 2010).

Limitations of the Current Study

This study took place in Newfoundland and Labrador, which impacts the transferability of the results. This province has only one school district and it covers a large geographical area. Based on geographical proximity, we focused on schools in the Eastern Region of the school district. Generally, these schools are larger and more populated than schools in rural Newfoundland, which are likely to be less populated and contain more multi-grade/age classes. There are many variations in how technology is distributed in schools, how technology is integrated, and how it is supported. There are wide variations in how individual teachers implement technology in their classes. We focused our investigation on teachers whose

instructional practices aligned with UDL guidelines (2011). These teachers do not represent the total population of teachers within the NLESD.

Numerous principals did not respond to my request to nominate potential participants for this study. Principals may not have wanted to spotlight certain exemplary teachers in their school as this could place them in an uncomfortable position. As I am a teacher within the NLESD, I met some of the participants in this study during my own professional teaching experiences. During the interviews, educators discussed exemplary technology innovators they were familiar with, as well as how technology was being used by Instructional Resource and Learning Resource Teachers, as well as junior high and high school teachers. Using the snowball sampling technique, the scope of the study was expanded to include nominated educators who were interested in participating.

Recommendations for Future Research

Several recommendations for further research can be made based on the findings from this study. The current study provided insight into how teachers use assistive technology to enable all students to be supported the inclusive classroom. During the classroom observations, it was difficult to decipher which students were on Individual Educational Plans as these students were seamlessly supported throughout classroom instruction and assessment practices. It was an honour to be in schools and have the opportunity to speak with teachers and students in their school. Future research should continue to take the same authentic context approach to data collection as there is a dearth of research surrounding how assistive technology is being used to support students in natural inclusive learning environments. This study also took an appreciative inquiry approach to research, which aimed to highlight effective teaching practices. This

approach facilitates a positive rapport with participants, which is neither judgemental or evaluative.

The current study was exploratory in nature. It was broad in scope we explored the instructional practices of teachers from Grade 3 to Grade 12 and included Learning Resource Teachers and Instructional Resource Teachers. This study could be repeated, with a specific emphasis on elementary, junior high or high school classes. In addition, future studies may choose to focus on general education teachers. This study investigated schools in the Avalon region of Newfoundland, which mainly consist of urban-type schools. Additional research should focus on a broader geographical area and select rural schools that would be more likely to have multi-age classes with a diverse range of learning needs and abilities. The current study could be replicated to determine if there are grade level and/or regional differences in how teachers use technology to support all students. In addition, the scope could be narrowed to focus on how universally designed instructional practices that incorporate technology can be used to support students with learning disabilities or other high incidence exceptionalities.

This study focuses on technology use in the inclusive classroom. There is a shift in how assistive technology is being integrated in schools and classrooms as current technologies have numerous accessibility features embedded within them. The research and practices surrounding technology integration within schools is shifting from studies focusing on students with individual computers or laptops, to how the purchase of site licences can be used to support accessible and equitable learning opportunities for all students. While computer labs remain popular, there is a trend toward integrating technology in the regular classroom. Teachers do not have to bring their students to the school’s computer lab to access technology. With the popularity of mobile iPad and laptop carts, teachers have the ability to implement technology

regularly in their classes. Future research should explore how teachers are implementing technology to support engaging and collaborative learning activities within inclusive classrooms. With the capabilities of modern technologies, classes of students are creating their own resources, such as a Tourism iBooks or novel study unit via iMovie. Studies could investigate student motivation and engagement in these types of activities. Future research should investigate how teachers and students use technology to collaborate with classmates on class work or projects. Students can avail of real-time feedback from peers or their teacher and teachers are capitalizing on accessibility and other motivating features of technology that can be used to support student learning. Future studies can look at how teachers use technology to facilitate choice in demonstrating knowledge and skills. Researchers could also investigate how current technologies such as iPads or Google Classroom facilitate collaboration and independence in an inclusive learning environment.

Future research should provide an in-depth investigation of how teachers effectively learn about instructional practices involving technology. A key finding from this study was that teachers were learning about technology implementation through informal conversations with other teachers. Future studies could investigate how teachers learn about new instructional strategies or factors that motivate teachers to try new technology to support their instruction. Research in this area would be valuable as there has been little evidence that teachers transformed their knowledge into classroom practice as a result of large group, one-day workshop type of approach to professional development (Kooy, 2009).

Concluding Comments

This study explored how teachers in Newfoundland and Labrador use assistive technology in inclusive classrooms within the context of universal design for learning. This

research highlights best instructional practices for using technology to support teaching and learning and reveals the types of supports needed for effective integration of technology. Enabling meaningful participation in key educational activities within the general education curriculum is an essential component of creating a successful inclusive learning environment (Dell, Newton, & Petroff, 2008). Teachers of inclusive classes are faced with the enormous task of meeting the diverse needs of all students and enabling all students to achieve learning outcomes. Teachers are harnessing the power of current technologies to help overcome this challenge. By integrating technology into their instructional practices teachers are able to provide students with multiple paths to learning. Assistive technology has the potential to provide students with learning needs to access course material and support meaningful engagement with curriculum expectations. Interactive whiteboards, iPads and other mobile devices are being used to provide flexibility in how information is presented, how learning is demonstrated, and how students are engaged in learning. Teachers are engaged in self-initiated professional learning and are collaborating with colleagues to enhance their knowledge of using technology to help students achieve educational outcomes. We need to build upon this type of professional learning where teachers have more opportunities to learn from and feel supported by other educators at their school. Students have access to technology in their classes and many have the option to avail of assistive technology features that are embedded into current technologies. Many students, but not all, are motivated by using technology and find it beneficial for their learning. However, it must be emphasized that it is not the technology itself that makes learning happen for students; the true power lies within the teacher's effective implementation of technology that helps make learning more accessible for all students.

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Appendix A

Letter of Information for Teachers

Title: *Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms*

Researchers: Primary Investigator
Dr. Gabrielle Young, Assistant Professor, Faculty of Education
Box 169 - G. A. Hickman Building
Memorial University of Newfoundland
St. John's, NL A1B 3X8
gabrielle.young@mun.ca
(709) 864-4413

Graduate Student Investigator
Ms. Christine Careen, Master's Candidate, Faculty of Education

Invitation to Participate

You are invited to take part in a research project entitled *"Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms."*

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact Dr. Gabrielle Young, if you have any questions about the study or would like more information before you consent.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in the research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction

Dr. Gabrielle Young is an Assistant Professor with the Faculty of Education at Memorial University of Newfoundland. She obtained her Bachelor of Arts and Bachelor of Education from Brock University, with an emphasis on Child and Youth Studies and Primary/Elementary Education. Her Masters and Doctorate were from Western University, in the area of Educational Psychology and Special Education. Gabrielle's Master's and Doctoral research surrounded the use of assistive technology by students with learning disabilities, and with a continued interest in technology and universal design form learning, she will be the Primary Investigator of this project.

Christine Careen is a Master's student with the Faculty of Education at Memorial University of Newfoundland. Christine obtained her Bachelor or Education (Primary/Elementary) and Bachelor of Special Education from Memorial University. She is also an Instructional Resource Teacher at Holy Family Elementary in Paradise, Newfoundland. Christine is currently completing her Masters of Education, with a focus on Special Education; her Master's thesis is based on the proposed study and will be supervised by Dr. Gabrielle Young.

Along with researchers from Ontario and Alberta, Gabrielle and Christine are working together to explore how teachers implement assistive technology in general education classrooms within a universally designed context, and students' response to using these methods and tools.

Purpose of Study

This study is designed to understand how teachers develop instructional practices that incorporate assistive technology within the context of universal design for learning, what supports and challenges influence these practices, as well as students' perceptions of utilizing technology within the framework of universal design for learning. The findings from this exploratory study will be used to equip teachers and teacher educators to better meet the learning needs of all students.

What You Will Do in This Study

Interviews

Teachers who are recognized for their innovative use of technology will be asked to participate in a semi-structured, open-ended interview. This interview will last approximately one hour and will be conducted at your school and at a time that is convenient for you. This interview will be relaxed and informal. We will audio record our conversation so that we can accurately capture all responses. These recordings will then be transcribed. All of the information from your interview will be kept confidential and all identifying information will be removed from the transcribed interviews.

Interviews with teachers will focus on:

- Your understanding of universal design for learning.
- How you became familiar with universal design for learning and its impact on your teaching and student learning.
- The way information is presented to the class.
- Learning activities and assignments that students undertake.
- The range of student learning needs in the class.
- Assistive technology recommended for use on students' individual education plans.
- Assistive technology that is available in the school.
- Where technology is located in the school.
- How technology is used at the individual and classroom level.
- Teachers' perceptions of students' adoption and use of technology to support their learning.

Classroom Observations

We will visit your class to observe how assistive technology is used within an inclusive classroom. These observations are not meant to be evaluative and will in no way be used to judge your teaching capabilities. Instead, we are interested in learning about the methods, strategies and tools you use to support instruction and engage students in using technology. Participating in this study will not require any extra work from you. The observations will take place over a two-week span for one class period a day. We will correspond with you and your principal in order to decide upon a convenient observation schedule.

We will take notes during classroom observations. In addition to field notes, with your signed consent, we would like to video record you teaching with technology during one unit of instruction. Students who have provided personal and parental consent will be video recorded engaging with technology (e.g., using concept mapping programs, word-prediction programs, or talking word processors when writing). We will also photograph samples of consenting students' work (e.g., writing, drawings, and computer-generated work).
We understand that being video recorded may cause some trepidation amongst teachers and students. We will strive to complete video recordings in an unobtrusive manner using an iPad or secured iPhone. With teacher consent, video recordings will be used at professional development seminars and research conferences in order to demonstrate best practices surrounding the use of assistive technology in inclusive learning environments. In presenting the data, identifying information will be removed and pseudonyms will be used for the teacher, school, and students.

Informal Conversations

During visits to your school for observations, we will engage in informal classroom conversations. Brief informal conversations will be used to provide clarification on classroom observations, these conversations will occur after class on days we conduct classroom observations. These informal chats will be used to help us better understand our classroom observations as well as prior experiences that assisted you in implementing universal design for learning and the level of planning required to do so.

Member Checks

You will be provided with a copy of your interview transcript, as well as a summary of the research findings. You will have the opportunity to provide clarification, further elaborate on your interview responses, and comment on the findings, before they are prepared for publication.

Length of Time

We are interested in understanding current classroom practices. As such, participating in this study will not add to your workload. It is estimated that the interview will take one hour. Classroom observations will occur during once class period each day (approximately one hour), over a two-week span, for a maximum of 10 hours of observation time. The informal conversations will occur during or briefly before or after observation times. Focus groups will be conducted with students over the lunch hour and students will be provided with the opportunity to comment on the focus group transcript during a second lunch hour; however, you are not required to be in attendance.

Possible Benefits

For teachers, the benefits of participating in this study include enhanced knowledge about yourself as an educator and being able to highlight your work as a means to contribute to future professional development opportunities based on the findings from this study. Participating in this study will enable you to enhance the knowledge of other educators in regards to effective educational practices to support diverse learners. Societal benefits from participating in this study include enhanced professional practices for teachers, training and skill development for teachers, and contributing to the development of new research partnerships education. Your participation will benefit the broader educational community, as findings from this study may be used to help inform policy makers in their consideration and development of policies that support the use of assistive technology in student learning. The research findings may also be used to inform teacher educators as they prepare pre-service teachers to meet the needs of all students.

Possible Risks

There are no known risks to participating in this study.

Withdrawal From the Study

You can withdraw from participation in this study at any point during data collection, without giving any reason. There are no consequences for withdrawal from the study. If you decide to withdraw, you will be given the opportunity to remove previously collected data from the study. Data will be anonymized, but it cannot be withdrawn once the study has been completed and the data has been aggregated and prepared for publication.

Confidentiality and Anonymity

In order to ensure confidentiality, the identities of participants will only be accessible to the authorized researchers. Data from this research project will be published and presented at conferences; however, your identity will be kept confidential. The interview and focus group data will be reported in aggregate form, so that it will not be possible to identify individuals. Moreover, the consent forms will be stored separately from the interview transcripts, so that it will not be possible to associate a name with any given set of responses.

Anonymity refers to not disclosing participant's identifying characteristics, such as name or description of physical appearance. Every reasonable effort will be made to ensure anonymity. Although we will report direct quotations from the interview, you will be given a pseudonym, and all identifying information pertaining to the student, teacher, school, school district and region will be removed. Identifying information will be removed from photographs of consenting student's work. Teachers and students may consent to be videotaped teaching and engaging with technology; while pseudonyms will be used, video data will be shared with educators to support professional development. Participants will not be identified by name in any reports and publication, and they will not be videotaped without their explicit permission.

Although the researchers will safeguard the confidentiality of classroom discussions to the best of their ability, the nature of focus groups prevents the researcher from guaranteeing that other members of the group will do so. Students will be encouraged to respect the confidentiality of other students by not repeating what is said in the focus group to others, and will be reminded to be aware that other members of the group may not respect their confidentiality.

After participating in an interview, and before data is included in the final report, you will be able to review the transcript of your interview and to add, change, or delete information from the transcripts.

Recording of Data
In regards to recording data: interviews will be voice recorded and transcribed and the researcher will take notes during the conversation; classroom observations will be video recorded and the researcher will take notes during classroom instruction; informal conversations will be recorded in the researcher's notes; and student work samples will be captured through photographs.

Reporting of Results
Data from this study will be shared with all members of the research team. Data from this study will be used in conference presentations, submitted in journal publications, and presented to university faculty and classroom teachers. In addition, Christine will analyze part of the data for her Master's thesis, and upon examination, her thesis will be publically available at the QEII library. The data from consenting individuals will be reported in summarized form and through the use of direct quotations and video segments.

Storage of Data
All data, including audio recordings and transcription records, will be kept in a locked filing cabinet and on password protected devices; consent forms will be stored separately from the data. Data will be kept for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research. Only the researchers involved in the project will have access to the data. When the data is no longer required, all data will be appropriately destroyed (i.e., papers will be shredded and audio and video recordings will be erased).

Sharing of Results with Participants
We would be happy to provide you with the results of this study. Please provide your e-mail address if you would like a summary of the research findings e-mailed to you.

Questions
You are welcome to ask questionsassistive technologyany time before, during, or after your participation in this research. If you would like more information about this study, please contact Gabrielle Young through e-mail (gabrielle.young@mun.ca) or phone (709-864-4413).

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

This letter is yours to keep for future reference.

Appendix B

Teacher Consent Form

Project Title: *Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms*

Consent:

Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw participation in the study without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that withdrawal from participation in the study will not affect your current employment.
- You understand that if you choose to end participation *during* data collection, any data collected from you up to that point will be retained by the researcher, unless you indicate otherwise.
- You understand that if you choose to withdraw *after* data collection has ended, your data can be removed from the study up to *December 15th, 2015*.
- Data will be anonymized, but it cannot be withdrawn once the study has been completed and the data has been aggregated and prepared for publication.

Consent for recording of data:

I agree to be audio-recorded during the interview for later transcription.	☐ Yes	☐ No
I agree to be video-recorded teaching with technology and discussing this process.	☐ Yes	☐ No
I agree to allow my video data to be used in professional development resulting from this study.	☐ Yes	☐ No
I agree to be photographed teaching with technology.	☐ Yes	☐ No
I agree to permit student work samples to be photographed.	☐ Yes	☐ No
I agree to the use of direct quotations	☐ Yes	☐ No
I am aware that that the data collected for this study will also be used for the purpose of Christine's master's thesis	☐ Yes	☐ No

If you sign this form, you do not give up your legal rights, and do not release the researchers from their professional responsibilities.

We would be happy to provide you with results from this study. Please provide your e-mail address below if you would like a summary of the research findings e-mailed to you.

☐ Yes _____

Please e-mail the results from this study to the above listed e-mail address.

Questions:
You are welcome to ask questions at any time before, during, or after your participation in this research. If you would like more information about this study, please contact Gabrielle Young (709-864-4413; gabrielle.young@mun.ca).

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHRicehr@mun.ca or by telephone at (709) 864-2861.

The researcher will give you a copy of this form for your records.

Your signature confirms:

- ☐ I have read what this study is about and understand the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.
- ☐ I agree to participate in the research project, I understand the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.
- ☐ A copy of this Informed Consent Form has been given to me for my records.

Signature of teacher **Date**

Researcher's Signature:
I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

Signature of primary investigator **Date**
Gabrielle Young
Assistant Professor
Faculty of Education
Memorial University of Newfoundland
gabrielle.young@mun.ca
(709) 864-4413

Signature of graduate student investigator **Date**
Christine Careen
Master's of Education Candidate

Appendix C

Letter of Information for Parents

Title: *Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms*

Researchers: Primary Investigator
Dr. Gabrielle Young, Assistant Professor, Faculty of Education
Box 169 - G. A. Hickman Building
Memorial University of Newfoundland
St. John's, NL A1B 3X8
gabrielle.young@mun.ca
(709) 864-4413

Graduate Student Investigator
Ms. Christine Careen, Master's Candidate, Faculty of Education

Introduction

Gabrielle Young is an Assistant Professor with the Faculty of Education at Memorial University of Newfoundland. She obtained her Bachelor of Arts and Bachelor of Education from Brock University, with an emphasis on Child and Youth Studies and she has training as an elementary educator. Her Masters and Doctorate were from Western University, in the area of psychology and special education. Gabrielle's Master's and Doctoral research surrounded the use of technology by students with learning disabilities, and she continues to be interested in how technology can be used to support all students. She will be the main researcher for this project.

Christine Careen is a graduate student with the Faculty of Education at Memorial University of Newfoundland. Christine obtained her Bachelor of Education (Primary/Elementary) and Bachelor of Special Education from Memorial University. Christine is an Instructional Resource Teacher at Holy Family Elementary in Paradise, Newfoundland. She is currently completing her Masters of Education, with a focus on special education. Her Master's thesis is based on this study and will be supervised by Dr. Gabrielle Young.

Along with researchers from Ontario and Alberta, Gabrielle and Christine are working together to explore how teachers implement technology in general education classrooms, and students' response to using these methods and tools.

Invitation for Your Child to Participate

You child is invited to take part in a research project entitled *"Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms."*

Your child's teacher has been recognized for their innovative use of technology and has been selected by the researchers as an ideal candidate to participate in this study. Your child's class was selected because of the teacher's expertise in integrating technology within the framework of universal design for learning.

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your child's participation will involve. It also describes your child's right to withdraw from the study. In order to decide whether you would consent for your child to participate in this research study, you should understand the potential risks and benefits for your child and be able to make an informed decision. Please take the time to read this carefully and to understand any other information given to you by the researchers. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please contact Dr. Gabrielle Young, if you have any questions about the study or would like more information before you consent.

It is entirely up to you to decide whether to allow your child to take part in this research. If you choose not to permit your child to take part in the research or if you decide to withdraw him or her from the research once it has started, there will be no negative consequences for you or your child, now or in the future.

Purpose of Study

This study is designed to better understand how teachers develop instructional practices that incorporate technology within the context of universal design for learning, what supports and challenges influence these practices, as well as students' perceptions of utilizing technology within the framework of universal design for learning. Universal design for learning is based on a set of principles that allows for flexibility and enables multiple learning paths for all students. Universally designed instruction utilizes proactive, intentional lesson planning to address the needs of the broad range of learners found in the classroom. The findings from this study will be used to equip teachers and teacher educators to better meet the learning needs of all students.

What Your Child Will Do in This Study

Classroom Observations

We will visit your child's class to observe how technology is used in an inclusive classroom. These observations are not meant to evaluate your child. Instead, we are interested in seeing the methods, strategies and tools the teacher uses to engage students with technology. This will not require any extra work from your child. Your child will not miss any classes, as these observations will occur during the regular school schedule. The observations will take place one class per day over a two-week period (for 10 hours of observational time). We will correspond with you to let you know the specific start and end dates of the observations.

The researcher will be taking notes during the observation session. In addition to field notes, with your signed consent, we would like to *video record* your child engaging with technology (e.g., using concept mapping programs, word-prediction programs, or talking word processors when writing). With your consent, we would also like to *photograph* samples of your child's work (e.g., writing, drawings, and computer-generated work).

We understand that being video recorded may be uncomfortable for some teachers and students. We will strive to do this in a very unobtrusive manner using an iPad or iPhone that is secured. We would like to use clips of the recordings to show at professional development seminars or conferences to demonstrate best teaching and learning practices using technology. Your child's information and school name will not be published or presented in any way.

Informal Conversations

During visits to your child's school for observations, we will engage students in informal classroom conversations. These conversations will only take a few minutes and will occur during the days we are visiting to observe their class. These informal chats will be used to help us better understand our classroom observations. We are interested in finding out about your child's perspective on using technology and universal design for learning.

Focus Groups with Students

All consenting students will be invited to participate in a focus group, which will be conducted in groups of six to eight students. Focus group sessions will last approximately 30 minutes and will occur during the lunch hour. The students' responses will be audio recorded so that they can be transcribed. The focus group questions will be developed based on the casual conversations with students and will surround students':

- Views on receiving instruction in a variety of formats.
- Views on demonstrating their knowledge in a variety of ways.
- Views on using technology to assist with learning activities.

Member Checks

Students who participated in the focus group will be invited to meet with the researchers to check the accuracy of the information presented in the focus group. The researchers will summarize the information, read it aloud, and allow the student to read it independently if they chose to do so. Students will be encouraged to comment on the findings; this review of the data should take approximately 15 minutes.

Length of Time

Your child's participation in this study will not add to his or her workload. Participation in the classroom observations will not require anything extra from your child, as the observations will occur during regular class time. Participating in the focus group will take 30 minutes. This will occur during the lunch hour; however, your child will be provided with enough time to eat his or her lunch. Member checks will take 15 minutes and will occur during a separate lunch hour following the focus group. If your child consents to participate in the focus group, they will meet with the researchers during two separate lunch hours and each meeting will not exceed 30 minutes.

Possible Benefits

For students, the possible benefits to participation include enhanced knowledge about themselves as learners and being able to share their unique perspective about using technology in an inclusive class that is designed prevent barriers to learning. Your child's participation in this study will enhance the knowledge of educators and the academic community in regards to effective practices to support diverse learners. These findings will also inform teacher educators as they prepare future teachers to meet the learning needs of all students. Participation will also benefit the broader educational community, as the findings from this study may help inform policy makers in their consideration and development of policies that support the use of technology in student learning.

Possible Risks
There are no known risks or harms associated with participation in this study.

Withdrawal from the Study
You can withdraw your child from participation in this study at any point without giving any reason. There are no consequences for withdrawing your child from the study. If you decide to withdraw your child, you will be given the opportunity to remove previously collected data from the study. Data will be anonymized but it cannot be withdrawn once the study has been completed and the data has been aggregated and prepared for publication.

Confidentiality and Anonymity
In order to ensure confidentiality, the identities of participants will only be accessible to the authorized researchers. Data from this research project will be published and presented at conferences; however, your child's identify will be kept confidential. The focus group data will be reported in aggregate form, so that it will not be possible to identify individual students with any given set of responses.

Anonymity refers to not disclosing participant's identifying characteristics, such as name or description of physical appearance. Every reasonable effort will be made to ensure anonymity. All identifying information pertaining to the student, teacher, school, school district and region will be removed. Identifying information will be removed from photographs of consenting student's work. Teachers and students may consent to be videotaped teaching and engaging with technology; while pseudonyms will be used, video data will be shared with educators to support professional development. Participants will not be identified by name in any reports and publication, and they will not be videotaped without their explicit permission.

Although the researchers will safeguard the confidentiality of classroom discussions to the best of their ability, the nature of focus groups prevents the researcher from guaranteeing that other members of the group will do so. Students will be encouraged to respect the confidentiality of other students by not repeating what is said in the focus group to others, and be reminded to be aware that other members of the group may not respect their confidentiality.

After participating in the focus group, and before data is included in the final report, students will be able to review the focus group transcript, and add or clarify any of the information in the transcript.

Recording of Data
In regards to recording data: classroom observations will be video recorded and the researcher will take notes during classroom instruction; informal conversations will be recorded in the researcher's notes; student work samples will be captured through photographs; and focus groups will be voice recorded and transcribed and the researcher will take notes during the conversation.

Reporting of Results
Data from this study will be shared with all members of the research team. Data from this study will be used in conference presentations, submitted in journal publications, and presented to university faculty and classroom teachers. In addition, Christine will analyze part of the data for her Master's thesis, and upon examination, her thesis will be publically available at the QEII library. The data from consenting individuals will be reported in summarized form and through the use of direct quotations and video segments.

Storage of Data
All data, including audio recordings and transcription records, will be kept in a locked filing cabinet and on a password protected devices; consent forms will be stored separately from the data. Data will be kept for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research. Only researchers involved in the project will have access to the data. When the data is no longer required, all data will be appropriately destroyed (i.e., papers will be shredded and audio recordings will be erased).

Sharing of Results with Participants
We would be happy to provide you with results from this study. Please provide your e-mail address below if you would like a summary of the research findings e-mailed to you.

Questions
You are welcome to ask questions at any time before, during, or after your participation in this research. If you would like more information about this study, please contact Gabrielle Young through e-mail (gabrielle.young@mun.ca) or phone (709-864-4413).

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

This letter is yours to keep for future reference.

Appendix D

Parent Consent Form

Project Title: *Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms*

Consent:
Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what your child will be doing.
- You understand that you are free to withdraw your child's participation in the study without having to give a reason, and that doing so will not affect you or your child now or in the future.
- You understand that withdrawal of your child's participation in the study will not affect your child's academic achievement now or in the future.
- You understand that if you choose to end participation *during* data collection, any data collected from you up to that point will be retained by the researcher, unless you indicate otherwise.
- You understand that if you choose to withdraw *after* data collection has ended, your data can be removed from the study up to *December 15th, 2015*.
- Data will be anonymized, but it cannot be withdrawn once the study has been completed and the data has been aggregated and prepared for publication.

Consent for recording of data:

I agree to have my child audio-recorded	☐ Yes	☐ No
I agree to have my child video-recorded during classroom observation sessions	☐ Yes	☐ No
I agree to allow my child's video-recorded data to be used in professional development resulting from this study	☐ Yes	☐ No
I agree to have my child photographed while using technology in the classroom	☐ Yes	☐ No
I agree to permit my child's work samples to be photographed	☐ Yes	☐ No
I agree to have my child's direct quotes used	☐ Yes	☐ No
I am aware that that the data collected for this study will also be used for the purpose of Christine's master's thesis	☐ Yes	☐ No

If you sign this form, you do not give up your legal rights, and do not release the researchers from their professional responsibilities.

We would be happy to provide you with results from this study. Please provide your e-mail address below if you would like a summary of the research findings e-mailed to you.

☐ Yes _____
Please e-mail the results from this study to the above listed e-mail address.

Questions:
You are welcome to ask questions at any time before, during, or after your participation in this research. If you would like more information about this study, please contact Gabrielle Young (709-864-4413; gabrielle.young@mun.ca).

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 864-2861.

The researcher will give you a copy of this form for your records.

Your signature confirms:

- ☐ I have read what this study is about and understand the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.
- ☐ I agree to participate in the research project, I understand the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.
- ☐ A copy of this Informed Consent Form has been given to me for my records.

Signature of parent **Date**

Researcher's Signature:
I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

Signature of primary investigator **Date**
Gabrielle Young
Assistant Professor
Faculty of Education
Memorial University of Newfoundland
gabrielle.young@mun.ca
(709) 864-4413

Signature of graduate student investigator **Date**
Christine Careen
Master's of Education Candidate

Appendix E

Letter of Information for Students

Title: *Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms*

Researchers: Primary Investigator
Dr. Gabrielle Young, Assistant Professor, Faculty of Education
Box 169 - G. A. Hickman Building
Memorial University of Newfoundland
St. John's, NL A1B 3X8
gabrielle.young@mun.ca
(709) 864-4413

Graduate Student Investigator
Ms. Christine Careen, Master's Candidate, Faculty of Education

Introduction

Gabrielle Young works at the Faculty of Education at Memorial University of Newfoundland, where she teaches teachers who are looking to improve their knowledge and skills in the area of special education. Gabrielle has training as an elementary teacher. She continued her studies and pursued her Master's and Doctoral research on the use of technology by students with learning disabilities. Gabrielle continues to be interested in how technology can support all students. She will be the main researcher for this project.

Christine Careen is an Instructional Resource Teacher at Holy Family Elementary in Paradise, Newfoundland. She is currently completing her Masters with the Faculty of Education at Memorial University of Newfoundland and her graduate research is based on this study.

Along with researchers from Ontario and Alberta, Gabrielle and Christine are working together to understand how teachers implement technology in the classroom, and what students' think about using these methods and tools.

Invitation to Participate

You are invited to take part in a research project called, *"Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms."*

The purpose of this letter is to provide you with information to decide whether or not you would like to participate in this study. It is your choice if you want to participate in this research. If you decide not to participate, or decide to participate and then change your mind, there will be no negative consequences for you now or in the future.

In order to decide whether you want to participate in this research study, you should understand what the study is about. Please take the time to read this carefully and to listen to information given to you by the researchers. If you do not understand something, or have any questions, you should ask before you decide whether you want to participate.

Purpose of Study

This study is designed to understand how teachers use technology in a way that allows all students in their classroom to learn. We want to find out what types of supports and challenges your teacher may experience as he or she uses technology as a tool to support the learning of all students. We also want to find out what you think about learning in a class that uses these tools and methods to support teaching and learning.

What You Will Do in This Study

- We will *observe* your class as your do your work as usual.
- We may *chat* about your activity or your thoughts on activities that involves technology while we are observing your class.
- You will be invited to participate in a *focus group*.
- You may *check* to make sure you agree with the information that was given by students in the focus group.

Classroom Observations

The researchers will visit your class to see how technology is used in teaching and learning. These observations are not meant to judge your work. You simply carry on as usual. Your participation will not require any extra work and you will not miss any classes. The observations will take place during two weeks, for one class period a day (for 10 hours of observation time). Your teacher will inform you of the days and times we will be visiting your class.

The researchers will be taking notes during the observation sessions. We will record your teacher teaching with technology, and with your permission, we would also video record you using technology (such as using graphic organizers, word-prediction programs, or talking word processors when writing). With your permission, we would like to take pictures of your work (such as writing, drawings, and computer-generated work).

We understand that being video recorded may cause you to feel nervous. We will try our best not to disrupt you as you work. We will use an iPad or iPhone to record your class in action. We would like to use clips from these videos to help other teachers and researchers learn new teaching and learning practices using technology. Your name and school name will not be published or shared in any way.

Informal Conversations

During visits to your school for observations, we would like to be able to speak with you. These conversations will take only a few minutes and will occur during the days we are observing your class. These informal chats will be used to help us better understand your perspective on how technology is used in your class.

Focus Groups

You are invited to participate in a focus group, which will have six to eight other students. Focus groups will last 30 minutes and will be held during your lunch hour. Your responses will be audio recorded so that they can be turned into written text. The focus group questions will be based on the casual conversations with you and your classmates.

At the focus group you will be asked about your:

- Views on receiving instruction in a variety of formats.
- Views on demonstrating your knowledge in a variety of ways.
- Views on your experience using technology to learn and complete school work.

Member Checks

You will have the chance to review and comment on what was said in the focus group. The researchers will summarize the information. You will have a chance to have the researcher or yourself read what was said in focus group and you will have the opportunity to share additional thoughts. This will take 15 minutes and happen during your lunch hour.

Length of Time

Your participation in this study will not add to your workload. Participation in the classroom observations will not require anything extra from you, as these observations will occur during regular class time. Participating in the focus group will take 30 minutes. This will occur during the lunch hour, and you will be provided with enough time to eat your lunch. Member checks will take 15 minutes, and will occur during a lunch hour after the focus group. If you participate in the focus group, you will meet during two separate lunch hours, for no more than 30 minutes at a time.

Possible Benefits

By participating in this study you may increase your knowledge about yourself as a learner. You will also be able to share your opinion, and help others learn how technology can be used to help students learn and complete school tasks. By participating in this research project, you will become more knowledgeable about the research process and you will help educators learn about technology.

Possible Risks

There are no known risks or harms connected to participating in this study.

Withdrawal From the Study

You can withdraw your participation from this study at any point without giving any reason. There are no consequences for withdrawing from the study. If you decide to withdraw, you will be given the opportunity to remove previously collected data from the study. Data will not include your name, but it cannot be withdrawn once the study has been completed and the data has been gathered and prepared for publication.

Confidentiality and Anonymity

Confidentiality means that only the researchers will know your identity. Data from this research project will be published and presented at conferences; however, your identity will be kept confidential. In publishing the focus group data, it will not be possible to identify what individual students said.

Anonymity means that your identifying characteristics, such as name or description of physical appearance, are not shared. Every reasonable effort will be made to ensure anonymity. The names of students, and the teacher, school, school district and region will not be shared. If you agree to have photos taken of your schoolwork, your name will be removed from the photographs. Teachers and students may agree to be videotaped teaching and learning with technology; while your real name will not be used, video data will be shared with educators to help them learn about using technology. Your name will not be included in any reports or publications, and you will not be videotaped without your permission.

The researchers will ensure the classroom conversations remain confidential. However, the researchers cannot ensure that individuals who attend the focus groups will do the same. Please respect the confidentiality of other students by not repeating what is said in the focus group to others, and be aware that other members of the group may not respect your confidentiality.

Recording of Data

In regards to recording data: classroom observations will be recorded through note-taking and video recording; informal conversations with students will be recorded through note-taking; student work samples will be captured through photographs; and focus groups will be recorded through note-taking and audio recordings.

Reporting of Results

The findings from this study will be shared with all members of the research team. The data and results from this study will be used in conference presentations, submitted for journal publications, and presented to university instructors and classroom teachers. Christine will also use the data from this research for her Master's thesis. If you consent to participate, the information you share will be summarized alongside information shared from other students, and we will also use your direct quotations and videos of you using technology during class time.

Storage of Data

All data, including audio recordings, written records, videos and photographs, will be kept in a locked filing cabinet and on password protected devices; consent forms will be stored separately from the data. Data will be kept for a minimum of five years, as required by Memorial University policy on Integrity in Scholarly Research. Only the researchers involved in this project will have access to the data. When the data is no longer needed, all data will be destroyed; this means that papers will be shredded and audio recordings will be erased.

Sharing of Results with Participants

We would be happy to provide you with results from this study. Please provide your e-mail address if you would like a summary of the research findings e-mailed to you.

Questions

You are welcome to ask questions at any time before, during, or after your participation in this research. If you would like more information about this study, please contact Gabrielle Young through e-mail (gabrielle.young@mun.ca) or phone (709-864-4413).

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

This letter is yours to keep for future reference.

Appendix F

Student Consent Form

Title: *Using Assistive Technology in the Context of Universal Design for Learning in Inclusive Classrooms*

Consent:

Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are happy with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw your participation in the study without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that withdrawal from participation in the study will not affect your academic achievement now or in the future.
- You understand that if you choose to end participation *during* data collection, any data collected from you up to that point will be kept by the researcher, unless you indicate otherwise.
- You understand that if you choose to withdraw *after* data collection has ended, your data can be removed from the study up to *December 15th, 2015*.
- While your name will not be shared, your data cannot be withdrawn once the study has been completed and the data has been summarized and prepared for publication.

Consent for recording of data:

I agree to be audio-recorded during the focus group.	☐ Yes	☐ No
I agree to be video-recorded during classroom observation sessions and discussing my use of technology.	☐ Yes	☐ No
I agree to allow my video-recorded data to be used to help educators learn how to use technology.	☐ Yes	☐ No
I agree to have my photograph taken while using technology in the classroom	☐ Yes	☐ No
I agree to have my work samples be photographed	☐ Yes	☐ No
I agree to have my direct quotes used	☐ Yes	☐ No
I am aware that that the data collected for this study will also be used for the purpose of Christine's master's thesis	☐ Yes	☐ No

If you sign this form, you do not give up your legal rights, and do not release the researchers from their professional responsibilities.

We would be happy to provide you with results from this study. Please provide your e-mail address below if you would like a summary of the research findings e-mailed to you.

☐ Yes _____

Please e-mail the results from this study to the above listed e-mail address.

Questions:
You are welcome to ask questions at any time before, during, or after your participation in this research. If you would like more information about this study, please contact Gabrielle Young (709-864-4413; gabrielle.young@mun.ca).

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 864-2861.

Your signature confirms:

- ☐ I have read what this study is about and understand the risks and benefits. I have had time to think about this and had the opportunity to ask questions and my questions have been answered.
- ☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.
- ☐ A copy of this Informed Consent Form has been given to me for my records.

Signature of student **Date**

Researcher's Signature:
I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

Signature of primary investigator **Date**
Gabrielle Young
Assistant Professor
Faculty of Education
Memorial University of Newfoundland
gabrielle.young@mun.ca
(709) 864-4413

Signature of graduate student investigator **Date**
Christine Careen
Master's of Education Candidate

Appendix G

Interview Questions for Teachers

1. What is your understanding of universal design for learning?
2. How did you become familiar with universal design for learning?
3. How has UDL impacted your teaching and student learning?
4. How is information presented to your students?
5. What kinds of learning activities and assignments do students undertake?
6. What is the range of student learning needs in your class?
7. What types of assistive technology are recommended for use on students' individual education plans?
8. What assistive technologies are available in the school?
9. Where is technology located in the school?
10. What types of supports are available for using technology at your school?
11. How is technology used at the individual and classroom level?
12. What is your perception of students' adoption and use of technology to support their learning?

Appendix H

Focus Groups with Students

Rules of Engagement

Rule 1 - You may speak when you have the talking stick.

Rule 2 - You may "pass" when it's your turn.

Rule 3 - "Soft eyes turned to wonder".

Focus Group Questions

Check In:

What do you think about technology?

Question 1:

What are your thoughts on learning in a variety of ways (i.e., the teacher speaking, using the SMART Board, using the iPads etc.)?

Question 2:

What are your thoughts on being able to demonstrate what you know in a variety of ways (i.e., speaking, writing, using technology)?

Question 3:

What are your thoughts on being able to use technology to assist with learning and demonstrating what you know?

Check Out:

Did you enjoy being able to share your thoughts on teaching and learning with technology?

Appendix I

ICEHR Ethics Approval

MEMORIAL UNIVERSITY

Interdisciplinary Committee on Ethics in Human Research (ICEHR)

St. John's, NL Canada A1C 5S7
Tel: 709 864-2561 icehr@mun.ca
www.mun.ca/research/ethics/humans/icehr

ICEHR Number:	**20161185-ED**
Approval Period:	November 3, 2015 – November 30, 2016
Funding Source:	New Faculty Start Up; Seed, Bridge and Multidisciplinary Fund
Responsible Faculty:	Dr. Gabrielle Young Faculty of Education
Title of Project:	*An Exploration of Teachers' Use of Assistive Technology in General Education Classrooms within the Context for Universal Design for Learning and Students' Response to these Tools and Methods*

Title of Parent Project:	*Using Assistive Technology in Inclusive Classrooms within the Framework of Universal Design for Learning*
ICEHR Number:	*20151117-ED*

November 3, 2015

Ms. Christine Careen
Faculty of Education
Memorial University of Newfoundland

Dear Ms. Careen:

Thank you for your submission to the Interdisciplinary Committee on Ethics in Human Research (ICEHR) seeking ethical clearance for the above-named research project. The Committee has reviewed the proposal and agrees that the proposed project is consistent with the guidelines of the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans* (TCPS2). *Full ethics clearance* is granted for one year from the date of this letter.

If you need to make changes during the course of the project, which may raise ethical concerns, please forward an amendment request form with a description of these changes to icehr@mun.ca for the Committee's consideration.

The *TCPS2* requires that you submit an annual update form to ICEHR before October 31, 2016. If you plan to continue the project, you need to request renewal of your ethics clearance, and include a brief summary on the progress of your research. When the project no longer requires contact with human participants, is completed and/or terminated, you need to provide the annual update form with a final brief summary, and your file will be closed.

The annual update form and amendment request form are on the ICEHR website at http://www.mun.ca/research/ethics/humans/icehr/applications/.

We wish you success with your research.

Yours sincerely,

Russell J. Adams, Ph.D.
Chair, Interdisciplinary Committee on Ethics in Human Research
Professor of Psychology and Pediatrics
Faculties of Science and Medicine

RA/lw

cc: Supervisor – Dr. Gabrielle Young, Faculty of Education
Director, Research Grant and Contract Services
Associate Dean, Graduate Programs, Faculty of Education

Appendix J

NLESD Ethics Approval

Newfoundland & Labrador English School District

OFFICE OF THE ASSOCIATE DIRECTOR OF EDUCATION

Jeff Thompson
709-757-4663

Chairperson: Milton Peach
CEO/Director of Education: Darrin Pike

Conditions of Approval for Research Project: Using Assitive Technology in inclusive Classrooms with the Framework...Dr. G. Young

Your request to conduct research in our district is approved subject to the conditions / requirements checked below:

1. A list of selected schools must be forwarded to my office before the research can begin. ☑
   1a. The list of targeted schools has been received. ☐
2. Final approval to conduct this study will rest with the principal of each targeted school and the targeted group of teachers/students where applicable. ☑
3. Conducting the research will in no way negatively impact instructional time for students and teachers. ☑
4. Conducting this research must not put any burden of responsibility on our school administrators or other staff unless they specifically agree to it. Such agreement must not negatively impact instructional time. ☑
5. Participation in the study will be voluntary and participants will be able to opt out at any time without prejudice. This must be clearly communicated to the participants at the outset. ☑
6. For students under 16 years of age, the researcher must secure parental consent and confirm such consent with the principal before the research proceeds. Students 16 years of age and older must provide their own consent. Regardless of age, youth must be clearly informed from the outset that they may refuse to participate, even if their parents consented to their participation. ☑
7. Anonymity of participants must be ensured. ☑
8. Before the research project can begin, it must receive final approval from your university's Research Ethics Committee and a copy of this approval must be sent to the Associate Director of Education as per the contact information listed below. ☐
   8a. Ethics Committee approval letter has been received ☑ 8b. Not applicable ☐
9. Given the inherent potential risk in this research project that some participants may relive a traumatic experience which can cause emotional or psychological stress, counseling services and other appropriate supports must be available during and subsequent to the data collection process. ☐
10. A copy of the research findings and resulting papers/reports must be directed to the Associate Director of Education and to the regional Assistant Directors of Education (Programs) where applicable. ☑
11. Research results must be made available to the schools involved and the individual participants who request them. ☑
12. The Newfoundland and Labrador English School District takes no responsibility in conducting this research, and will not be held liable for any negative impacts relating to this research effort. ☑

Signature of Approval: _____ November 4, 2015
Jeff Thompson — Date
Associate Director of Education

Signature of Compliance: _____ Nov. 9, 2015
Researcher — Date

A signed copy of this form MUST be returned to the address below and to the target schools before research can begin:

Attention: Associate Director of Education
Newfoundland and Labrador English School District Suite 601, Atlantic Place
215 Water Street
St. John's, NL A1C 6C9
jeffthompson@nlesd.ca

Appendix K

Recommended Resources for Educators

Online Resources	
Website Name	**Description**
Math Antics	Our math lessons are organized by subject rather than grade level. Our goal is to create math videos that clearly explain math concepts to students of any age. http://mathantics.com/
Braining Camp	Brainingcamp offers interactive math content aligned with the Common Core, available online for computers or as apps for iPads. Abstract math concepts become engaging and understandable through hands-on, visual, real-world learning. https://www.brainingcamp.com/
Xtramath.org	XtraMath is a Seattle 501(c)(3) nonprofit organization dedicated to math achievement for all. Our goal is to develop effective, efficient, adaptive, and intrinsically rewarding supplemental math activities. https://xtramath.org/#/home/index
Raz-Kids	Raz-Kids delivers hundreds of interactive, leveled eBooks spanning 29 levels 400+ eBooks and open-book eQuizzes, with new books added every month, even in Spanish! Corresponding eQuizzes test comprehension, providing teachers with skill reports for data-driven instruction. Online running records let teachers digitally assess each student, saving valuable classroom time. The motivational "Raz Rocket" gets students excited about reading and strengthens the school-to-home connection. https://www.raz-kids.com/
IXL	IXL is an immersive learning experience that provides comprehensive, curriculum-aligned math and English content for junior kindergarten to grade 12. PRACTICE THAT FEELS LIKE PLAY Practice makes perfect, and IXL makes math and English language arts practice fun! IXL sets a new standard for online learning, offering unlimited, algorithmically generated questions; real-time analytical reports; and dynamic scoring to encourage mastery. Released in 2007, it has since become the world's most popular subscription-based learning site for K–12. With more than 4,000 unique and challenging skills to master, IXL offers a dynamic and enjoyable environment suitable for any learning style. Students who use IXL are succeeding like never before. https://ca.ixl.com/company/

Brain Pop	In classrooms, on mobile devices, and at home, BrainPOP engages students through animated movies, learning games, interactive quizzes, primary source activities, concept mapping, and more. Our award-winning resources include BrainPOP Jr. (K-3), BrainPOP, BrainPOP Español, and, for English language learners, BrainPOP ESL. They cover topics within Science, Math, Social Studies, English Language Arts, Technology, Engineering, Arts, Music, Health, Reading, and Writing. Our content is carefully mapped to the Common Core, aligned to academic standards, and searchable with our online Standards Tool. We are also home to GameUp, an educational games portal for the classroom; Make-a-Map, an innovative concept mapping tool powered by Ideaphora®; and "My BrainPOP," which lets teachers customize assessments, incorporate gaming into instruction, spur meaningful reflection, and keep track of learning. BrainPOP Educators offers professional development and an array of lesson plans, video tutorials, graphic organizers, and a rich curriculum calendar. https://www.brainpop.com/
Tumblebooks	Online Database for Elementary Schools and Public Libraries. TumbleBook Library is an online collection of TumbleBooks, animated, talking picture books which teach kids the joy of reading in a format they'll love. TumbleBooks are created by taking existing picture books, adding animation, sound, music and narration to produce an electronic picture book which you can read, or have read to you. www.tumblebooks.com
Reading Eggs	Reading Eggs makes learning to read interesting and engaging for kids, with great online reading games and activities. And it really works! Children love the games, songs, golden eggs and other rewards which, along with feeling proud of their reading, really motivate children to keep exploring and learning. http://readingeggs.com/
NLESD YouTube Videos	NLESD developed digital math lessons for grades 7 and 10. Website: https://www.youtube.com/user/nlesdmathdevelopment/feed

 **Hero Machine**	Thanks to HeroMachine, now if you can *imagine* it, you can *create* it, absolutely free. With thousands of hand-drawn custom-colorable line art, you can outfit any character from any genre. Whether you're an RPGer who wants to bring a character sketch to the game, a novelist who wants to capture that perfect face to refer to as you write, or a gamer who wants a more comics-style rendering of your warrior, ninja, wizard, or archer, HeroMachine can bring that illustration to life. Just choose the type of item you want, click on it to add it to the canvas, and choose your colors. In minutes you can build your very own customized, beautiful character sketch. http://www.heromachine.com/
Quizlet **Quizlet**	Quizlet is a free website providing learning tools for students, including flashcards, study and game modes Our tools are designed for the digital age, not just replacing paper predecessors (flashcards, matching games, etc), but using the best of new mobile and audio technologies to create new kinds of learning tools and games. And beyond tools for practice and recall, we've also added tools that focus on longer term learning and mastery for every level learner. https://quizlet.com/
Starfall **Starfall**	Starfall has been teaching children to read with phonics for well over a decade. Our systematic approach, in conjunction with audiovisual interactivity is perfect for preschool, kindergarten, first grade, second grade, special education, homeschool, and English language development (ELD, ELL, ESL). Starfall is an educational alternative to other entertainment choices for children. In May of 2009, we released the Starfall Kindergarten Reading and Language Arts Curriculum and in June 2013 the Starfall Pre-K Curriculum. Our methodology motivates children in an atmosphere of imagination and play. The teacher-guided and child-directed nature of our curriculum products ensure English language learners and struggling readers learn alongside their peers. http://www.starfall.com/
multiplication.com **Multiplication.com**	Teaching multiplication to kids can be a breeze! Our bestselling books and other resources include everything needed to help students memorize and learn the times tables. http://www.multiplication.com/

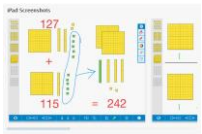
Apps	
Name of App	**Description**
Seesaw	Seesaw empowers students of any age to independently document what they are learning at school. Students capture learning with photos and videos of their work, or by adding digital creations. Everything gets organized in one place and is accessible to teachers from any device. Student work can be shared with classmates, parents, or published to a class blog. Seesaw gives students a real audience for their work and offers parents a personalized window into their child's learning.
EPIC $4.99/month	Epic! is the leading all-you-can-read eBook library for kids 12 and under offering unlimited access to over 10,000 high-quality children's books, now including thousands of read-to-me and Audio books.
Learn zillion	The LearnZillion app offers a free and growing Math and English Language curriculum that has been developed by expert teachers directly from the Common Core State Standards. Thousands of exceptional lessons for teaching or learning the new standards. You don't have to start from scratch anymore.
Hero Creator	Ever dream about being a Hero? This is it! Start by giving your hero an identity and then an awesome costume! It doesn't end there because you'll also decide his super powers and abilities for battle!
BitStrips	BitStrips is a web and mobile application that allows users to create a cartoon of themselves and their friends. Users create animated avatars of themselves by adjusting multiple physical characteristics and accessories of a virtual figurine. They allow users to create comics starring themselves and friends, designing the panels and characters.
Socrative	"Socrative is a smart student response system that empowers teachers to engage their classrooms through a series of educational exercises and games via smartphones, laptops, and tablets. Socrative is simple to set up and there are a variety of options for you to use. You can ask multiple choice questions, have exit tickets to gauge understanding at the end of the lesson, you can include pictures in your questions and you can also have Socrative answers your short answer questions too."

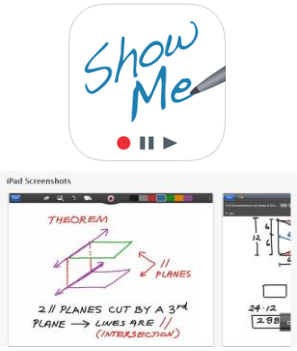
  **Kahoot!**	Kahoot! is a learning game created on the Kahoot! platform, which consists of multiple choice questions - as a quiz, discussion or survey - in any topic, language or ability. It's projected at the front of the classroom, & played by the whole class together in real-time (answering on their own personal device). Kahoot! is a great student response system that teachers can use to create and deliver quizzes and surveys to students. Kahoot! provides a learning environment that is ideal for engaging students for it incorporates the precepts of both game-based learning and inquiry-based learning. Kahoot! allows teachers to create quizzes and surreys that include a wide variety of multimedia elements such as videos, pictures and text. Each quiz you create can be accessed by students across different devices. Also teachers have the possibility to create time-controlled quizzes. You can set a specific period of time for the answer of each question. In this way students are rewarded not only for the correct answer but also for their timeliness.
 **Snap Type**	SnapType helps students keep up with their peers in class even when their penmanship holds them back. Students can easily complete school worksheets with the help of an iPad or iPhone. With SnapType, students can take a picture of their worksheets, or import worksheets from anywhere on their device. They can then use their iOS device keyboard to add text to these documents and print, email, or share their creations. It is the perfect solution for kids, and even adults, who struggle with their handwriting. SnapType for Occupational Therapy is an easy to use, intuitive app allowing completion of worksheets using the camera on an iPad to create an image and type answers on it. This free app greatly assists students who have handwriting difficulties, learning disabilities, low vision, low muscle tone and Parkinson's.
 **Tools4students**	Tools 4 Students is a library of 25 organizational charts that help students with analyzing text and pre-writing. The charts include Cause/Effect, Main Idea/Detail, Story Arcs, and much more. Students can customize each graphic and then save it to the app's library, email it, or print it. If you are limited to one iPad for your classroom, you can print the blank charts for your students fill out while you demonstrate using the version on the iPad.

Tools4Students2™	Tools4Students2™ features 25 Graphic Organizers suitable for grade 4 -12 students. Available for purchase through the educator volume purchasing program, this app includes new organizers for: Chapter Notes, Document Analysis, Writing Organizers, Drawing Conclusions and 7 different blank templates where students and teachers can create their own labels, titles and headings. If you like Tools4Students check out CompareNContrast. New to this app, users can create their own text or photos to compare and contrast.
Schoology	Schoology is an online learning, classroom management and social networking platform that provides educators and students with more effective, efficient and engaging ways to learn.
iBeacon	The technology currently is suited for use in educational institutions, and it soon could be applied in classrooms globally at all levels. The GPS capabilities enable teachers to administer pop quizzes, track attendance and provide lecture slides, among other content items
Math Manipulatives (Brainingcamp - see website above), $5.49	Virtual manipulatives to make math visual and interactive! Bring abstract theory to life with this collection of visual models that easily drag, copy, annotate, and snap into place. Includes: ▪ Algebra Tiles ▪ Number Lines ▪ Pattern Blocks ▪ Base Ten Blocks ▪ Connecting Cubes ▪ Number Rods ▪ Color Tiles 
Hands-on Math	Hands-On Math: Interactive Hundreds Chart creates a virtual math playground where students explore, investigate and discover mathematical concepts. Students use colored markers on the Interactive Hundreds Chart to represent patterns and number sequences. Using Hands-On Math: Interactive Hundreds Chart students can develop the following important mathematical concepts: Skip-Counting; Number Patterns; Multiplication and Division Facts; Prime and Composite Numbers; Least Common Multiple; Divisibility of Numbers and more...

Class Dojo	ClassDojo is a classroom tool that helps teachers save time, boost classroom engagement, and improve student behavior quickly and easily, with no painful data entry. ClassDojo also lets you communicate student progress with parents and students. Best of all, it's completely free.
Plickers	"Plickers lets you poll your class for free, without the need for student devices. Just give each student a card (a "paper clicker"), and use your iPhone to scan them to do instant checks-for-understanding, exit tickets, and impromptu polls. Best of all, your data is automatically saved, student-by-student, at plickers.com."
Edmodo	Edmodo is a web-based platform that provides a safe and easy way for your class to connect and collaborate, share content, and access homework, grades and school notices. It is like Facebook but in a safe and controlled environment appropriate for school.
XtraMath App $6.99	"XtraMath helps your child master the basic addition, subtraction, multiplication and division facts that are the building blocks of your child's math education. Recalling the basic arithmetic facts quickly and easily is essential for success with fractions, decimals, and multi-digit algorithms. It also frees up mental resources for more complex problem solving. XtraMath student activities are simple and straightforward and take only a few minutes each day. The program uses sophisticated methods to present your child with the right problem at the right time to maximize the effectiveness of practice. Students earn a certificate of achievement when they complete an operation. You will receive a weekly progress report in e-mail. The report shows how well your child knows their math facts and the progress they are making toward mastery. More detailed reports can be accessed via the web at any time.
NearPod	The Nearpod platform enables teachers to use their iPads to manage content on students' iPads, iPhones or iPods. It combines presentation, collaboration, and real-time assessment tools into one integrated solution.
Stop Go! $1.29	"A simple to use timer in the form of a traffic light. Set whether you want it to run red-amber-green or green-amber-red, set the times in minutes and seconds and then off it goes! A bell chimes as each light changes."

 **Kids A-Z**	Welcome to Learning A-Z's app for reading eBooks from Raz-Kids and Headsprout! The Kids A-Z app lets you access eBooks and eQuizzes for the 300+ titles on Raz-Kids, all on your iPad, iPod Touch, or iPhone! Raz-Kids gives you hundreds of interactive, leveled books spanning 27 levels of difficulty, covering a wide range of subjects. In addition to engaging kids at their reading level and in their area of interest, this award-winning website gives kids 24/7 Web access to the practice they need to become better, more confident readers. At the same time, teachers can customize assignments, view reports, and track student progress every step of the way. All student activity in the app is captured and reported to teachers at Raz-Kids, thus helping teachers monitor student progress and determine the instruction needed for each student.
 **Google Classroom**	"Classroom is a new tool in Google Apps for Education that helps teachers create and organize assignments quickly, provide feedback efficiently, and easily communicate with their classes. Classroom helps students organize their work in Google Drive, complete and turn it in, and communicate directly with their teachers and peers."
Google Docs – voice typing	This is basically a voice enabled formatting functionality that allows Docs users to easily edit and format their documents using voice commands. This new feature comes to complete the Voice Typing functionality that was added to Google Docs a few months ago. Users of Google Docs are now able to not only compose documents and write down notes without touching their keyboards but are also able to format their documents using speech commands such as "copy," "insert table," and "highlight."
 **Too Noisy**	This is a fun app that children enjoy and respond to. It's a real boon to any adult who needs to control the levels of noise of a group of children. "Too Noisy" displays graphically the background noise level in a room in a fun and engaging way.
 **Explain Everything $5.49**	Explain Everything is an excellent interactive screen casting whiteboard that students can use to create video tutorials and explanatory guides to share with others. The app is easy to use and offers a host of features that allow students to create and share their learning experiences.

Penultimate	This is a great note taking app that simulates the traditional pen and paper note taking. Students can use it comfortably handwrite or sketch their notes and capture fleeting ideas. The app supports Evernote syncing so students can organize their notes in notebooks and access anywhere with Internet connection. The best digital handwriting on iPad. Penultimate combines distraction-free, natural handwriting and sketching with the power of Evernote's sync and search. Take class or meeting notes, journal your thoughts, or outline your next big idea—in the office or on the go. From the first stroke, Penultimate makes the experience of pen and paper more productive
 **Ideament (Formerly Idea Sketch)**	Ideament lets you easily draw a diagram - mind map, concept map, or flow chart - and convert it to a text outline, and vice versa. You can use Ideament for anything, such as brainstorming new ideas, illustrating concepts, making lists and outlines, planning presentations, creating organizational charts, and more!
 **Stick Pick $3.99**	Pick a student at random just by giving your device a shake or tapping the screen -- but that's just the beginning. Stick Pick suggests question starters for learners at different levels and also records how well students respond during classroom discussions. If a student is consistently scoring near the top or bottom, simply change the level so students aren't bored or frustrated.
  **Number Pieces**	Number Pieces helps students develop a deeper understanding of place value while building their computation skills with multi-digit numbers. Students use the number pieces to represent multi-digit numbers, regroup, add, subtract, multiply, and divide. Note: Number Pieces Basic, a simplified version of Number Pieces, is also available in the App Store. Number Pieces Basic is designed for primary students. It has fewer features, putting greater focus on place value, counting, addition, and subtraction.
 **Spell Grid**	Swipe over the letters in the grid to spell as many words as you can. Discover 3, 4, 5, 6 & 7-letter words.
 **Spelling City**	VocabularySpellingCity is a fun way to learn spelling and vocabulary words by playing engaging games using any word list. The most popular activities are Spelling TestMe, HangMouse, and our vocabulary and phonics games, available to Premium Members. The most popular word lists are Sound Alikes, Compound Words, Hunger Games and SAT Words. The free app includes ten of our most popular learning activities and ten of our most popular word lists.

 **Show Me**	Turn your iPad into your personal interactive whiteboard! ShowMe allows you to record voice-over whiteboard tutorials and share them online. It's an amazingly simple app that anyone can use. Voice-record - Multiple brush colors - Enter text - Pause and erase - Import pictures from your photo library, built-in camera, or web image search - Import documents as pictures from dropbox, or google drive - Create video from any document - Unlimited lesson length - Free to upload and share your recordings with friends - Easy embedding for sharing anywhere - Manage students with Groups
 **Dream Box**	Students empowered to think - not just memorize. DreamBox combines a highly personalized math learning experience with a rigorous curriculum for deep understanding of math concepts, so students learn to solve real-world math problems. RESULTS ARE DRIVEN BY: * Intelligent Adaptive Learning technology that differentiates content, pace, and lesson sequence in real-time * A rigorous K–8 math curriculum with reporting for CCSS, TEKS, SOL, WNCP, and Ontario Curriculum * A highly motivating learning environment that encourages students to persist and progress
 **Symbaloo**	With Symbaloo you surf with one click to all of your favorite websites. Symbaloo you have all of your favorite websites at your fingertips, anywhere and always. Choose your favorite websites and within a few clicks you can create your very own homepage. With an account your favorites are available on any iPhone, PC, Mac, iPad and tablet. Wherever you go, you always have access to your favorite websites. Simple, easy and with one click you can go anywhere on the web!
 **Kidspiration ($13.99)**	Colorful and constructive: with Kidspiration Maps, students create visual maps that build reading, writing and thinking skills.

 **Write About This ($5.50)**	Write About This is a visual writing prompt & creation platform perfect for classrooms and families! With endless ways to respond and the ability to craft custom photo prompts, it will kick-start any writing activity. 125 categorized images & 375 text+voice prompts included.
 **Word Maker**	Word Generator will help you find all words required for games like 'Words with Friends', 'Hanging with Friends', 'Scrabble' etc. You can also upload screenshots of your gameplay to make easy decision on word selection. It let you do two simultaneous searches in single app, so that you can compare results and decide best word to use. This best anagram search app is now available for FREE!!!
 **Bits Board**	Study almost anything for free across 25 addictive mini-games in one app Easily create your own study sets or download study sets from teachers and classmates WHAT YOU GET: • Access to the Bitsboard catalog including tens of thousands of gorgeous flashcards and carefully curated lessons covering hundreds of topics. • Bitsboard is ideal for learning languages, mastering vocabulary, learning to read, learning to speak, becoming the next spelling champion and so much more… • Bitsboard is fully customizable to meet your specific learning needs
 **Book Creator $6.99**	Book Creator is the simple way to make your own beautiful e-books, right on your iPad. With over 15 million e-books created so far, Book Creator is ideal for making all kinds of books, including children's picture books, comic books, photo books, journals, textbooks and more. And when you're done, easily share your book, or even publish to the iBooks Store! * Add text, choosing from over 50 fonts * Add photos and images from your iPad's photo library, from the web, or use the iPad's Camera * Resize, rotate and position content as you like with guidelines and snap positioning * Add video and music, and even record your voice * Use the pen tool to draw and annotate your book * Choose from portrait, landscape or square book sizes * Add super powers to your books with comic templates, stickers and styles * A quick tap and you're reading your book in iBooks!

 **Proloquo2Go** **$349.99**	Proloquo2Go's unique features make it the premier Augmentative and Alternative Communication solution for children, teenagers and adults who need symbol support. Proloquo2Go has been used successfully with individuals with the following diagnoses: autism, cerebral palsy, Down syndrome, developmental disabilities, apraxia, stroke, traumatic brain injury and others. Proloquo2Go is designed to ensure growth of communication skills and to promote language development. It covers all users, from beginning to advanced users, while catering for a wide range of fine-motor, visual and cognitive skills.
 **Children's Countdown – Visual Timer**	Watch as the timer runs from green to amber to red, helping the child understand that time is running out. A fun picture is slowly revealed as the time runs down and when the time is up the child is rewarded with an exciting sound and the picture spins. Background image changes to match the time of day, so that your child is given subtle hints as to what time of day the task they are being asked relates to.
Software	
Name	**Description**
 **Smart Notebook**	SMART Notebook Software allows you to create interactive learning experiences.
wordQ+speakQ  **WordQ+SpeakQ**	WordQ™ is a software tool used along with standard writing software. WordQ suggests words for you to use and provides spoken feedback to help you find mistakes. Users of all ages who have problems writing and editing, particularly those with learning disabilities (LD), can benefit from using WordQ. SpeakQ enables users to dictate words into any standard Microsoft Windows document in either a continuous or discrete word-by-word manner. SpeakQ is used in combination with WordQ 4, a writing tool with advanced word prediction and text-to-speech capabilities. Together, these tools provide an integrated and flexible approach to writing, and assist students with their spelling, proofreading, and editing activities.
Clicker 7 Clicker7	Clicker 7 builds on the worldwide success of its award-winning predecessors. There's even more writing support for pupils, and it's easier than ever for teachers to provide personalized literacy support across the curriculum. The complete literacy toolkit. From planning, to writing, to proofing - Clicker includes all the tools your pupils need to succeed.

Devices	
Name	**Description**
 **Frontrow Juno**	The benefits of classroom sound have been proven in study after study. But does sound quality make a difference? Absolutely! Only Juno provides classroom-wide digital sound from a single 2.1 tower system. Once you experience the power of Juno, you won't want to teach without it.
 **HoverCam**	Document cameras are great tools to engage students in learning. They are often also called visualizers (visualizers in Europe). This is because they do a great job in presenting materials teachers present in live video and still images. With document cameras, teachers can create highly interactive learning experiences. For this reason, document cameras are becoming an essential and indispensable tool for virtually every teacher, especially in the United States. Teachers in many European countries are also learning about the benefit of document cameras and increasingly adopting them.
 **Elmo Visual Presenter**	The visualizer/document camera is a COST-EFFECTIVE, TIME-SAVING, and EASY-TO-USE ICT (Information & Communication Technologies) tool. Simply connect the visualizer/document camera with a projector or monitor or interactive whiteboard and just switch it on. All that's left to do is to place the desired object under the camera. A visualizer/document camera is an extremely flexible teaching tool which allows teachers or students to display just about anything from a piece of paper to a piano, in glorious color, or even a person in a room. You can point, annotate, zoom in and out, or get different views by turning the arm/camera-head of the visualizer/document camera. Its flexibility can also help to develop teachers' and students' creativities. Why is the visualizer/document camera a favorite ICT tool for daily productive teaching? Because it is so simple to use for enriching lessons. Teachers do not need to waste their precious time on learning how to use this ICT tool so they can concentrate on planning lectures or spending more time with students.

  **Magnifying Camera**	If you're an educator who has used the Point 2 View USB Document Camera, you know about the camera's crystal-clear images, thanks to a 2-Megapixel CMOS sensor. And you might have taken advantage of the camera's macro mode for capturing fine details and text from as close as 2 inches (5 cm) away. Now with the Magnifying Lens — P2V's newest accessory — you can bring your teaching materials even closer to your students. The Magnifying Lens is designed to fit snugly right over the front of the Point 2 View camera body — no clips or bolts or anything like that — and taking the lens off is just as easy. All you need to do after that is flip a switch to turn on the Lens' built-in LED light to illuminate your subject. Then, lay the P2V and Magnifying Lens directly onto your subject. The Lens provides 2x magnification to make tiny details large and clear for projection and for sharing with the whole class. If you thought the Point 2 View alone could capture some stunning images, wait until you use the Magnifying Lens. What type of things can the Magnifying Lens be used for in the classroom? Science stuff like leaves, wood grain, fabric, metals or electronic parts. Math stuff like diagrams and measuring instruments. Fine details from reproduced or original artwork. Money. Maps. A chart or timeline from the history textbook. And that's just scratching the surface. http://www.ipevo.com/
 **Hushh Ups**	Hushh-Ups are a unique product designed to calm furniture noise in school classrooms. Based on latex-free tennis balls, precision-cut to fit standard chair and table legs, Hushh-Ups drastically reduce background noise in classrooms with uncarpeted floors.
 **Visual Schedule**  Digital Visual Schedule: WONKIDO	Visual supports can be low tech paper schedules to schedules created on electronic devices providing photos, text and/or audio output. A combination of visual schedules is typically needed such as display of a hard copy classroom schedule in class, individual schedules or direction for individual students to using mobile electronic devices offering pictures, text and audio. The WONKIDO Visual Organizer helps your children learn responsibility and independence by empowering them to manage and organize their daily activities, assignments and schedule through a child-friendly, custom interface.
 **Slant Board**	Get a posture-perfect writing surface. A 20-degree angle compensates for fatigue in the back, neck, shoulder and eye muscles. Enhances concentration too. Made of sturdy aluminum. It folds flat for storage. Allows for a range of angle adjustments from 20 to 40 degrees.

 **Disc'O'Sit**	Disc' O' Sit is an inflatable disk having smooth tactile bumps. Students can balance the activities in seated or standing positions and allows your students to work on postural training while seated. This latex-free seat can be inflated to desired level and is ideal for those who require dynamic seating activities